

## Diseases of Ruminants

The Gross Morbid Anatomy of Diseases of Animals  
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### Lecture 1. Gross Diagnosis of Selected Bovine Lesions (cardiovascular, muscle, respiratory and lymphoid systems)

Slide	Description of Photo	Diagnoses
<b>Cardiovascular System and Skeletal Muscle</b>		
1	Yearling heifer, alive and standing, short stature and enlargement of the brisket	Morphologic diagnosis: ectopia cordis (stethoscope needed for diagnosis!)
2	Calf; opened pulmonary and aortic outflow tracts	Morphologic Diagnosis: anomalous origin of left coronary artery from pulmonary artery
3	Bovine fetal heart; pulmonic valve reddened, thickened, nodular without exudate	Morphologic Diagnosis: pulmonic valvular dysplasia Associated lesions: chronic passive hepatic congestion; ascites
4	Calf; opened thorax; enlarged heart, dilated aorta; lungs dark blue-red with widened interlobular septa	Morphologic Diagnosis: cardiomegaly; aortic dilation; pulmonary congestion and edema
5	Opened heart of calf in slide 4; view of aortic outflow tract; subvalvular ventricular septa defect; thickened, nodular aortic valve leaflets; ballooned ascending aorta	Morphologic Diagnosis: ventricular septal defect; aortic valvular dysplasia; aortic dilation
6	Heart and lungs of another calf with ventricular septa defect; heart is enlarged and rounded	Morphologic diagnosis: cardiomegaly (difficult to tell from photo whether there is dilation, hypertrophy or actually both)
7	Heart and lungs of another calf with enlarged heart (and pale streaked myocardium); middle lung lobes depressed and dark red	Morphologic diagnosis: cardiomegaly; myocardial degeneration and necrosis; bronchopneumonia
8	Calf; heart with white myocardial streaking, especially in left ventricle	Morphologic Diagnosis: myocardial necrosis & mineralization Cause: Vitamin E / Selenium deficiency
9	Calf; section of heart; pale tan mottling of left ventricular myocardium	Morphologic Diagnosis: myocardial degeneration and necrosis Possible causes: white snakeroot, ionophores
10	Cross section of skeletal muscle from calf in slide 9; muscle pallor and mottling	Morphologic Diagnosis: degeneration and necrosis, skeletal muscle Cause: white snakeroot toxicosis, other mycotoxins (Cassia, ionophores, etc)
11	Feedlot calf; photos of whole heart and cross-section through ventricles	Morphologic diagnosis: Myocardial degeneration and necrosis Cause: ionophore toxicosis; also consider white snakeroot, coffee senna ( <i>Cassia</i> )
12	Cow; opened right atrium and ventricle; multifocal, coalescing nodular infiltration by pale tan tissue	Morphologic diagnosis: Lymphoma, myocardium Cause: Bovine leukemia virus

Slide	Description of Photo	Diagnoses
<b>Cardiovascular System and Skeletal Muscle (continued)</b>		
13	Calf; view of epicardial surface of heart and longitudinal section through ventricle; red fibrinous exudate on epicardium; dark red mottling of myocardium	Morphologic Diagnosis: fibrinous epicarditis; hemorrhagic or necrotizing myocarditis Cause: <i>Clostridium chauvoei</i> or <i>Histophilus somni</i>
14	Calf; hind limb reflected to expose adductor muscles; scattered muscle bundles are dry, red-black, with gas bubbles	Morphologic Diagnosis: hemorrhagic and necrotizing myositis with emphysema Cause: <i>Clostridium chauvoei</i>
15	Section through muscle of calf in slide 14; red-black, dry mottling of muscle with gas bubbles	Morphologic Diagnosis: necrotizing myositis with emphysema Cause: <i>Clostridium chauvoei</i>
16	Feedlot calf; section through musculature of thigh; pale green gelatinous mottling	Morphologic diagnosis: eosinophilic myositis Cause: <i>Sarcocystis</i> spp.
17	Calf heart; opened right atrioventricular valve with rough-surfaced, yellow-red vegetations on valve leaflets	Morphologic diagnosis: vegetative endocarditis, right atrioventricular valve Cause: <i>Streptococcus</i> spp.
18	Calf heart; opened left atrioventricular valve with rough-surfaced, yellow-red vegetations on valve leaflets	Morphologic Diagnosis: vegetative endocarditis, left atrioventricular valve Cause: <i>Streptococcus</i> spp. or <i>Arcanobacterium pyogenes</i>
19	Cow heart; opened pulmonary outflow tract with clotted blood and yellow-tan vegetation on pulmonic valve; (this cow had mastitis)	Morphologic diagnosis: vegetative endocarditis, pulmonic valve Cause: <i>Arcanobacterium pyogenes</i>
20	Cow opened thoracic cavity with glimpse of cranial abdomen; fibrinopurulent exudate on reticulum and pericardial sac; pericardial sac filled with yellow fluid pus	Morphologic diagnosis: fibrinopurulent reticuloperitonitis and pericarditis; pericardial empyema Disease: traumatic reticulopericarditis
<b>Cardiopulmonary System</b>		
21	Ox; opened thoracic cavity; amber watery fluid in pleural space, red-blue lungs	Morphologic Diagnosis: pulmonary congestion and edema; hydrothorax Pathogenesis: left heart failure
22	Ox; opened thoracic cavity; amber watery fluid in pleural space, dark blue lungs; amber fluid in retroperitoneum and around kidney	Morphologic Diagnosis: pulmonary congestion and edema; hydrothorax; perirenal edema Pathogenesis: acorn consumption → nephrotoxicosis → renal failure
23	Ox; heart and lungs; thrombus in left pulmonary artery with infarction of left lung; notice normal right lung	Morphologic Diagnosis: pulmonary arterial thrombosis and infarction
24	Ox; lateral view of lung and cross-section of lung; thrombus in lobar pulmonary artery with hemorrhagic and necrosis of adjacent tissue	Morphologic Diagnosis: pulmonary arterial thrombosis; pulmonary hemorrhagic infarction Condition: caudal vena caval thrombosis
25	Cow with <i>Arcanobacterium pyogenes</i> mastitis (not shown); lungs and opened pulmonary artery with thrombus	Morphologic Diagnosis: pulmonary arterial thrombosis with embolic pneumonia Cause: <i>Arcanobacterium pyogenes</i>
<b>Respiratory System</b>		
26	Ox; sagittal section of nasal cavity; reddened mucosa; fibrinous to purulent exudate in nasal cavity and frontal sinus	Morphologic diagnosis: suppurative or mucopurulent rhinitis and sinusitis Cause: bovine herpesvirus 1 with secondary bacterial infection
27	Calf; en face view of larynx; pale gray	Morphologic Diagnosis: laryngeal edema

