

Field necropsy and diagnostic sample submission

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Abstract

Field necropsies can provide a wealth of information that can help guide production management decisions. Techniques outlined can allow a veterinary practitioner to complete a thorough necropsy of a bovine, including examination of the brain when indicated, in less than 20 min. Outlined procedures emphasize not detaching organs from the carcass unless necessary, thereby making carcass removal by rendering companies more efficient and minimizing cleanup on the production unit premise. An observation and history collection system using form templates and photographs is outlined that improves efficiency of recording necropsy results. One key to necropsy efficiency, speed, and enjoyment is having sharp knives. The first part of this paper includes tips for sharpening knives, and also includes detailed information on appropriate diagnostic specimen handling, packaging, and shipping.

Key words: necropsy, diagnostic, sharpening knives, shipping specimens, data collection

Field Necropsy and Diagnostic Sample Submission

This section includes:

- a brief overview of knife-sharpening skills and sharpening tools
- a step-by-step field necropsy technique for ruminants
- review of simplified observations collection
- techniques for handling laboratory samples, including proper packaging and shipping of samples to diagnostic facilities

The principal purpose of field necropsies is to gain information that may be used to evaluate production or influence production management decisions, since many production management issues relate to a complete and thorough assessment of organ systems, including their associated lymph nodes.

Safety is paramount so always have protective clothing, gloves, and boots which allow for disinfection. Remind all bystanders and observers of the importance of being careful to minimize their personal contamination. Have water, soap, disinfectant, and cleaning brushes readily available.

Knife-sharpening Skills

A quick alternative to using a knife-sharpening abrasive is using a “V” carbide blade knife sharpener. These put a very coarse, semi-shaped, yet usable edge on a knife blade.

Sharpening abrasives. While 3-sided oil stones work well, these are generally expensive and do not travel well when needed for field necropsies. Solid abrasives such as diamond coated steel slabs are more durable than stone abrasives. They are easily cleaned and come in an assortment of grits. Most knives can be sharpened nicely with any abrasive finer than 300 grit (medium or fine).

Angle consistency, meaning the angle the blade is held as the abrasive is stroked, is by far the most important key to developing a sharp cutting edge. There are a number of diamond-coated sharpening abrasives designed to maintain a consistent sharpening angle. Most feature a clamp to hold the knife blade, and the abrasive is connected to a rod that slides through angle slots above and below the knife’s cutting edge.

A consistent edge can be maintained on a flat abrasive if the back of the knife blade is pushed into the palm side of your thumb and the side of your thumb is laid flat against the abrasive as it is stroked (Figure 1). It is very difficult to maintain a consistent angle when using a diamond-coated sharpening rod or steel, and for this reason these sharpening tools are not recommended.

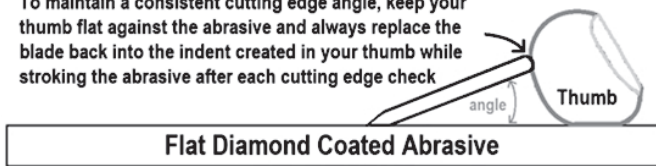
The best knife-sharpening abrasives for veterinary practitioners are motorized. I would strongly encourage having a high quality diamond-coated, set-angle disc sharpener in your clinic. The better diamond-hone machines have 3 sharpening stages, meaning there are 3 slightly different angles for their abrasives. The final stage in these is generally 5 degrees wider, which provides increased durability to the cutting edge. Diamond-honing knife sharpeners can be found at most large department stores in the kitchen appliance area. Buy lots of knives and keep several sharp knives in your practice vehicle. Purchase a quality motorized knife sharpener and delegate the sharpening to a technician.

Angles of a sharp cutting edge. There is not a perfect angle for a cutting edge ... but rather, knives with a cutting edge angle not suitable for the intended job. The steeper the angle, the thinner the blade near the cutting edge and the less-durable the cutting edge. While durability is lost with steeper angles, the resistance caused by the knife sliding through the tissue is less. Examples would be slicing knives. Similarly, the flatter the sharpening angle, the thicker the steel to support the cutting edge, and therefore more durable. The kind of angle targeted for axes and shears is shown in Figure 2. A flat file works well for sharpening the soft metal found in axes and shears. Necropsy knives seem to work well if the angle is 15 to 25 degrees. Again, the key is keeping the angle constant when developing a cutting edge.

