



THE UNIVERSITY OF GEORGIA

College of Veterinary Medicine

Elephant Postmortem Examination

Practical Application
of General Principles

Rita McManamon, DVM
Scott P. Terrell, DVM, DACVP

Compilation of Experiences “Lessons Learned”

academic, zoo, field situations
clinician/pathologist perspective

Elephant Necropsy Procedure

<http://www.nature-documentaries.com/wildlife-documentaries1/352-inside-natures-giants.html>

Essential References

(*equipment, techniques, tissues)

- ▶ *** Montali RJ: *Chapter 14: Postmortem Diagnostics*. Fowler & Mikota (eds): Elephant Biology, Medicine, and Surgery. Blackwell Publishing, 2006. Pp. 199–209.**
- ▶ **Guidelines for Control of Tuberculosis in Elephants, USDA (current)**
- ▶ *** Elephant SSP Necropsy Protocol (current)**
- ▶ **Elephant SSP EEHV Protocol (current)**

Why perform
a postmortem examination ?

***“The purpose of a necropsy
is to answer questions.”***

Barry G. Harmon, DVM, PhD, DACVP

What are the questions ?

- ▶ *“There are known knowns.*
These are things we know that we know.
- ▶ *There are known unknowns.*
There are things that we know we don't know.
- ▶ *But there are also unknown unknowns.*
There are things we don't know we don't know.”

Donald Rumsfeld

Identify and Agree on Questions, Expectations And Plan Before Necropsy

- ▶ Establish cause of death ?
- ▶ Scientific/health benefit to elephants/humans ?
- ▶ Confirm or determine TB status ?
- ▶ Document “known” health issues ? (best way?)
- ▶ Discover “unknown” health issues ?
- ▶ Necropsy leader must know questions, make a plan with prioritized tasks
- ▶ **Establish agreement on Plan A**
- ▶ **Also agree on Plan B for “unknown” (granulomatous disease)**

Pre-Planning

- ▶ Plan before needed
- ▶ Identify necropsy team/leader in advance (Plan A/Plan B)
- ▶ Ideal leader: pathologist/clinician with elephant necropsy experience
- ▶ Institution ? Vet School / Diagnostic Lab ?
Field Situation ?
- ▶ Animal <-> Necropsy Team ?

Balancing Act

▶ Time available

Tissue deterioration–Personnel–Equipment–Tasks

▶ Personnel

◦ Academic/non–TB case

- 10–20 people (teams) @ 5–6 hours for complete details

◦ Field or TB suspect/positive

- Smaller group(s) of “essential” team members

▶ Level of Detail

All tissues? TB only ? Joints? Feet? Neuro ?

▶ Equipment Choice and Power Availability

Other Factors

- ▶ **Weather:** Cold, Heat, Rain, Snow, Wind
- ▶ **Exposure/Spread of Potential Pathogens:**
TB but also *Salmonella* sp. ? Others ?
- ▶ **Sensitivity:** Beloved animal, grief, psychological effect on staff, other animals; choice of procedures and equipment

Preparation for Procedure

- ▶ Heavy equipment /personnel move animal to necropsy site (platform helpful in field)
- ▶ Back up equipment (if breakdown)
- ▶ Hoist or Equipment to manipulate at beginning/after necropsy
- ▶ Ice in bags (1 000 – 2000 #)
on/around abdomen to counteract heat from digestive tract
- ▶ Remove ice before procedure (slippery !)

Settle Responsibility/Authority

- ▶ Owner, Vet, Pathologist of Record
- ▶ Choice of necropsy site/burial (local regs)
- ▶ Choice/training necropsy team members
- ▶ Safety/risk hazards/PPE
- ▶ Submit tissues, distribute lab results
- ▶ Reporting to health authorities if needed
- ▶ How is client/record confidentiality handled
- ▶ Press Inquiries
- ▶ Issuing Preliminary (if any) vs Final Results

Personal Protective Equipment (PPE)

- ▶ Tyvek gowns/hoods – sturdy, room for physical exertion, water resistant
- ▶ Gloves – double
- ▶ Aprons on dissection team members
- ▶ Respiratory Protection
- ▶ Face Protection ?