	glistening, thickened laryngeal mucosa	
Slide	Description of Photo	Diagnoses
<b>Respiratory System (continued)</b>		
28	Calf; laryngeal opening occluded by fibrinonecrotic exudate	Morphologic Diagnosis: fibrinonecrotic laryngitis Disease: calf diphtheria Cause: <i>Fusobacterium necrophorum</i>
29	Feedlot calf; fibrinonecrotic vegetation over bilateral laryngeal ulcers	Morphologic Diagnosis: fibrinonecrotic laryngitis Pathogenesis: <i>Histophilus somni</i> → phlebitis → laryngeal infarcts → ulceration
30	Feedlot calf; early lesions of fibrinonecrotic laryngitis	Morphologic Diagnosis: fibrinonecrotic laryngitis
31	Section of lung from calf in slide 30; necrotizing pneumonia is often associated with laryngitis; <i>Histophilus</i> was suspected in this case, but only <i>Arcanobacterium</i> was isolated at this late stage	Morphologic Diagnosis: necrotizing pneumonia with abscessation
32	Feedlot calf, tracheal cross-section; mucosa/submucosa thickened by edema; lumen partially filled with fibrin and hemorrhage	Morphologic diagnosis: tracheal edema with hemorrhagic cast Cause: unknown, usually in summer and associated with bronchopneumonia
33	Feedlot calf, longitudinal tracheal section; red mucosa, fibrinohemorrhagic exudate	Morphologic Diagnosis: fibrinonecrotic or fibrinohemorrhagic tracheitis Disease: infectious bovine rhinotracheitis
34	Calf, opened thoracic cavity; pleura, pericardium, and epicardium coated with thick gray-white fibrinous exudate	Morphologic Diagnosis: fibrinous pleuritis, pericarditis and epicarditis Pathogenesis: <i>E. coli</i> or other gram-negative septicemia
35	Ox, lateral view of lung in thoracic cavity; red purple discoloration, wide interlobular septa, diffuse pattern	Morph Dx: pulmonary congestion and edema with interlobular emphysema Disease: acute bovine pulmonary edema and emphysema (ABPE) Cause: 3-methylindole, perilla ketone Histologic lesion: alveolar edema, interlobular emphysema, hyaline membranes, type 2 pneumocyte hyperplasia
36	Ox, thoracic cavity; diffuse change of interstitial pneumonia	Morphologic diagnosis: interstitial pneumonia (or alveolitis) Condition: atypical interstitial pneumonia
37	Section of lung from fat yearling heifer in slide 36; pale pink tan parenchyma with alveolar pattern; wet, bubbly interlobular septa; BRSV or other virus suspected, but not documented	Morphologic Diagnosis: interstitial pneumonia (or alveolitis) and pulmonary edema Histologic features: diffuse alveolar damage with type II pneumocyte hyperplasia
38	Ox, opened thoracic cavity; diffuse pink interstitial pattern with scattered depressed red lobules; emphysematous bullae especially in dorsocaudal aspect	Morphologic Diagnosis: lobular bronchopneumonia & interstitial pneumonia with bullous emphysema Cause: <i>Pasteurella multocida</i> & BRSV
39	Ox, opened thoracic cavity and cross-sections of lung; yellow fibrinous exudate on pleura and in interlobular septa; cranioventral red consolidated lobules	Morphologic Diagnosis: fibrinous or necrotizing bronchopneumonia, fibrinopurulent pleuritis Cause: <i>Mannheimia haemolytica</i>
40	Ox, opened thoracic cavity and cross-section of lung; more abundant fibrinous pleural exudate than in slide 36	Morphologic Diagnosis: fibrinous or necrotizing bronchopneumonia, fibrinopurulent pleuritis Cause: <i>Mannheimia haemolytica</i>

Slide	Description of Photo	Diagnoses
<b>Respiratory System (continued)</b>		
41	Ox, opened thoracic cavity and cross-section of lung; similar changes to those in slide 36, more necrosis, less fibrin	Morphologic diagnosis: necrotizing lobar bronchopneumonia Disease: shipping fever Cause: <i>Histophilus somni</i> ; accept <i>Mannheimia haemolytica</i>
42	Ox, lungs with cross-section of lung; red lobular to lobar consolidation; suppurative exudate on cross-section	Morphologic Diagnosis: suppurative bronchopneumonia Cause: <i>Mycoplasma bovis</i>
43	Ox, opened thoracic cavity; cranioventral aspect of lung dark purple with fibrinous exudate on visceral pleura	Morphologic Diagnosis: necrotizing bronchopneumonia with fibrinous pleuritis Cause: <i>Mannheimia haemolytica</i> plus BVDV
44	Ox, opened thoracic cavity; mostly cranioventral lobular to lobar red-brown to purple consolidation; disseminated abscesses in cranioventral affected lung	Morphologic Diagnosis: bronchopneumonia with abscessation Cause: <i>Pasteurella multocida</i> plus <i>Actinomyces pyogenes</i> ; consider <i>Mycoplasma bovis</i>
45	Ox, lung. Diffuse pink solid appearance; reddening and emphysematous bullae in caudodorsal aspect	Morphologic Diagnosis: interstitial pneumonia with bullous emphysema Cause: bovine respiratory syncytial virus
46	Ox, lung. Caudal lobe opened along the lobar bronchus; bronchial lumen contains mucus and nematodes.	Morphologic Diagnosis: catarrhal bronchitis Cause: <i>Dictyocaulus viviparus</i>
<b>Lymphoid System</b>		
47	Ox, lung. Trachea and bronchi opened at the bifurcation; enlarged, tan tracheobronchial lymph nodes	Morphologic Diagnosis: tracheobronchial lymphoid hyperplasia / lymphadenitis
48	Yearling calf, head and neck. Skin excised to reveal pale gray-tan mass extending from angle of the jaw to thoracic inlet	Morphologic diagnosis: thymic lymphoma Disease: juvenile sporadic lymphosarcoma