Finishing the cutting edge. A ceramic sharpening rod is 1 of the better tools found for honing a fine edge on a

Consistent Angle Is Key to Sharpening

To maintain a consistent cutting edge angle, keep your thumb flat against the abrasive and always replace the blade back into the indent created in your thumb while stroking the abrasive after each cutting edge check



Flat Diamond Coated Abrasive

Figure 1. A consistent angle can be maintained while developing a cutting edge by holding the back of the knife blade against your thumb and resting your thumb on the flat sharpening abrasive.

Cutting Edge Angles Relate To Use Needs

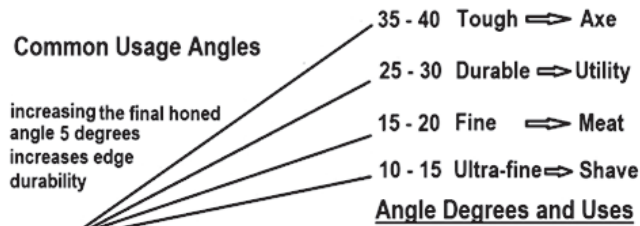


Figure 2. The angle of the knife's cutting edge determines its durability and the ease with which a sharp-cutting-edge slides through tissues. Select the edge best suited for the job.

properly sharpened knife blade. When using a ceramic rod or metal steel stroke the blade gently, feeling for defects in the cutting edge as the blade slides down the tool.

Determining when the edge is sharp. A sharp cutting edge should be as smooth as glass. The best and safest way to test the edge is to hold a plastic ink pen at a 45-degree angle and see if the knife blade will sit on the pen without sliding down the pen barrel. If it holds onto the plastic barrel, the cutting edge is sharp. Additionally, no defects should be felt when the plastic barrel of the ink pen is lightly slid down the cutting edge (Figure 3).

TESTING THE CUTTING EDGE

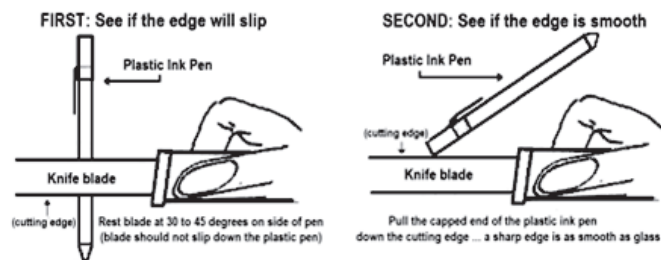


Figure 3. Testing the sharpness of a cutting edge is easily done using a plastic ink pen or your thumbnail. Sharp cutting edges will grab the barrel or your thumbnail when held at a 45-degree angle and not slip down. Additionally, a sharp cutting edge will feel smooth as you slide a plastic pen or thumbnail down the edge.

The keys to having sharp necropsy knives. Don't use your necropsy knife for jobs that will damage its cutting edge. For example, use a disposable-bladed box cutter for skin incisions, thereby not damaging the cutting edge of the necropsy knife on hide, hair, and dirt. Don't use a necropsy knife for cutting rib cartilage unless on a very young animals. A shear or axe works well and saves the cutting edge of the knife. Use a ceramic rod to repeatedly touch up the cutting edge during the necropsy.

Field Necropsy Procedure with Minimal Loose Parts

Important note. Animals that will be rendered must not contain chemical residues that could be harmful to other animals that would consume rendered products.²

Start with the ruminant on its left side. Think about what you are observing. Collect your histopathology and culture specimens as you work. Histopathology specimens should not be thicker than 5 to 7 millimeters. Try to connect observations into a unifying diagnosis or production management observation.