Respiratory Protection

- ▶ “Surgical mask is not adequate” to prevent transmission of *M. tuberculosis*
- ▶ NIOSH-rated N-, R-, P-95, 99, 100 mask
- ▶ +/- face shield
- ▶ PAPR (powered air-purifying particulate respirator)

N95 mask fit test

- proper size, correct fit
- PAPR better if facial hair



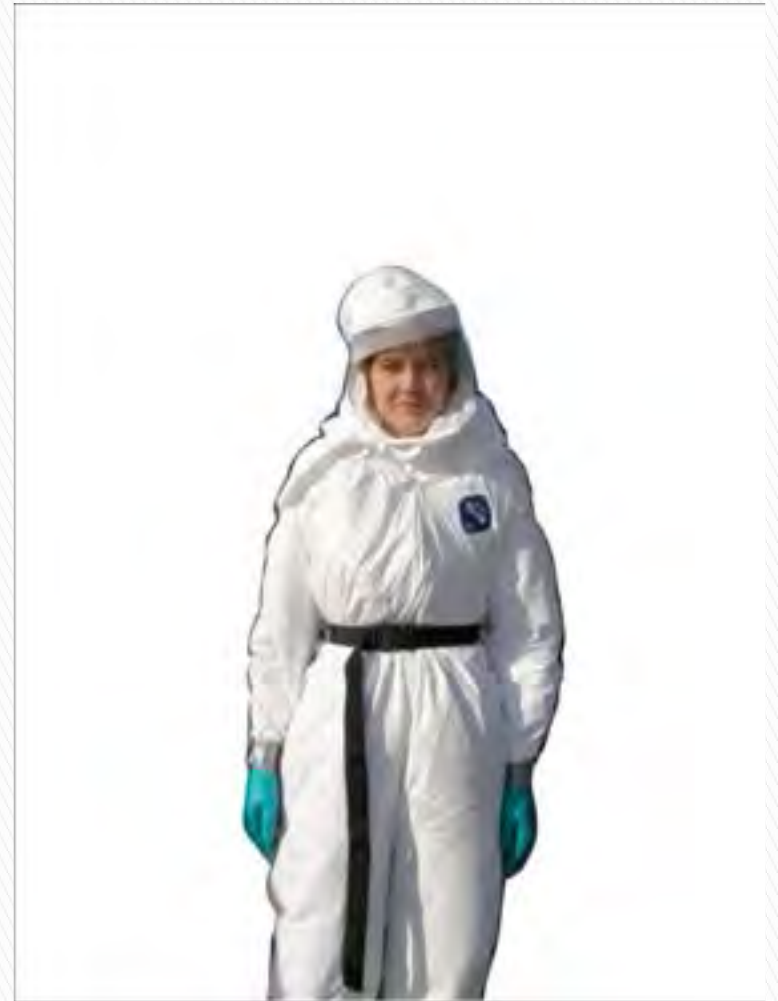
N95 mask, gown/hood, apron, boots



PAPRs



Half hood PAPR



Full hood with scarf



CDC Guidelines for TB Prevention in Health Care Settings (2005)

“The facility's risk assessment may identify a limited number of selected settings (e.g., bronchoscopy performed on patients suspected of having TB or *autopsy performed on deceased persons suspected of having had active TB at the time of death*) where the *estimated risk* for transmission of *M. tuberculosis* may be such that a level of respiratory protection exceeding the standard criteria is appropriate. *In such circumstances, a level of respiratory protection exceeding the standard criteria and compatible with patient-care delivery (e.g., negative-pressure respirators that are more protective; powered air-purifying particulate respirators {PAPRs}; or positive-pressure airline, half-mask respirators) should be provided by employers to HCWs who are exposed to M. tuberculosis.* Information on these and other respirators may be found in the NIOSH Guide to Industrial Respiratory Protection (55)”

Organizing the Procedure Institution or Field

- ▶ **Move animal to necropsy site**
- ▶ **Clean/dirty tables (material storage/tissue processing)**
- ▶ **Cold packs for fresh tissues**
- ▶ **Respiratory protection (levels) available**
- ▶ **Extra PAPRs and charged batteries**