**Lecture 2. Gross Diagnosis of Selected Bovine Lesions (alimentary, hepatobiliary, peritoneal, hematopoietic/lymphoid, and urinary systems)**

Slide	Description of Photo	Diagnoses
<b>Alimentary System</b>		
1	Face of long yearling Hereford, crusted nasal planum; Inset: reddened eroded mucocutaneous junction of eyelids with mucopurulent exudate	Morphologic Diagnosis: ulcerative mucocutaneous dermatitis Cause: bovine virus diarrhea virus
2	Ox, cross-section of muzzle with maxillary swelling and inflammation; not the 'classical presentation of lumpy jaw (usually confined to mandible)	Morphologic Diagnosis: pyogranulomatous or suppurative maxillary osteomyelitis Cause: <i>Actinomyces bovis</i>
3	Ox, view of roof of mouth; lips, buccal mucosa and entire hard and soft palate affected by erosion, ulceration, and gray fibrinous exudate	Morphologic diagnosis: ulcerative stomatitis Cause: bovine viral diarrhea virus
4	Ox, roof of mouth; circular lesions in hard and soft palate with central crateriform necrosis and peripheral rim of hyperplasia	Disease: papular stomatitis Cause: parapox virus (bovine papular stomatitis virus)
5	Ox, tongue; ulcerated necrotic mass near base	Morphologic diagnosis: fibrinonecrotic (or pyogranulomatous) glossitis Cause: <i>Actinobacillus ligniersi</i>
6	Ox, opened esophagus with linear to ovoid mucosal erosions and ulcers	Morphologic diagnosis: ulcerative esophagitis Cause: bovine viral diarrhea virus
7	Ox, opened rumen with focal mucosal necrosis and hemorrhage	Morphologic diagnosis: mucosal hemorrhage and necrosis, rumen Cause: arsenic
8	Ox, opened abdominal cavity; massive mural hemorrhage in rumen	Morphologic diagnosis: ruminal hemorrhage Cause: bovine viral diarrhea virus; thrombocytopenic syndrome
9	Ox, opened rumen with red-brown flukes on mucosal surface	Agent: Paramphistomum
10	Ox, reticulorumen at esophageal groove	Morphologic diagnosis: fibropapilloma, esophageal groove Cause: bovine papillomavirus 4
11	Bison, opened rumen with contracted, scarred ulcers	Morphologic diagnosis: contracted (scarred) ruminal ulcers Pathogenesis: ruminal acidosis → <i>Fusobacterium necrophorum</i> invasion of damaged mucosa → ulceration → healing/scarring
12	Ox, thoracic and cranial abdominal cavity; heavy deposition of fibrinopurulent exudate on serosa of reticulum; less severe involvement of pericardial sac	Morphologic diagnosis: fibrinopurulent reticuloperitonitis and pericarditis Disease: hardware disease, traumatic reticulopericarditis
13	Ox, opened omasum; numerous shallow to deep circular ulcers in omental leaves	Morphologic diagnosis: multifocal ulcerative omasitis Cause: <i>Mucor</i> species, other zygomycetes Pathogenesis: sequel to mucosal damage by acidosis or bovine viral diarrhea virus
14	Ox, opened abomasum; marked thickening of rugae by edema; punctate circular red foci in mucosal surface	Morphologic diagnosis: abomasal edema with multifocal hemorrhage and necrosis Cause: <i>Ostertagia ostertagi</i>

Slide	Description of Photo	Diagnoses
<b>Alimentary System (continued)</b>		
15	Ox, abomasal mucosal surface; multiple ulcers (without apparent inflammation) expose thickening of the submucosa by homogeneous tan tissue	Morphologic diagnosis: lymphoma, abomasum Cause: bovine leukemia virus
16	Calf, opened abomasum; rugae thickened by emphysema; perforating ulcer in fundus/pyloric region	Morphologic diagnosis: emphysematous abomasitis; abomasal ulcer Cause: <i>Clostridium perfringens</i> type A
17	Calf abomasums; all rugae expanded by emphysema; dark pink mucosa coated in yellow-gray fibrinous exudate	Morphologic diagnosis: necrotizing and emphysematous abomasitis Cause: <i>Clostridium perfringens</i> type A
18	Ox, abomasal mucosa thickened by coalescing nodules 1-2 mm in diameter	Morphologic diagnosis: proliferative lymphohistiocytic or eosinophilic abomasitis Cause: <i>Ostertagia ostertagi</i>
19	Ox, abomasal mucosa with numerous circular, shallow to deep, red ulcers	Morphologic diagnosis: ulcerative abomasitis Cause: <i>Mucor</i> or other zygomycete
20	Bison, abomasal mucosa with punctate to oval red ulcers, coated in fibrinous exudate	Morphologic diagnosis: ulcerative abomasitis Cause: bovine viral diarrhea virus? Stress?
21	Calf, opened thorax and abdomen; bloated, dark red abomasums is twisted; hemorrhage in wall and abdominal cavity	Morphologic diagnosis: abomasal volvulus
22	Calf, opened thorax and abdomen; most peritoneal surfaces in yellow-white fibrinous exudate	Morphologic diagnosis: fibrinopurulent peritonitis
23	Calf, loops of small intestine, some opened to reveal fibrinous exudate on serosal surface	Morphologic diagnosis: fibrinous enteritis Cause: <i>Salmonella</i> Dublin or <i>S. Typhimurium</i>
24	Ox, opened segments of small intestine with reddened mucosa, coated with hemorrhagic to fibrinous exudate	Morphologic diagnosis: fibrinohemorrhagic erosive enteritis Cause: bovine viral diarrhea virus
25	Ox, opened segment of ileum with ulceration and fibrinonecrotic exudate over sunken Peyer's patch	Morphologic diagnosis: focal ulcerative enteritis; lymphoid atrophy, Peyer's patch Cause: bovine viral diarrhea virus
26	3-year-old Guernsey cow, emaciated with fecal staining of tail and hind limbs; Inset: ileal mucosa with rugose thickening	Morphologic diagnosis: granulomatous enteritis Cause: <i>Mycobacterium avium paratuberculosis</i> Histologic characteristics: acid-fast bacteria, macrophage infiltration of lamina propria
27	Calf, loops of small intestine; marked dilation proximal to aplastic segment	Morphologic diagnosis: segmental intestinal aplasia
28	Ox, cross-section of intestine; mural thickening and infiltration of serosa/mesentery by homogeneous tan tissue	Morphologic diagnosis: intestinal lymphoma
29	Ox, opened segments of colon with reddened, thickened to cystic mucosa, luminal cast of blood	Morphologic diagnosis: hemorrhagic colitis Cause: <i>Eimeria bovis</i> or <i>E. zurnii</i>
30	Ox, opened loops of spiral colon; multifocal linear to ovoid erosions and ulcers coated with fibrinohemorrhagic exudate	Morphologic diagnosis: fibrinohemorrhagic colitis Cause: bovine viral diarrhea virus