The procedure outlined is designed to make it easier for animals to be picked up by rendering trucks and to minimize hide damage, thereby improving the hide value to renderers. Detaching any organs that are not required to be detached for examination is not being considerate of the people working for the rendering company and is more likely to create a mess at the farm, ranch or feedlot on which you preformed the necropsy examination.

Review your anatomy and gross pathology.^{1,3} Knowledge of the structure and function of the organ tissues you examine can be key to linking observations to a meaningful diagnosis. Be slow to jump to diagnostic conclusion based on your first observations. The "lift a leg and look" or "peekaboo" necropsies generally leave important production management observation undiscovered and minimize the value of the observations that could have contributed to better animal care and management.

Accessing the brain. (Note - check with the rendering company serving the animal facility about the acceptability of examining the brain, as some companies will not pick up carcasses that have had their cranium opened.) Remember that rabies should be on the differential list for all CNS cases, therefore take all appropriate precautions.

Figure 4 demonstrates the appropriate lines for removal of the calvaria. The cut needs to be approximately as deep as the distance from the front of the skull to the lateral canthus. Make sure the axe cuts are completely through the cranium. Using the blunt or hammer side of the single-bit axe, strike the cut edge of the cranium along the frontal crest at a 45-degree angle (Figure 4).

To remove the brain, cut the dura mater across the cerebral falx, the tough medial division of the dura. Extend this cut to allow your fingers to slide beneath the cerebrum. Using your necropsy knife, cut between the cerebrum and

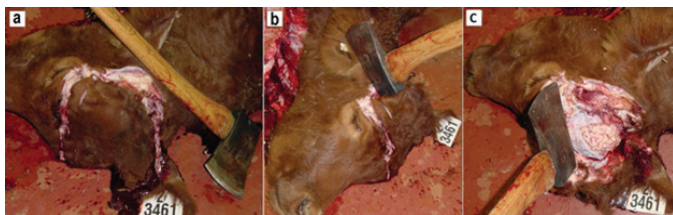


Figure 4. The steps for opening the skull with an axe to expose the brain are: a) cut across the face just dorsal to the lateral canthus, then cut from the lateral canthus dorsal in front of the ear over to the poll, across the poll to the level of the opposite ear. b) Using the blunt side of the single-bit axe, strike the edge of the cut bone between the lateral canthus and the ear at a 45-degree angle. c) This will break the skull away from the brain.

the cerebellum at the level of the pons and lift the cerebrum out of the cranium. Next, split the dura mater covering the cerebellum dorsally. Slide the tip of your necropsy knife behind the cerebellum into the spinal canal and cut across the spinal cord distal to the obex. Lift the cerebellum and spinal cord containing the obex, out.

Opening the hide and reflecting the legs. Using a box cutter, cut along the underside of the jaw, over the larynx, down the neck over the trachea. The incision should drift toward the animal's right foreleg axillary space. Continue the skin incision along the ventral thorax crossing the costal cartilages and along the abdominal wall toward the right rear inguinal area. The incision across the thorax and abdomen will be lateral to the midline 3 to 6 inches (7-15 cm) (Figure 5).

Do not cut the hide upward toward the scapula as you pass the foreleg axillary space. The hide is worth half of the value of the carcass to the renderer, and mutilating the hide reduces its value so much so that many renderers will not



Figure 5. Note the rear leg is reflected while the foreleg remains unreflected. Working from the back side, continue to skin forward toward the foreleg. Lift the foreleg and cut through the latissimus dorsi, holding the foreleg down.

pick up necropsied carcasses without charging a fee if the hide is damaged.

Reflect the rear leg before attempting to reflect the foreleg. To reflect the rear leg, cut the heavy muscles (adductor, semimembranosus, pectineus, and sartorius) that hold the coxofemoral joint in place. The round ligament will be easily identified and the joint examined (Figure 5).