Organizing the Procedure Institution or Field

- ▶ Heavy equipment operator
- ▶ Dissection team (3–5)
- ▶ Tissue transfer/processing person(s) or teams
- ▶ “Helpers” :
 - Notetaker(s) – tissue collection/tissue processing
 - Photodocumenter(s)
 - Safety monitor
 - Gown assist/re-taping person(s)
 - Re-supply person(s)



Field Situation/Burial

- ▶ **Ideal if potential TB case**
- ▶ **Establish a perimeter – exclude other animals and non-essential personnel**
- ▶ **Power? Water? Shade? Rain/Snow shelter?**
- ▶ **Rest breaks ? Monitor for exhaustion**
- ▶ **Perform procedure, bury all non-disinfectable/reusable materials in grave**

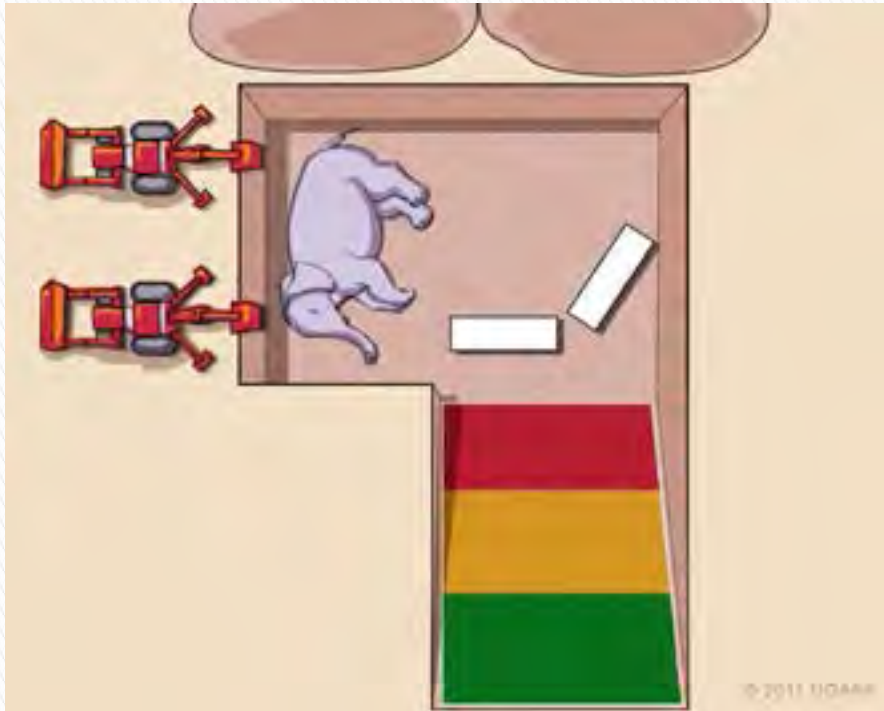
Gravesite overview



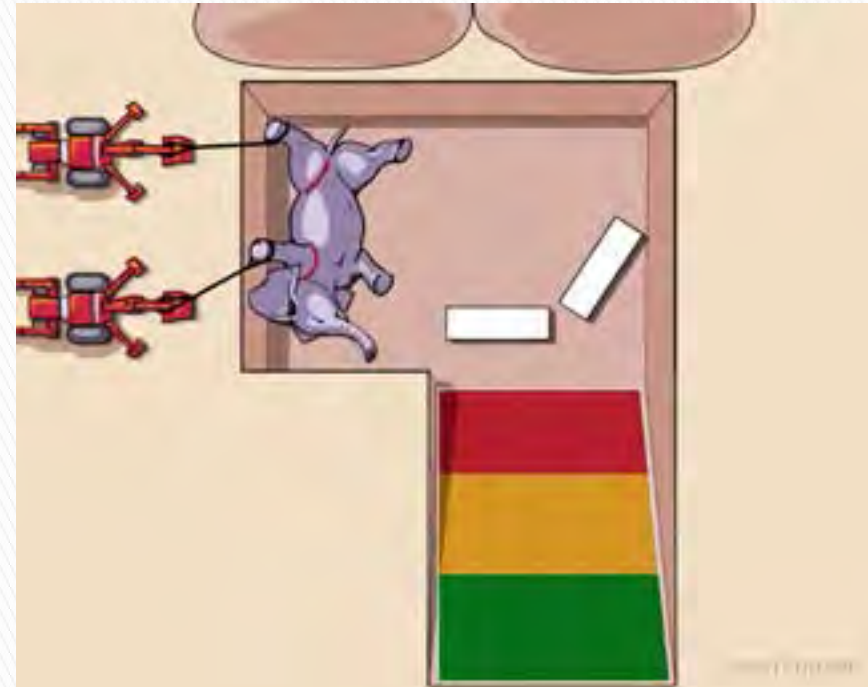
Gravesite with ramp

- ▶ Move on platform
- ▶ Plastic lining around site and down edges
- ▶ Tables on edge (if not TB suspect)
- ▶ Tables inside grave (if TB suspect)
- ▶ Plastic cover on tables
- ▶ Red–yellow–green zones
 - during procedure
 - at clean up
 - bury contaminated on site

Gravesite orientation/ clean up zones



Heavy equipment needed



Move animal to site
Manipulate during/after procedure

Basic Approach

- ▶ **Assess risk/choose PPE for dissection team/processor/”helpers”**
- ▶ **General exam, dissection, abdominal tissue exam/collection**
- ▶ **Distance/dismiss non-essential personnel until thoracic cavity entered and declared “OK” by “thoracic team” members with PAPRs**
- ▶ **Approach thoracic cavity through diaphragm (Montali protocol for TB suspect)**