Slide	Description of Photo	Diagnoses
<b>Hepatobiliary System</b>		
31	Calf, section of liver; multiple pin-point tan foci	Morphologic diagnosis: multifocal necrotizing hepatitis Cause: Salmonella Dublin or Typhimurium
32	Yearling calf, section of liver; coalescing, indistinct foci of pale gray tissue infiltration	Morphologic diagnosis: lymphoma, liver
33	Ox, section of liver; classic nutmeg pattern of centrilobular degeneration and fibrosis	Condition: chronic passive hepatic congestion Pathogenesis: right heart failure
34	Ox, sections of liver; fibrous thickening of bile ducts; brown staining of bile duct lumen	Morphologic diagnosis: fibrosing cholangitis, cholangiohepatitis Cause: <i>Fasciola hepatica</i>
35	Ox, liver sections; pale gray-tan, circular to irregularly shaped, coalescing foci	Disease: hepatic necrobacillosis Cause: <i>Fusobacterium necrophorum</i>
36	Cow, liver section; diffuse parenchymal swelling with pale yellow discoloration	Morphologic diagnosis: hepatic lipidosis Pathogenesis: ketosis associated with insufficient energy intake during lactation
37	Ox, liver with spherical accumulation of pus bulging from surface of left lobe; Inset: section through abscess	Morphologic diagnosis: hepatic abscess Cause: Arcanobacterium pyogenes et al bacteria
38	Ox, liver section; red splotchy foci composed of clusters of dilated sinusoids	Morphologic diagnosis: hepatic telangiectasis
39	Calf, umbilicus, opened umbilical vein and liver; vein is dilated and lined by pale tan fibrinopurulent exudate; scattered abscesses in left lobe of liver	Morphologic diagnosis: fibrinopurulent omphalophlebitis; hepatic abscesses Pathogenesis: failure of passive transfer → colonization of umbilical vein with E. coli or other bacteria
40	Calf liver with opened gall bladder; gall bladder wall thickened by edema; lumen filled with coagulum of yellow-white fibrinous exudate	Morphologic diagnosis: fibrinous cholecystitis Cause: Salmonella Dublin
<b>Hematopoietic System</b>		
41	Ox, opened thoracic and abdominal cavities; pale yellow tissues; enlarged and dark spleen; widened interlobular septa of lung; Inset: impression smear of spleen with organisms in erythrocytes	Morphologic diagnosis: splenomegaly; icterus; pulmonary interlobular edema Cause: <i>Anaplasma marginale</i>
42	Bison; spleen focally adhered to rumen where abscesses extend through capsule	Morphologic diagnosis: splenic abscesses Cause: <i>Arcanobacterium pyogenes</i>
43	Ox, kidney; multiple bulging nodules of pale tan homogeneous tissue, mainly in cortex	Morphologic diagnosis: lymphoma, kidney Cause: bovine leukemia virus

Slide	Description of Photo	Diagnoses
<b>Urinary System</b>		
44	Calf; both kidneys are small and misshapen	Morphologic diagnosis: bilateral renal hypoplasia or dysplasia
45	Calf; sectioned kidney with indistinct pale gray foci and streaking, mainly in cortex	Morphologic diagnosis: lymphocytic interstitial nephritis Cause: <i>Escherichia coli</i>
46	Ox, kidney; diffuse pallor, yellowish discoloration, and swelling of cortex; red streaks and wedges extend from corticomedullary junction to capsule	Morphologic diagnosis: hemorrhagic renal infarcts, renal cortical degeneration/necrosis Cause: <i>Escherichia coli</i> , other gram negative septicemia, other bacteria
47	Ox, kidney section; yellow-white exudate in renal calices and bulging as small coalescing abscesses mainly in the cortex	Morphologic diagnosis: suppurative pyelonephritis Cause: <i>Corynebacterium renale</i>
48	Ox, urinary tract; saccular distension of the urachus by pus; continuity of urachus and urinary bladder; crystalline material in bladder and on preputial hairs; ascending pyelonephritis	Pathogenesis: persistent urachus→urachal abscess→cystitis and crystalluria (urolithiasis)→pyelonephritis
49	Water buffalo, mucosal surface of urinary bladder with multiple red polypoid masses protruding into lumen	Differential diagnosis: Polyps, hemangiomas, urinary bladder Cause: brackenfern ( <i>Pteridium aquilinum</i> )
50	Ox, urinary tract; unseen obstruction at sigmoid flexure; hemorrhage and necrosis of bladder wall with perforation	Pathogenesis: urethral obstruction (usually at sigmoid flexure)→dilation of urinary bladder→hemorrhagic necrosis→bladder rupture



**Lecture 3. Gross Diagnosis of Selected Bovine Lesions (skeletal, nervous, special senses, integumentary, and reproductive systems)**