The best approach to examining the stifle and hock joints starts with the rear leg reflected, then skinning along the inside of the leg from the stifle joint past the hock joint. To examine the stifle joints cut along the side of the femoral trochlea and cut above the patella through its attachment to the quadriceps down to the femur. The patella will rotate over, yielding a great view to the stifle joint. To examine the hock joint, slide your necropsy knife between the extensor muscles and the tibia, and cut the extensors loose below the stifle joint. Retracting the extensor muscles will allow sliding your knife down to the hock joint and pulling the joint capsule up, thus allowing you to cut open the joint capsule without invading the joint with the tip of your knife blade. This allows for cleaner joint sampling.

Working from the back side, continue to skin the carcass toward the foreleg. When skinned to the level of the transverse processes and proximal rib attachments, the latissimus dorsi holding the foreleg down will be easily cut. Move to the sternal side of the animal and lift the foreleg, cutting the pectoral muscles. The foreleg should lay over with only minor fascia dissection.

Examining the oral cavity and neck structures. Incise along the side of the cheek, exposing the premolars and molars. This approach allows a very good view of the oral cavity and allows for examining molar eruption (Figure 6). The first molar erupts in cattle at approximately 7 months of age and is in full wear at approximately 12 months.⁴ This information can be useful when examining stocker and light-weight feeder cattle.

To examine the tongue and larynx, slide your knife on the caudal side of the hyoid bones feeling for the bend formed between the epiphyoid and the ceratohyoid bones. Your knife will generally cut the cartilage connection easily in younger animals. Shears can be used if needed.

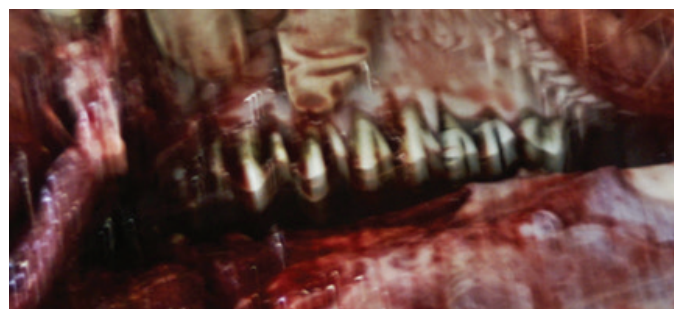


Figure 6. The cheek has been incised, exposing the molars and oral cavity for examination.

Reflect the tongue while dissecting the larynx, trachea, and esophagus. Open the esophagus, larynx, and trachea down to the level of the thoracic inlet for examination. If a “bloat-line” observation is potentially important in the necropsy, this would be a good time to separate the esophagus from the trachea to the level of the thoracic inlet. Later in the necropsy, when the pluck is reflected over the first rib, the esophagus can be retracted through the thoracic inlet and its entire length can be examined.

Opening the abdomen and thorax. There are several acceptable ways to gain entry into the abdomen. I generally start by incising the abdominal wall along the greater curvature of the last rib, being careful not to incise the intestine. Once a hand-sized hole is made, I reverse the grip on my necropsy knife so the tip of the handle is forward, and slide my hand in the abdomen with the knife handle leading the cutting edge and incise the abdominal wall as I advance my hand (Figure 7). The incision is continued until the abdominal wall can be reflected.

The greater omentum is cut away revealing the small intestines and allowing the abdominal viscera to shift away from the diaphragm, which is examined and cut free along its costal attachment. Using a shear or axe, cut across the distal ribs close to the costochondral junctions. The ribs may be separated and manually reflected by breaking the costovertebral joint or you can cut across the proximal ribs close to the costovertebral joints and reflect the entire plate of ribs forward off the top of the thoracic organs (Figures 8 and 9). Leave the first rib intact. This will hold the thoracic organs in the carcass as it is winched onto the rendering truck. It is always a good idea to be considerate of both production personnel as well as those who work for the renderer.

Examining the thoracic cavity. First, examine the pericardial sac and fluid. Detach the lung by cutting between the thoracic vertebra and aorta. Then dissect the dorsal lung free from the anterior thoracic to the diaphragm (Figure 10). Next, free the caudal right lung lobe from the diaphragm by cutting the aorta, esophagus and mediastinal reflections



Figure 7. Opening the abdomen by working with your hand inside and the knife blade pointing outside will help prevent puncturing loops of intestine.