- ▶ **Or disarticulate ribs manually (BBC video) ?**

Modifications:

Granulomas found during necropsy/ TB suspect/TB positive

- ▶ Distance/dismiss non-essential personnel
- ▶ PAPRs for dissection team + processor(s)
- ▶ N95s +/- face shields for “helpers”
- ▶ Tissue collection inside grave (tables)
- ▶ Re-prioritize tissue collection/reduce time of exposure
- ▶ May divide cranial/caudal teams for speed
- ▶ Avoid power tools

TB or Not TB ? That is the question “Careful Examination of Respiratory System”

- ▶ We do not use acid fast staining at site (time, technique, few bacilli in *Mtb*)
- ▶ Trunk -> pharynx -> trachea -> lungs + lymph nodes
- ▶ Normal elephant LNs inapparent
- ▶ Tonsillar regions, submandibular, tracheobronchial, regional tracheal and thoracic LN priority
- ▶ All LN (mesenteric, perirenal, reproductive) if evidence of advanced pulmonary TB

“Careful Examination of Respiratory System”

- ▶ Palpate lobes of both lungs thoroughly
- ▶ Sample all areas
- ▶ Subdivide tissues : Formalin and Fresh
- ▶ NUMEROUS (5 or more) sections of suspicious lesions
- ▶ Take and label matching samples
(Granuloma #1 A, 1 B, etc) for histo–culture–PCR
- ▶ Submit lung and LN samples for culture if ruling out mycobacterial infection even if no lesions are evident

Tissue Check Lists - laminated/use dry erase pens

Elephant Tissue Check List

Name _____ Date _____ FEMALE

Adult Elephant African Elephant

FORMALIN (pink stamp)

