FINAL REPORT

MYSTIC AQUARIUM
55 COOGAN BLVD
MYSTIC CT 06355

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Animal ID: Havok
Species: Marine
Breed: Beluga
Sex: M
Age: 6Y
Wt: 300 kg

FINAL DIAGNOSIS:
EMACIATION
LYMPHOPLASMACYTIC ENTERITIS, MODERATE TO MARKED
CUTANEOUS ULCERS, FLUKE & ROSTRUM, SEVERE
GRANULOMATOUS PANNICULITIS, THORACIC WALL, MARKED, WITH INSOLUBLE LIPID RESIDUES
ESOPHAGEAL ULCERS, MULTIPLE, MARKED TO SEVERE
GASTRIC ULCERS, SECOND COMPARTMENT, MARKED
ENDOCARDIAL FIBROSIS, MODERATE TO MARKED
EPICARDIAL FIBROSIS, SEVERE, WITH PROMINENT BLOOD VESSELS
LUMBOCAUDAL SCOLIOSIS, SEVERE
HEMORRHAGE AND EDEMA, EPAXIAL MUSCLES, MARKED
LYMPHOID DEPLETION, GASTRIC, MESENTERIC, AND TRACHEOBRONCHIAL LYMPH NODES, MODERATE TO MARKED
KERATITIS, LEFT EYE, MODERATE

MORPHOLOGIC DIAGNOSIS:
SKIN AND BLUBBER, FLUKE: [1] severe, focal, epidermal ulcer, with necrotizing, suppurative, dermatitis and panniculitis, thrombosis, hemorrhage, edema, and gram-negative bacteria; [2] moderate, multifocal, superficial epidermal, hydropic and spongiotic change, with lightly proteinaceous edema
SKIN AND BLUBBER, ROSTRUM: severe, focal, epidermal ulcer, with superficial collagen lysis thrombosis, edema, congestion, and spotty hemorrhage
SKIN AND BLUBBER, RIGHT DORSAL THORACIC WALL: [1] moderate, multifocal, superficial epidermal, hydropic and spongiotic change, with lightly proteinaceous edema; [2] moderate, multifocal, granulomatous panniculitis, with mild congestion, hemorrhage, and intrahistiocytic pigmented lipid residues
SKELETAL MUSCLE AND FASCIA, RIGHT & LEFT EPAXIAL: marked, diffuse, edema, with hemorrhage
ESOPHAGUS, PERI-LARYNGEAL including GLANDS & MUCOSA ASSOCIATED LYMPHOID TISSUE: marked, multifocal, ulcers, with thrombosis, suppurative inflammation, edema, congestion, and granulation tissue
STOMACH, FIRST COMPARTMENT: marked, diffuse, hydropic change of mucosal epithelium STOMACH, SECOND COMPARTMENT: [1] marked, multifocal, ulcers with necrosis and suppurative inflammation, thrombosis, hemorrhage, and superficial pigment; [2] marked, multifocal, lamina proprial congestion
INTESTINE: [1] moderate to marked, segmental, lymphoplasmacytic enteritis with lymphofollicular arrangements; [2] mild, multifocal, crypt ectasia, with luminal necrotic debris
GASTRIC LYMPH NODE: [1] marked, diffuse, follicular, lymphoid depletion; [2] marked, diffuse, sinus histiocytosis, with sinus hemorrhage and erythrophagocytosis
MESENTERIC LYMPH NODE: [1] moderate, diffuse, follicular, lymphoid depletion; [2] marked, diffuse, sinus histiocytosis, with sinus hemorrhage
TRACHEOBRONCHIAL LYMPH NODE: [1] marked, diffuse, lymphoid depletion; [2] marked, diffuse, sinus histiocytosis, with mild neutrophilia
KIDNEY: [1] mild, multifocal, acute, tubular epithelial necrosis; [2] minimal, focal, medullar, tubular mineral deposition
LIVER: moderate, multifocal, biliary epithelial hyperplasia and fibrosis, with minimal to mild, lymphocytic, histiocytic portal infiltrates
HEART: [1] severe, locally extensive, perivascular, epicardial fibrosis; [2] moderate to marked, focal, endocardial fibrosis
LEFT EYE: marked, focal, chronic, lymphohistiocytic keratitis, with marked neovascularization
BRAIN: minimal, multifocal, perivascular, lymphohistiocytic meningoencephalitis
WHOLE BODY: emaciation (GROSS DIAGNOSIS)
VERTEBRAL COLUMN: severe, lumbocaudal scoliosis (GROSS DIAGNOSIS)