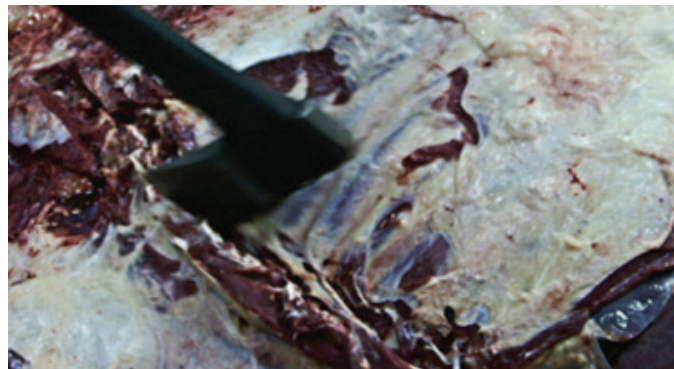


Figure 8. Cut across the ribs close to the costovertebral junctions.



Figure 9. After cutting across the ribs dorsally and the ventral costochondral junctions, reflect the rib plate forward.

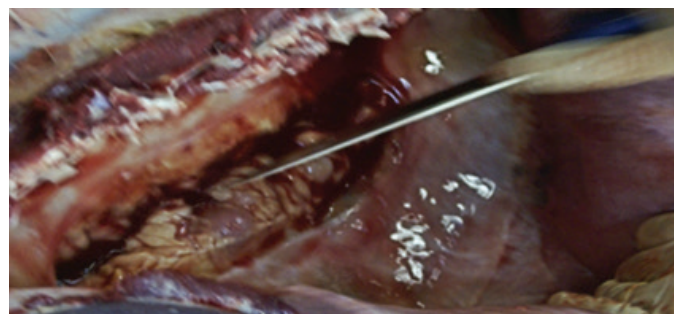


Figure 10. To remove the lung and heart, start by dissecting the lung away from the thoracic vertebra. Continue dissecting the lung free from the diaphragm and the pericardial attachments from the sternum.

(right and left) between the pericardial sac and diaphragm. Continue to free the pluck by cutting attachments between the pericardial sac and ventral thoracic. Reflect the lungs and heart forward over the first rib (Figure 11).

Palpate the lung for abnormalities. Examine the tracheobronchial lymph nodes and airways. Examine the thoracic esophagus. The esophagus can be pulled through the thoracic inlet if a potential bloat line is of interest.

The heart’s pericardium, myocardium and endocardium are evaluated as the organ is opened. Start the examination with the right heart. Make an incision in the right ventricle just below the vena cava and extend the incision through the



Figure 11. Reflecting the lung over the first rib allows for complete examination of the lung, associated lymph nodes, and heart.

semilunar valves. Extend the incision distally along the border of the right ventricular wall around its entire connection to the septal wall. This flaps the right ventricle and allows an excellent view of the tricuspid valve. To open the left ventricle, make an incision in the middle of the ventricle such that when opened the 2 large papillary muscles will lay on either side of the incision. Cut across the ventricle just below the coronary groove. This forms a “T”-shaped incision, allowing the bicuspid valves to be examined. The left semilunar valves can be examined by extending the vertical incision into the aorta. These steps are illustrated from left to right in Figure 12.

Examining the abdominal cavity. The small intestines can be fanned out or spread over the rumen for examination (Figure 13). Autolysis generally makes opening the entire length of the intestine pointless. However, mesenteric lymph nodes will retain their architecture longer than bowel, and are useful in evaluating inflammatory changes. Always examine the ileocecal valve for signs of inflammation, as it could be associated with salmonellosis.

While the small intestine is spread over the rumen, examine the right kidney and liver. Flip the small intestine over the transverse processes, exposing the small colon (Figure 14), left kidney, bladder, distal colon, and rectum (if a female, their reproductive organs) for examination.