SKIN and APPENDAGES	<input type="checkbox"/> CAUDAL R / L	<input type="checkbox"/> _____
<input type="checkbox"/> SKIN	CIRCULATORY SYSTEM	<input type="checkbox"/> _____
<input type="checkbox"/> TESTICULAR GLAND R / L	<input type="checkbox"/> HEART	<input type="checkbox"/> _____
<input type="checkbox"/> SAR R / L	<input type="checkbox"/> ATRIUM R / L	<input type="checkbox"/> _____
DIGESTIVE SYSTEM	<input type="checkbox"/> VENTRICLE R / L	<input type="checkbox"/> _____
<input type="checkbox"/> TONGUE	<input type="checkbox"/> APEX	SKELTAL MUSCLE
<input type="checkbox"/> SALIVARY GLAND	<input type="checkbox"/> SEPTUM	<input type="checkbox"/> DIAHRAGM
<input type="checkbox"/> ESOPHAGUS	<input type="checkbox"/> MITRAL VALVE	<input type="checkbox"/> MM HINDLIMB R / L
<input type="checkbox"/> LIVER	<input type="checkbox"/> TRICUSPID VALVE	<input type="checkbox"/> MM FORELIMB R / L
<input type="checkbox"/> PANCREAS	<input type="checkbox"/> PULMONARY ARTERY	<input type="checkbox"/> _____
<input type="checkbox"/> BILE DUCT	<input type="checkbox"/> AORTIC VALVE	REPRODUCTIVE TRACT
<input type="checkbox"/> OMENTUM	<input type="checkbox"/> PAPILLARY MUSCLE	<input type="checkbox"/> UTERUS R / L
SKELTAL	<input type="checkbox"/> AORTA	<input type="checkbox"/> OVARY R / L
<input type="checkbox"/> CARCIN	NERVOUS SYSTEM	<input type="checkbox"/> TESTIS
<input type="checkbox"/> PLEURIS	<input type="checkbox"/> SCIATIC NERVE	<input type="checkbox"/> CERVIX
<input type="checkbox"/> TARSUS	<input type="checkbox"/> SPINAL	<input type="checkbox"/> VAGINA
SKELTAL	ENDOCRINE SYSTEM	<input type="checkbox"/> VESTIBULUM
<input type="checkbox"/> SHOULDER	<input type="checkbox"/> THYROID R / L	OTHER TISSUES
<input type="checkbox"/> ELBOW	<input type="checkbox"/> PARATHYROID R / L	<input type="checkbox"/> EYE R / L
<input type="checkbox"/> CARPUS	<input type="checkbox"/> ADRENAL R / L	<input type="checkbox"/> NONE
<input type="checkbox"/> COLON	<input type="checkbox"/> PANCREAS	<input type="checkbox"/> _____
<input type="checkbox"/> RECTUM	<input type="checkbox"/> PITUITARY	<input type="checkbox"/> _____
URINARY SYSTEM	HEMATOPOIETIC SYSTEM	<input type="checkbox"/> _____
<input type="checkbox"/> URINARY BLADDER	<input type="checkbox"/> TONSIL	<input type="checkbox"/> _____
<input type="checkbox"/> UTERUS	<input type="checkbox"/> THYMUS	<input type="checkbox"/> _____
<input type="checkbox"/> KIDNEY R / L	<input type="checkbox"/> SPLEEN	<input type="checkbox"/> _____
RESPIRATORY SYSTEM	<input type="checkbox"/> BONE MARROW	<input type="checkbox"/> _____
<input type="checkbox"/> TRUNK	<input type="checkbox"/> HEMAL NODE	<input type="checkbox"/> _____
<input type="checkbox"/> TRACHEA	Lymph Nodes	<input type="checkbox"/> _____
<input type="checkbox"/> LUNG	<input type="checkbox"/> MESENTERIC	<input type="checkbox"/> _____
<input type="checkbox"/> ORAL R / L	<input type="checkbox"/> SUBCAPSULAR R / L	<input type="checkbox"/> _____
<input type="checkbox"/> NODULE R / L	<input type="checkbox"/> SUBMUCOSAL R / L	<input type="checkbox"/> _____

Elephant Tissue Check List

Name _____ Date _____ FEMALE

Adult Elephant African Elephant

FRESH TISSUES (green stamp)