Slide	Description of Photo	Diagnoses
<b>Skeletal System</b>		
1	Calf, longitudinal and cross-section of long bone; primary spongiosa extends from growth plate into diaphysis; no medullary cavity	Condition: osteopetrosis Cause: autosomal recessive genetic defect Pathogenesis: failure of osteoclastic resorption
2	Ox, articular surface of humeral head; opaque white cartilage with extensive erosion, exposing underlying bone	Condition: osteochondrosis dissecans or osteochondritis dissecans
3	Calf, articular surface of joint with glistening blue-white cartilage, but accumulation of cream-colored fibrinous exudate	Morphologic Diagnosis: fibrinous synovitis Cause: <i>Escherichia coli</i> , other bacteria
4	Calf, articular surface of joint; reddened synovial membrane with watery red synovial fluid; copious pale tan fibrinosuppurative exudate	Morphologic diagnosis: fibrinosuppurative synovitis Cause: <i>Escherichia coli</i> et al bacteria
5	Ox, opened joint with copious pale yellow, purulent exudate	Morphologic diagnosis: purulent synovitis Cause: <i>Arcanobacterium pyogenes</i> , <i>Mycoplasma bovis</i>
6	Ox, opened carpal joint; pale tan fluid exudate is concentrated in tendon sheaths and periarticular tissue	Morphologic diagnosis: fibrinopurulent tenosynovitis Cause: <i>Mycoplasma bovis</i>
7	Ox, opened joint with inspissated tan exudate and erosion of articular cartilage	Morphologic Diagnosis: fibrinopurulent arthritis Cause: <i>Streptococcus</i> spp. or <i>Arcanobacterium pyogenes</i>
8	Ox, longitudinal section through distal aspect of femurs; necrosis and suppuration mainly in metaphysis, extending focally to growth plate	Morphologic diagnosis: suppurative and necrotizing osteomyelitis Cause: <i>Arcanobacterium pyogenes</i> (also consider <i>Salmonella</i> )
9	Term bovine fetus with twisted limbs, fixed in flexion	Condition: arthrogryposis Cause: genetic, lupine, tobacco, poison hemlock, bluetongue, et al
10	Ox, longitudinal section of spine with inflammation and necrosis of vertebral body	Morphologic diagnosis: suppurative vertebral osteomyelitis Cause: <i>Arcanobacterium pyogenes</i> , <i>Escherichia coli</i> , <i>Salmonella typhimurium</i> , et al
<b>Nervous System</b>		
11	Ox, cranium opened to expose brain with small cerebellum and cavitated, collapsed areas in occipital lobes of cerebrum	Morphologic diagnosis: (1) cerebellar hypoplasia (2) porencephaly Cause: bluetongue virus; bovine viral diarrhea virus
12	Ox, cranium opened to expose brain; almost complete absence of cerebral tissue; note presence of meninges and normal thickness of cranium	Morphologic diagnosis: hydranencephaly Cause: bluetongue virus; bovine viral diarrhea virus
13	Ox, basilar aspect of brain; accumulation of purulent exudate in the leptomeninges	Morphologic diagnosis: purulent leptomeningitis, brain Cause: <i>Streptococcus</i> spp., other pyogenic bacteria

Slide	Description of Photo	Diagnoses
<b>Nervous System (continued)</b>		
14	Ox, sagittal section of skull with fibrinopurulent exudate in meninges caudal to tentorium; purulent exudate in middle and inner ear	Morphologic diagnosis: fibrinopurulent meningitis and otitis media/interna Cause: <i>Mycoplasma bovis</i> , other pyogenic bacteria
15	Ox, sagittal section through cerebellum and brain stem; softening, swelling and reddening in medulla oblongata	Morphologic diagnosis: encephalitis, medulla oblongata Cause: <i>Listeria monocytogenes</i>
16	Ox, lateral aspect of brain with cross-section of formalin-fixed cerebrum; irregular red foci around leptomeningeal vessels and in parenchyma	Disease: thrombotic meningoencephalitis Cause: <i>Histophilus somni</i>
17	Ox, cross-section of cerebrum; segmental yellowing and granular texture or loss of tissue from dorsal cerebral cortex	Morphologic diagnosis: segmental laminar cerebrocortical necrosis Cause: thiamine deficiency, high dietary sulfur, thiaminase, lead poisoning
18	Ox, termination of spinal cord with extra-dural mass of soft tan homogeneous tissue	Morphologic diagnosis: lymphoma, epidural, cauda equina Cause: bovine leukemia virus
<b>Ophthalmic System</b>		
19	Calf eye with strip of haired skin extending from bulbar conjunctiva across limbus onto cornea	Morphologic diagnosis: corneoscleral dermoid
20	Calf eye with accumulation of yellow-white fibrinopurulent exudate in anterior chamber	Morphologic diagnosis: hypopyon, suppurative/purulent endophthalmitis Cause: <i>Streptococcus pneumoniae</i> ; others?
21	Ox, face and eye; cloudy cornea with central opacity/ulceration; vessels extending from the limbus	Morphologic diagnosis: ulcerative keratoconjunctivitis Cause: <i>Moraxella bovis</i> Disease: infectious bovine keratoconjunctivitis, pink eye
22	Ox, face and eye; purulent exudate in anterior chamber; collapsed and opaque cornea; purulent exudate on reddened conjunctiva	Morphologic diagnosis: purulent keratoconjunctivitis or panophthalmitis
23	Ox, face and eye; ulcerated finely granular pink mass on bulbar conjunctiva	Morphologic diagnosis: ocular squamous cell carcinoma
24	Ox, face and eye; retrobulbar swelling causes protrusion of the eye	Morphologic diagnosis: exophthalmos Pathogenesis: bovine leukemia virus infection → retrobulbar lymphoma
<b>Integumentary System</b>		
25	Two calves; pigmented mass on the hock of one, over the pastern of the other	Morphologic Diagnosis: dermal melanocytoma
26	Feet of 2 different cattle; erosions and crusting around the coronary band	Morphologic diagnosis: erosive dermatitis, coronary band (coronitis) Cause: BVD on left; bluetongue on right
27	Yearling calf with warts; inset shows papillary fronds of hyperplastic epidermis with minimal dermal involvement	Morphologic Diagnosis: cutaneous papillomas Cause: bovine papillomavirus 3, 4, or 6