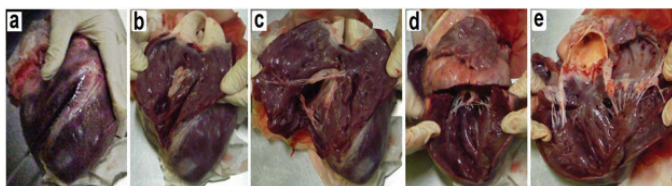


Figure 12. The sequence represents the recommended steps for examining the heart. This approach allows for thorough examination of all valves and myocardial muscle structure. a) The knife opens the right ventricle, allowing the incision (b) to extend into the outflow. c) The right ventricle has been completely opened, allowing examination of the tricuspid valve. d) Two incisions have been made in the left ventricle, one longitudinally and the other across the ventricle below the coronary groove. This exposes the bicuspid valve for examination. e) The longitudinal incision has been extended through the aorta.

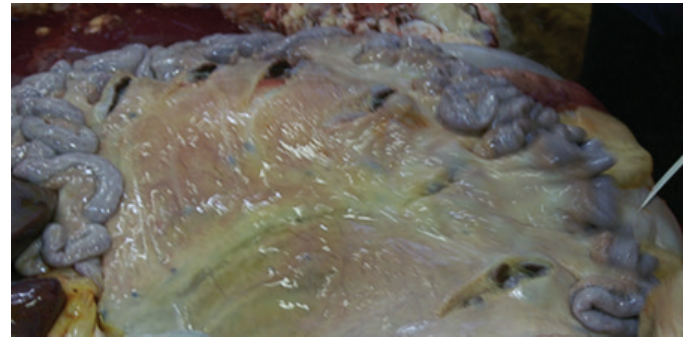


Figure 13. Fan the small intestine over the rumen for examination and cut across the mesenteric lymph nodes.

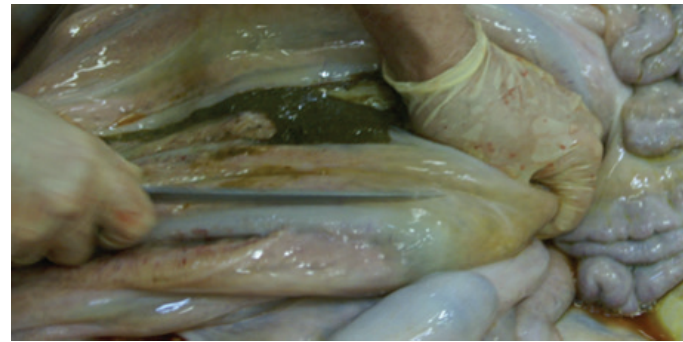


Figure 14. Flip the small intestine over the transverse processes to expose the small colon and allow access to the distal colon, left kidney, bladder, and reproductive system.

Make a palm-size hole in the rumen behind the anterior pillars. Reach in and find the ruminoreticular fold. Pull the fold to the surface and examine the side next to the cranial sack for acidosis lesions or scars.

Palpate the abomasum, reticulum, and omasum for masses and normal texture. Reach under the anteroventral edge of the abomasum next to the diaphragm and grasp the spleen. Retract the spleen for examination. Open the abomasum to examine the surface for lesions such as ulcers, parasites or scarring.

Recording your Observations

The principal purpose of field necropsies is to gain information that may evaluate or influence production management decisions. Necropsy reports are intended to communicate the necropsy observations to others and to serve as a record that can be used in production management. The brevity many of us practice in our reports creates severe deficiencies in communication. There is a better way.