SKIN and APPENDAGES	<input type="checkbox"/> CAUDAL R / L	<input type="checkbox"/> _____
<input type="checkbox"/> SKIN	CIRCULATORY SYSTEM	<input type="checkbox"/> _____
<input type="checkbox"/> TESTICULAR GLAND R / L	<input type="checkbox"/> HEART	<input type="checkbox"/> _____
<input type="checkbox"/> SAR R / L	<input type="checkbox"/> ATRIUM R / L	<input type="checkbox"/> _____
DIGESTIVE SYSTEM	<input type="checkbox"/> VENTRICLE R / L	<input type="checkbox"/> _____
<input type="checkbox"/> TONGUE	<input type="checkbox"/> APEX	SKELTAL MUSCLE
<input type="checkbox"/> SALIVARY GLAND	<input type="checkbox"/> SEPTUM	<input type="checkbox"/> DIAHRAGM
<input type="checkbox"/> ESOPHAGUS	<input type="checkbox"/> MITRAL VALVE	<input type="checkbox"/> MM HINDLIMB R / L
<input type="checkbox"/> LIVER	<input type="checkbox"/> TRICUSPID VALVE	<input type="checkbox"/> MM FORELIMB R / L
<input type="checkbox"/> PANCREAS	<input type="checkbox"/> PULMONARY ARTERY	<input type="checkbox"/> _____
<input type="checkbox"/> BILE DUCT	<input type="checkbox"/> AORTIC VALVE	REPRODUCTIVE TRACT
<input type="checkbox"/> OMENTUM	<input type="checkbox"/> PAPILLARY MUSCLE	<input type="checkbox"/> UTERUS R / L
SKELTAL	<input type="checkbox"/> AORTA	<input type="checkbox"/> OVARY R / L
<input type="checkbox"/> CARCIN	NERVOUS SYSTEM	<input type="checkbox"/> TESTIS
<input type="checkbox"/> PLEURIS	<input type="checkbox"/> SCIATIC NERVE	<input type="checkbox"/> CERVIX
<input type="checkbox"/> TARSUS	<input type="checkbox"/> SPINAL	<input type="checkbox"/> VAGINA
SKELTAL	ENDOCRINE SYSTEM	<input type="checkbox"/> VESTIBULUM
<input type="checkbox"/> SHOULDER	<input type="checkbox"/> THYROID R / L	OTHER TISSUES
<input type="checkbox"/> ELBOW	<input type="checkbox"/> PARATHYROID R / L	<input type="checkbox"/> EYE R / L
<input type="checkbox"/> CARPUS	<input type="checkbox"/> ADRENAL R / L	<input type="checkbox"/> NONE
<input type="checkbox"/> COLON	<input type="checkbox"/> PANCREAS	<input type="checkbox"/> _____
<input type="checkbox"/> RECTUM	<input type="checkbox"/> PITUITARY	<input type="checkbox"/> _____
URINARY SYSTEM	HEMATOPOIETIC SYSTEM	<input type="checkbox"/> _____
<input type="checkbox"/> URINARY BLADDER	<input type="checkbox"/> TONSIL	<input type="checkbox"/> _____
<input type="checkbox"/> UTERUS	<input type="checkbox"/> THYMUS	<input type="checkbox"/> _____
<input type="checkbox"/> KIDNEY R / L	<input type="checkbox"/> SPLEEN	<input type="checkbox"/> _____
RESPIRATORY SYSTEM	<input type="checkbox"/> BONE MARROW	<input type="checkbox"/> _____
<input type="checkbox"/> TRUNK	<input type="checkbox"/> HEMAL NODE	<input type="checkbox"/> _____
<input type="checkbox"/> TRACHEA	Lymph Nodes	<input type="checkbox"/> _____
<input type="checkbox"/> LUNG	<input type="checkbox"/> MESENTERIC	<input type="checkbox"/> _____
<input type="checkbox"/> ORAL R / L	<input type="checkbox"/> SUBCAPSULAR R / L	<input type="checkbox"/> _____
<input type="checkbox"/> NODULE R / L	<input type="checkbox"/> SUBMUCOSAL R / L	<input type="checkbox"/> _____