Slide	Description of Photo	Diagnoses
<b>Integumentary System (continued)</b>		
28	Hind feet from 3 different cattle; lesions vary from acute edematous stage to necrosis to dry leathery gangrene	Disease: fescue foot (accept ergotism) Pathogenesis: endophyte-infested fescue→ergovaline→vasoconstriction in cold weather→ischemic necrosis (gangrene) of hind feet, tail, and pinnae
29	Calf with multiple alopecic, crusted skin lesions especially over the dorsum of the trunk; Inset: impression smear of crust; branching filaments composed of coccoid bodies	Morphologic Diagnosis: multifocal exudative dermatitis Cause: <i>Dermatophilus congolensis</i>
30	Calf with alopecic, gray scaly circular plaques on neck and periocular skin	Disease: dermatophytosis Cause: <i>Trichophyton</i> spp.
31	Holstein heifer with extensive lack of hair; where present, hair is sparse, dry and poorly pigmented (in black areas)	Condition: viable hypotrichosis Cause: autosomal recessive trait
32	Ventral abdominal midline skin from 2 different cattle; one has patches of thickened, alopecic, and focally crusted skin; the other, patches of thickened, alopecic, and hyperpigmented skin	Cause: <i>Stephanofilaria stilesi</i>
<b>Mammary Gland</b>		
33	Ox, sagittal section of mammary gland through teat; tissue is reddened and necrotic; cessation of milk production; coagulum of inspissated casein in teat cistern	Morphologic diagnosis: gangrenous mastitis Cause: <i>Staphylococcus aureus</i>
34	Ox, close-up of mammary gland with miliary nodules, some of which contain purulent exudate	Morphologic diagnosis: pyogranulomatous mastitis Differential diagnosis: <i>Staph aureus, Nocardia, Mycobacterium</i> , fungal, algal
35	Ox, udder with multiple red infarcts visible through the skin	Morphologic diagnosis: necrotizing mastitis with infarction Cause: coliform ( <i>Klebsiella, E. coli, Pseudomonas</i> , et al.)
36	Sections through mammary gland of the cow in slide 35; cessation of secretion; coagulum of casein and red watery fluid in teat cistern; hemorrhagic infarcts in gland; fibrin deposits	Morphologic diagnosis: necrotizing mastitis with infarction Cause: coliform ( <i>Klebsiella, E. coli, Pseudomonas</i> , etc.)
<b>Reproductive System</b>		
37	Ox, prepubescent testis with spermatic cord; marked thickening of tunics by white fibrous to nodular tissue	Morphologic diagnosis: mesothelioma, tunica albuginea or tunica vaginalis
38	Ox, testis with scrotum opened to reveal red fibrinous to fibrous strands that adhere tunica albuginea to tunica vaginalis	Morphologic diagnosis: fibrinohemorrhagic to fibrosing periorchitis Pathogenesis: traumatic injury to scrotum and tunics→hemorrhage and fibrin deposition → granulation tissue→adhesion of t. albuginea to t. vaginalis→disrupted thermoregulation Sequel: testicular atrophy, infertility

Slide	Description of Photo	Diagnoses
<b>Reproductive System (continued)</b>		
39	Reproductive tract of neonatal heifer born twin to a bull; gonadal hypoplasia; ovotestis; hypoplasia with segmental aplasia of uterus; presence of vestigial seminal vesicles	Condition: freemartinism Pathogenesis: interplacental anastomosis between male and female twin fetuses→blood exchange and XX/XY chimerism of hematopoietic cells; testis-determining factor of the Y chromosome disrupts ovarian development; probably Müllerian inhibitory substance (from abnormal gonad or from the male twin?) prevents normal development of tubular portion of the tract
40	Ox, uterus; multiple homogeneous tan nodular masses	Morphologic diagnosis: uterine lymphoma Cause: bovine leukemia virus
41	Ox, uterus; nodular mass at bifurcation and extending into one uterine horn; Inset: cross-section of lung with scirrhous metastatic lesions that fill pulmonary lobules	Morphologic diagnosis: uterine carcinoma with pulmonary metastasis
42	Simmental cow with markedly distended uterus spilling from ventral midline abdominal incision	Morphologic diagnosis: hydroallantois
43	Ox, post-partum uterus, caruncles and intercaruncular endometrium coated with yellow-brown fibrinous exudate	Morphologic diagnosis: fibrinopurulent (endo)metritis Cause: <i>Escherichia coli</i>
44	Ox, opened uterus with retained placenta; diffuse fibrinonecrotic exudate	Morphologic diagnosis: fibrinonecrotic metritis with placental retention Cause: <i>Arcanobacterium pyogenes</i> ; <i>Brucella abortus</i> ; other bacteria, <i>Aspergillus fumigatus</i>
45	Bovine fetus; thoracic and abdominal viscera are coated with fibrinopurulent exudate	Morphologic diagnosis: fibrinopurulent polyserositis Cause: <i>Arcanobacterium pyogenes</i> or other bacteria
46	Bovine fetus; multiple circular, alopecic, gray scaly plaques in skin	Cause: <i>Aspergillus fumigatus</i>
47	Bovine fetal liver; swollen with coalescing yellow-tan miliary nodules	Morphologic diagnosis: granulomatous hepatitis Disease: epizootic bovine abortion Putative cause: <i>Borrelia coriaceae</i>
48	Middle trimester bovine fetus with placenta; white plaques on inner surface of amnion	Amniotic plaques (not a lesion!)
49	Bovine fetus with placenta; attached to placenta is a skin-and hair-covered spherical mass of soft tissue	Morphologic diagnosis: amorphus globosus
50	Term bovine fetus with alopecia and massive enlargement of thyroid gland	Morphologic diagnosis: goiter or thyroid hyperplasia. alopecia Cause: iodine deficiency or iodine excess or goitrogenic plants
51	Term bovine fetus with edematous thickening of skin and soft tissues of the head and neck; diffuse alopecia	Morphologic diagnosis: myxedema; alopecia Cause: iodine deficiency
52	Bovine fetus with abdomen distended by amber fluid; liver enlarged, purple and coarsely nodular.	Morphologic diagnosis: ascites; chronic passive hepatic congestion <i>Note: fetus had pulmonic valvular dysplasia</i>