Necropsy observations check-off form. A form can be created that allows you to rapidly highlight the circumstance and health management history, note by check-off body systems involved and highlight observations within each system examined and summarize tentative etiology or diagnosis (Figure 15). This is particularly beneficial when

Date: _____ Yard, Pen/Lot & Animal ID: _____ Samples taken Yes / No
 Sex (S-H-B/C) Breed (British-Zebu-Exotic-Dairy) Weight: (<4, 4-6, 6-8, 8-10, >10) Approx DOF: _____
 Died Where (Receiving, Home, Hosp, Recovery) Euthanized (Y / N) Type stress (Heat-Shipping-Rain-Mud)
 L temp: <40s, 50s, 60s, 70s H temp: <60s, 70s, 80s, 90s, >100
 Pull Dx _____ Previously Sick (N -Y: <30 or >30 days)
 RxAB: Exc-Exl-Nax, Draxxin, Zactran, Micofil, Nulflor, Baytril, OTC, Pen, Amp, Sulfa, / Mass Med: (Y-N-U)
 PHOTO Surface & Opened with ID in pic: Lung +LN, Heart, Liver, Kidney, Sm. Intestine +Mesenteric LN, Other

Place an "NE" next to body systems that NOT EXAMINED											
GENERAL CONDITION			HEART			Reproductive					
BCS ()			Outside infection			Infected					
Fresh (F) or Rotten (R)			Inside infection			pregnant (early, mid, late)					
			Bloody spots on surface								
SKIN			Enlarged			JOINTS & BONES					
General hair loss or skin infection						Injury					
Sinus injury or infection			INTESTINE			Infected					
Mammary gland infected			Contents bloody								
			Lymph nodes large			MUSCLES					
Oral Cavity Lesions (Y/N)			Infection			Neck – bloody					
			Peritonitis			Back & side – blood spots					
NECK			Obstructed			Hind leg – pale					
Bad IV injection						Injection site					
Dark blood filled neck			LIVER			Muscle injury					
			Rotten big yellow spots								
ESOPHAGUS			General yellow color			SPLEEN					
Ulcers or Erosions			Abscess			Swollen and full of blood					
Edema (Parasites)			Migrating Flukes (black streaks)								
			Large Hard Congested (Nutmeg)			Kidney (Lf/Rt)					
TRACHEA						Abnormal color (Pale / Dark)					
Larynx lesion			GALLBLADDER			Rough with scars or streaks					
Trachea Red or bloody			Enlarged			Bloody spots					
Top thick & bloody			Bloody inside surface			Mushy rotten					
Froth or fluid in lumen			Bile ducts-Flukes			Infection /Pus					
						Bladder – red spots or infected					
LUNG			RUMEN RETICULUM-OMASUM:			Urine – bloody or flocculent					
Fluid around lung			Free Gas								
Lung collapsed			Froth			BRAIN					
Lung fluid filled			Bloody spots on folds			Dark red and watery					
Lung gas / emphysema			Ulcers			Slight pus on the bottom					
Lung dark & hard			Traumatic adhesions			Small dark rotten areas					
Lung abscesses						Injury					
Lung stuck to ribs			ABOMASUM:								
Lung lymph node large & angry			Thick folds			CANCER ... where?					
%Affected (<1/3, 1/3-2/3, >2/3)			Ulcers								
Approx Age (<1, 1-3, >3 wks)			Thick with white spots								

CAUSE		U=Unknown	Rank Sys & Cause	Cause	Rank	Rank Sys & Cause	Cause	Rank	Rank Sys & Cause	Cause	Rank
C=Circulatory	E=Envirom	F=Feed Relat	Gen Body			Skin / SubQ			Musculo-Skeletal		
I=Infectious	M=Metabolic	Ne=Neoplasia	Respiratory			Circ / Hem / Lymp			Gastro-Intestinal		
P=Parasitic	T=Trauma	Tx=Toxic	Urinary			Reproductive			Nervous		

General Comments &/or Diagnosis: _____

Figure 15. Example of a "Check-Off" necropsy observation collection form.

necropsies are performed by trained personnel, rather than the veterinarian. A consistent set of digital photographs of each necropsy that includes the animal's identification tag in each photo can be very valuable when communicating with the removed veterinarian, pathologist or lawyer. The photos one may take include: the surface and opened view of the lung with the tracheobronchial lymph node, heart, kidney, and the small intestine with an associated mesenteric lymph node. An example of a necropsy form for cattle that can be

divided into the 3 parts noted above, history, observations, and etiology or diagnosis, is as follows.