Formalin Tissue List

Fresh Tissue List

Samples from dissection team (pathologist notes) for processing

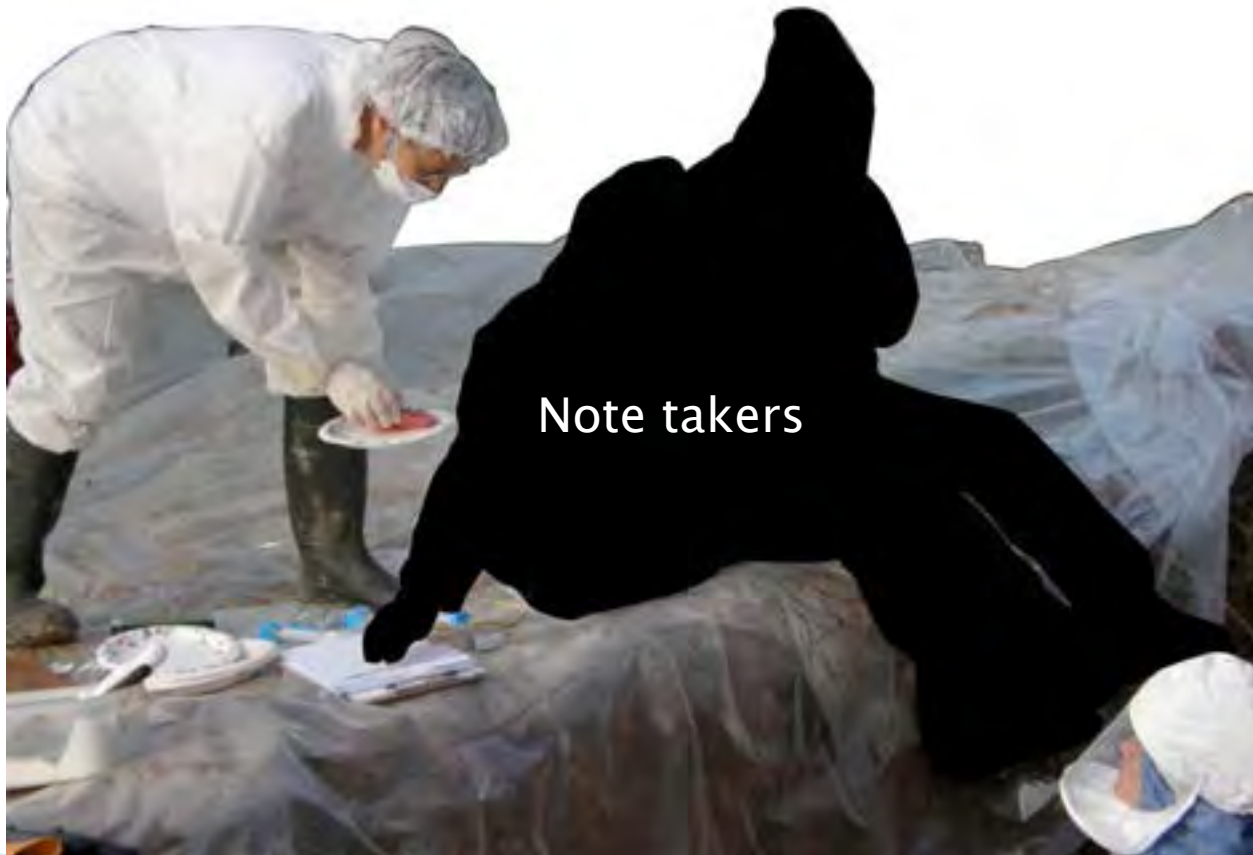


Identification



Abnormal findings,
Directives for PCR, culture

Passing tissue from pathologist to tissue processor



Tissue processing: Formalin (double sets ?) Fresh (# sets ?)