## Lecture 4. Gross Diagnosis of Selected Lesions of Sheep and Goats

Slide	Description of Photo	Diagnoses
<b>Alimentary System</b>		
1	Sheep, roof of mouth with coalescing mucosal ulcers, especially of dental pad and soft palate	Morphologic diagnosis: ulcerative stomatitis (palatitis) Cause: bluetongue virus
2	Sheep, abomasums; mucosal surface covered with tangles of slender nematodes	Organism: <i>Haemonchus contortus</i> Related clinical syndrome: anemia, bottle jaw
3	Sheep head, partially skin; pale tissues with watery blood; subcutis expanded by colorless watery fluid	Morphologic diagnosis: subcutaneous edema; anemia Cause: <i>Haemonchus contortus</i>
4	Goat, small intestine with white nodules visible through serosal surface and (Inset) appearing as plaques of polyps in mucosa	Morphologic diagnosis: proliferative enteritis Cause: <i>Eimeria arloingi et al</i>
5	Sheep, opened small intestine with rugose thickening of mucosa	Morphologic diagnosis: granulomatous enteritis Cause: <i>Mycobacterium avium paratuberculosis</i>
<b>Hepatobiliary System</b>		
6	Sheep, liver; numerous hydatid cysts	Condition: hydatid liver disease, hydatidosis Cause: <i>Echinococcus granulosus</i>
7	Goat, liver section with multiple tan foci and tracts of necrosis; bile duct lesions not evident; Inset: Immature flukes pulled from migratory tracts in hepatic parenchyma	Morphologic diagnosis: multifocal necrotizing hepatitis Cause: <i>Fasciola hepatica</i>
8	Sheep, thoracic and abdominal cavity; pale yellow tissues; pale brown liver; distended gall bladder; bluish discoloration of kidney	Morphologic diagnoses: Hepatic degeneration; icterus; hemoglobinuric nephrosis Cause: Copper poisoning
<b>Urinary System</b>		
9	Sheep, thoracic and abdominal cavity; yellow-brown liver; dark, red-blue kidney; red-brown transparent urine	Morphologic diagnoses: Hepatic degeneration; icterus; hemoglobinuric nephrosis Cause: Copper poisoning
10	Sheep; glans penis with urolith in urethral process; mild distension of ureters and renal pelvis	Morphologic diagnosis: urolithiasis, urethral process; hydroureter and hydronephrosis
<b>Lymphoid System</b>		
11	Goat, mandibular lymph node; accumulation of pale yellow caseous exudate	Morphologic diagnosis: caseous lymphadenitis Cause: <i>Corynebacterium pseudotuberculosis</i>
12	Goat, heart and lung; mediastinal lymph node expanded by pale yellow caseous exudate; abscesses in lungs; pleura thickened by organizing red fibrinous to fibrous exudate	Morphologic diagnosis: abscesses, mediastinal lymph node and lung; fibrosing pleuritis
13	Sheep, caudal mediastinal lymph node expanded by laminated pale yellow-green exudate	Disease: caseous lymphadenitis Cause: <i>Corynebacterium pseudotuberculosis</i>
14	Goat, thoracic cavity; lung with pleural and subpleural abscesses	Morphologic diagnosis: pleuropulmonary abscesses Cause: <i>Corynebacterium pseudotuberculosis</i>

Slide	Description of Photo	Diagnoses
<b>Respiratory System</b>		
15	Sheep, sagittal section of head; dark pink fleshy mass in caudal aspect of nasal cavity	Morphologic Diagnosis: ethmoidal (or nasal) adenocarcinoma Cause: beta retrovirus (ENTV-1) Disease: enzootic nasal tumor
16	Sheep, thoracic cavity; dark red consolidation of cranioventral aspect of lung; fibrinopurulent exudates on pleura of pneumonic lung	Morphologic diagnosis: bronchopneumonia with fibrinopurulent pleuritis Cause: <i>Mannheimia haemolytica</i> ± <i>Mycoplasma</i> spp. and other bacteria
17	Goat, lungs; cranioventral red consolidation; pleura heavily coated with gray fibrinous exudate	Morphologic diagnosis: bronchopneumonia with fibrinous pleuritis
18	Sheep, lung; opened bronchus filled with froth, mucus and numerous nematodes	Morphologic diagnosis: catarrhal bronchitis Cause: <i>Dictyocaulus filaria</i>
19	Fetal lamb, thoracic cavity; lung speckled with yellow foci or nodules (pleural or subpleural)	Morphologic diagnosis: multifocal suppurative pleuropneumonia Cause: <i>Campylobacter</i> , <i>Listeria</i> spp, et al bacteria
20	Goat, lungs with cross-section; pink, poorly collapsed lung with alveolar pattern	Morphologic Diagnosis: lymphocytic interstitial pneumonia Cause: CAE lentivirus Histologic lesion: Lymphocytic Interstitial Pneumonia + type II pneumocyte hyperplasia Other tissues/organs commonly affected: joints, mammary glands, CNS
21	Goat, lungs; dark red cranioventral consolidation; lobular to lobar pattern	Morphologic diagnosis: lobular to lobar bronchopneumonia Cause: <i>Pasteurella multocida</i>
22	Goat, lungs with nodules especially along dorsum of caudal lobe; Inset: cross section of sheep lung with pale nodules	Morphologic diagnosis: granulomatous pneumonia Cause: <i>Muellerius capillaris</i>
23	Goat, thoracic and abdominal cavities; red splotches on lungs; amber fluid in thoracic and abdominal cavity; congested liver	Morphologic diagnosis: pulmonary petechiae and ecchymoses; hydrothorax; hepatic congestion; ascites
24	Sheep, lung section; pallor, watery to frothy fluid exuding from cut surface	Morphologic diagnosis: pulmonary edema Cause: <i>Haemonchus contortus</i>
<b>Cardiovascular System</b>		
25	Sheep, opened heart; large interventricular septal defect between apex and base; probe inserted through patent ductus arteriosus	Morphologic Diagnosis: (1) patent ductus arteriosus (2) ventricular septal defect Histologic lesion in pulmonary vasculature: medial hypertrophy of muscular pulmonary arteries -> necrotizing arteritis
26	Sheep, heart; large defect in interatrial septum	Morphologic diagnosis: atrial septal defect
27	Sheep, heart; translucent gelatinous appearance to adipose tissue in coronary groove	Morphologic Diagnosis: serous atrophy of fat Pathogenesis: starvation, mobilization of fat