The history portion of the form should include the date, animal identification and description, environmental stress information and health information. It may or may not include a vaccination history but this could easily be added.

The observation portion of the form includes each body system and a number of observations that can be made in each body system. Users will likely feel uncomfortable try-

ing to limit their observations to the number available on a form. The quality and quantity of information gathered will far exceed what is typically found in most practitioners' brief necropsy reports.

The etiology and diagnostic section of the form may include a series of boxes that allows you to numerically rank the observer's opinion of the importance of the body system involved and rank the suspected etiology involved. The final portion of the form has a place for comments and suspected diagnosis.

The highlights of each necropsy can be kept in a simple Microsoft® Excel® spreadsheet or Microsoft® Access® database. This allows necropsy report forms to be easily searched for relationships between cases and production management decisions.

Handling Diagnostic Specimens

Tissue specimen degradation is a serious issue that can severely handicap a diagnostic laboratory's ability to provide you with usable information. Histopathology specimens should be sliced thin, less than 7 millimeters, at the time they are collected. Intestine tissue samples are especially sensitive to crushing damage, and it is important to insure your 10% formalin (3.7% formaldehyde) is in contact with the intestinal lining. If formalin is not available at the time of necropsy, keep the samples cold and separated. Most pathologists suggest samples from all major body systems with associated lymph nodes if changes are noted. More than 1 sample would be appropriate from the body system(s) that exhibited significant pathology, including sections along the boundaries between normal and abnormal tissue.

Tissue samples collected for microbiology pose unique challenges. These specimens generally are not sliced as thin as specimens for histopathology, and therefore are more prone to heat degradation. The bacteria in the specimen, both targeted for culture and contaminants, continue to grow. Contaminant bacteria may replicate faster, and/or they may produce substances as they grow that inhibit the replication and subsequent recovery of your targeted bacterium. For this reason, I frequently collect a needle aspirate of the tissue

I wish to culture as well as collect a tissue specimen for the laboratory microbiologist.

Needle aspirate collection for microbiology is a simple procedure that allows submission of an inoculated blood agar plate to the laboratory along with your other specimens. Starting cultures in the field improves the turnaround and can improve the accuracy of diagnosis of some diseases. I take aspirates using a 10 mL syringe and a 20-gauge, 1.5-inch needle. I flame the needle using a butane lighter until it is red hot, then insert in to the target tissue to be cultured. The hot needle should sear the surface and prevent contamination of the aspirate from surface contaminants. Aspirate fluid and tissue into the needle and syringe. After necropsy, I spray collected aspirates on blood agar plates. Next, bend the 1.5-inch needle into a 45-degree angle and flame the angle formed until sterile. Use the bent needle to streak the agar plate (Figure 16). Tape the edges of the agar plates. Double bag each plate and it is ready for shipping to the diagnostic laboratory.

Field Streaking a Blood Agar Plate (needle aspirate inoculated with a bent 20 gage needle)

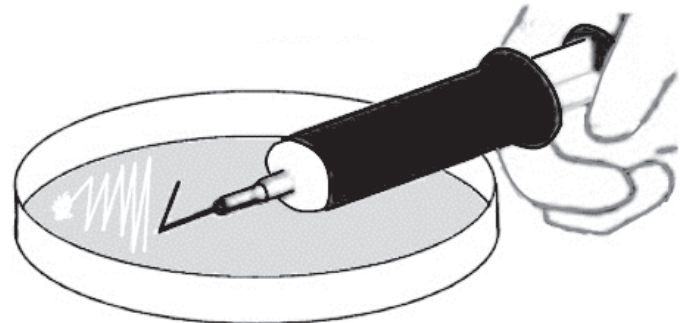


Figure 16. Starting bacteriology culture shortly after the necropsy provides an additional opportunity for the diagnostic laboratory to make a better evaluation. In this illustration a needle aspirate has been inoculated on a blood agar plate and the aspirating needle, after bending and heat sterilizing, is used to streak the agar inoculum.