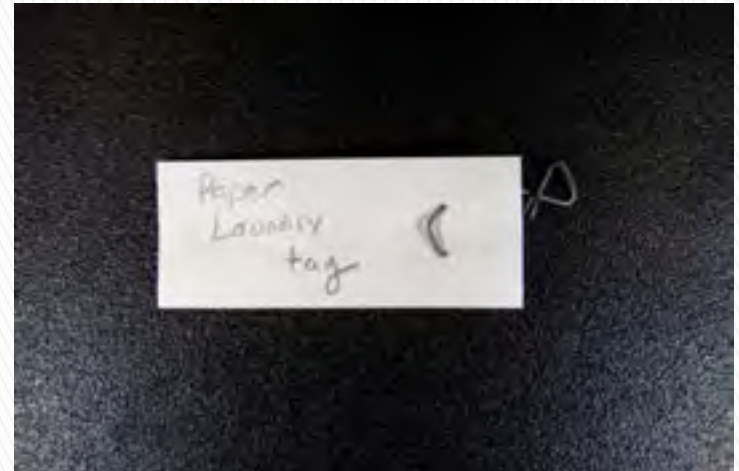
Sample Collection

- ▶ Pieces of tissue (not swabs)
- ▶ Culture: multiple (~1–2 inch) pieces
- ▶ Tissue for formalin: ½ inch thick (maximum)
- ▶ 10 parts formalin: 1 part tissue ratio
- ▶ Collect from normal and abnormal (transition zones are best)

Labelling tissues



Mega Cassettes



Paper Laundry Tags

Tubes for collection of fresh tissues



Collection of fresh tissues

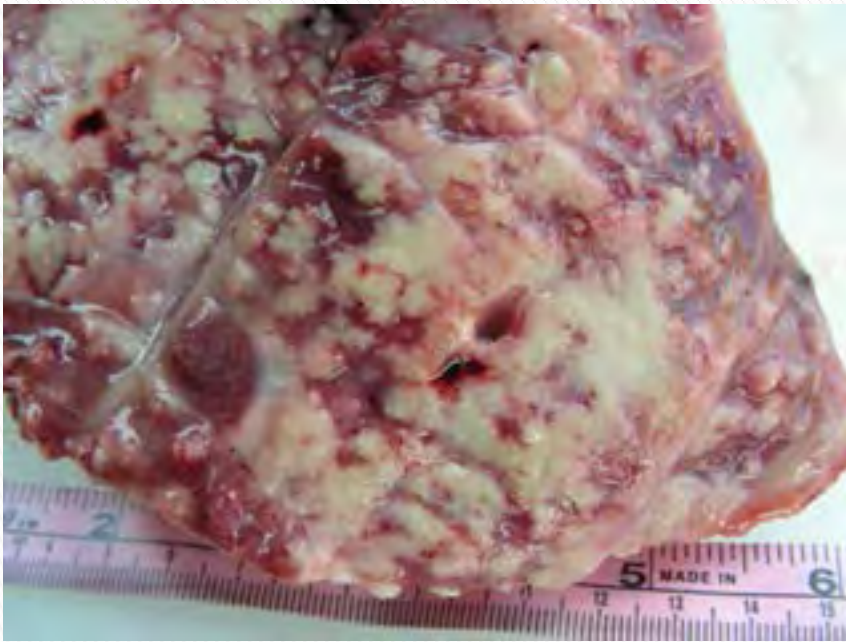


Whirl-paks



Chemical - proof pen

Don't forget sampling for non-TB cultures, histopathology, PCR



TB



Not TB

Clean up / Disinfection

- Tuberculocide outside containers
- Back out: Red/yellow/green zones
- Wipe/soak/contact time for removed disinfectables
- “Helpers” (masked) help degown
- Green zone: extra scrubs, boots
- Leave materials in grave
- Roll plastic *et al* into grave
- Fresh tissues – freezing/shipping
- Fresh tissues for non-TB culture ?
- Formalin tissues 7–14 days
- We cut in tissues while masked
- Process, read slides, issue report
- Storage of duplicate samples ?



Acknowledgments

- ▶ UGA Exotic Animal Pathology Necropsy Team Members
- ▶ UGA – SAMS/Infectious Diseases Laboratory personnel
- ▶ UGA– Department of Pathology personnel
- ▶ Dr. Susan Mikota
- ▶ The Elephant Sanctuary in Tennessee
- ▶ Animals, caretakers, staff, management at client institutions
- ▶ Mr. William K. Carter, UGA–CVM Educational Resources
- ▶ Dr. Murray E. Fowler
- ▶ Dr. Linda J. Lowenstine
- ▶ Dr. Richard J. Montali

QUESTIONS ?