Slide	Description of Photo	Diagnoses
<b>Cardiovascular System (continued)</b>		
28	Goat, heart; opened pericardial sac containing amber fluid	Morphologic Diagnosis: Hydropericardium Pathogenesis: starvation or intestinal parasitism →hypoproteinemia →decreased blood osmotic pressure →leakage of fluid from vessels
29	Goat, heart; opened to reveal exudate and vegetations on the right atrioventricular valve	Morphologic diagnosis: vegetative endocarditis, right atrioventricular valve Cause: <i>Streptococcus</i> spp., other bacteria
30	Sheep, opened heart; exudate on aortic, left atrioventricular valvular and mural endocardium with abscesses in myocardium	Morphologic diagnosis: valvular and mural endocarditis with myocardial abscesses Cause: <i>Arcanobacterium pyogenes</i>
<b>Nervous System</b>		
31	Sheep fetus with one eye, other facial deformities	Condition: cyclopia and various facial anomalies Associated brain defect: holoprosencephaly Cause: cyclopamine or other toxin from <i>Veratrum californicum</i> Pathogenesis: maternal ingestion of <i>Veratrum californicum</i> on 14 <sup>th</sup> day of gestation→ cyclopamine and other toxins disrupt cholesterol metabolism and sonic hedgehog signal transduction→holoprosencephaly, cyclopia, and other facial/cerebral anomalies (general tendency toward loss of midline structures, etc)
32	Sheep, brain; small cerebellum, thin-walled, flattened cerebrum	Morphologic diagnosis: hydranencephaly; cerebellar hypoplasia Cause: bluetongue virus, Cache valley virus
33	Sheep, cross-section of cerebrum; bilaterally symmetrical foci of liquefactive necrosis in basal nuclei and internal capsule	Disease: focal symmetrical encephalomalacia Cause: <i>Clostridium perfringens</i> type D, epsilon toxin
34	Sheep, cross-section of cerebrum; segmental yellowing and disintegration of cerebral cortex in dorsal gyri with focal separation from white matter	Disease: polioencephalomalacia Cause: thiamine deficiency, high dietary sulfur, thiaminase
35	Goat brain; abscess filled with pale green pus	Morphologic diagnosis: cerebral abscess Cause: <i>Corynebacterium pseudotuberculosis</i>
36	Lamb; opened lumbosacral vertebral canal; opaque yellow fluid pus surrounds spinal cord (extension from tail dock abscess)	Morphologic diagnosis: purulent meningitis Cause: <i>Arcanobacterium pyogenes</i>
37	Goat, eye; cloudy cornea with accumulation of pale yellow exudate in anterior chamber	Morphologic diagnosis: corneal edema, suppurative keratitis and anterior uveitis Cause: <i>Mycoplasma ovipneumonia</i> , other bacteria ( <i>Branhamella</i> , et al), herpesviruses?

Slide	Description of Photo	Diagnoses
<b>Skeletal System</b>		
38	Sheep, longitudinal section through scapula and humerus; islands and coalescing bands of persistent cartilage around multiple ossification centers in scapula	Disease: spider lamb syndrome Cause: A,r point mutation in <i>FGFR3</i> Histologic lesion: multiple abnormal ossification centers
39	Lamb, opened stifle joint; pale yellow tan fibrinous exudates on synovial surfaces	Morphologic diagnosis: fibrinopurulent synovitis Cause: <i>Streptococcus</i> spp.
40	Goat kid, opened shoulder joint; irregularly eroded articular cartilage; reddened synovium Another kid, opened carpal joint with dark pink, thickened and nodular synovial membrane	Morphologic diagnosis: proliferative synovitis; erosive arthritis Disease: caprine arthritis encephalitis
<b>Integumentary System</b>		
41	Goat, muzzle; with proliferative, nodular and crusted skin lesions	Disease: contagious ecthyma/orf Cause: parapoxvirus
42	Goat, skin; brown-black multinodular cutaneous mass in skin near mammary gland	Morphologic diagnosis: cutaneous melanoma
43	Sheep, well-demarcated hemorrhagic necrosis of ventral portion of one mammary gland	Morphologic diagnosis: gangrenous mastitis Cause: <i>Staphylococcus aureus</i>
44	Sheep, mammary gland, well-demarcated hemorrhagic necrosis of ventral aspect	Morphologic diagnosis: gangrenous mastitis Cause: <i>Staphylococcus aureus</i>
<b>Reproductive System</b>		
45	Sheep, sagittal section of testis with segmental dilation of epididymal tubule by inspissated secretion	Morphologic diagnosis: spermatocele or sperm granuloma Pathogenesis: failure of efferent ductule(s) to unite with epididymal duct
46	Neonatal goat with massive enlargement of thyroid gland	Morphologic diagnosis: hyperplastic goiter Cause: genetic dysmorphogenesis or iodine deficiency
47	Fetal lamb, thoracic and abdominal cavity; large pale foci of hepatic necrosis	Morphologic diagnosis: multifocal necrotizing hepatitis Cause: <i>Campylobacter fetus</i> subsp <i>fetus</i> (or <i>Campylobacter jejuni</i> or <i>Flexispira rappini</i> )
48	Ovine fetuses; one perinatal death; one mummified	Morphologic diagnosis: fetal mummification
49	Ovine placenta, dark pink to gray-tan fibrinous exudate in cotyledon and intercotyledonary placenta	Morphologic diagnosis: fibrinous placentitis Cause: <i>Chlamydomphila abortus</i>
50	Ovine placenta; numerous yellow-brown foci of necrosis in cotyledons; normal intercotyledonary placenta	Cause: <i>Toxoplasma gondii</i>
51	Normal caprine placenta	Normal caprine placenta