COMMENTS:
Along with and corroborating grossly apparent lesions identified in this beluga whale, there were several noteworthy histopathologic findings which could help explain the clinical signs and death. There is evidence of lymphoplasmacytic enteritis, gastric ulcers, and esophageal ulcers, which together could have contributed to the lack of appetite, weight loss, and emaciation reported by the submitting veterinarians. In comparison with intestinal sections from other beluga whales from this institution, multiple segments of intestine from this beluga whale demonstrated marked infiltration of the submucosa by high numbers of lymphocytes, sometimes forming follicular arrangements, and accompanied by scattered aggregates of low numbers of macrophages. Relatively high numbers of plasma cells expanded the overlying lamina propria. Microscopic examination confirmed mucosal ulceration of the second compartment of the stomach. In the esophagus, there were multiple ulcers, some of which had granulation tissue along their deep margins as well as varying degrees of inflammation, which was supplicative in some instances. Histologic sections of several of the multiple skin ulcers seen grossly revealed a range of inflammatory reactions. In the skin ulcer on the fluke, which was complicated by superficial bacteria, there was necrotizing and supplicative dermatitis and panniculitis. Conversely, the skin ulcer at the rostrum was lacking significant inflammation, with little or no evidence of wound healing. Consideration was given to the delayed or lack of wound healing possibly being related to emaciation and prolonged negative energy and protein balance. Within one section of blubber, there was a granulomatous panniculitis associated with intrahistiocytic pigmented lipid residues, which could be the result of incomplete lipid peroxidation associated with oxidative stress and/or antioxidant imbalance. Subjectively in sections of skeletal muscle, myofibers were slender with reduced sarcoplasm, and consideration was given to an interpretation of myofiber atrophy. The areas of grey endocardium were revealed to be areas of marked endocardial fibrosis. The arrangement of prominent blood vessels along the epicardium beneath the heart base noted on gross examination were resolved in histologic sections to be blood vessels surrounded by abundant vascularized fibrous connective tissue. The fibrosis is severe in the absence of epicardial adipose tissue, and it is unclear whether this fibrous connective tissue replaced the typical epicardial adipose tissue or whether this is an anomalous arrangement of fibrous connective tissue and blood vessels along this region of epicardium. There was chronic keratitis. Nodal lymphoid depletion could be interpreted as evidence of immunologic and/or physiologic stress. Other findings, e.g. minimal renal mineral deposition and minimal chronic inflammation in the meninges and brain, could be interpreted as incidental given the other findings in this case.

PATHOLOGIC FINDINGS

HISTORY:
History of reduced appetite and weight loss (est. 2 month duration). Transferred to medical pool for ongoing medical management and advanced diagnostics. Blood work suggestive of inflammation, mild anemia, elevated muscle and liver enzymes. History of gastritis/gastric ulceration, responsive to medical management. Recently developed spinal curvature that has progressed over last 3 days. Current medications include: antibiotics, antifungals, muscle relaxers, GI medications, misoprostol, probiotics, liver support, fluid therapy, nutritional support.
GROSS FINDINGS:
A 6-year-old, approximately 300kg, male, Beluga Whale (Delphinapterus leucas, Mystic Aquarium ID: Havok) was presented for postmortem examination. The whale was in thin body condition with prominent dorsal and transverse spinous processes. An S-shaped lateral curvature of the spine (scoliosis) was evident involving the mid-lumbar spine to the peduncle. Spanning the segment of the body involved in the scoliosis, there was severe bilateral subcutaneous and intramuscular edema of the epaxial muscles. Multiple abrasions of the skin were present on the head, dorsum, lateral body wall, peduncle, and fluke with the more severe including an ulcer of the rostrum and a large, oval ulcer on the fluke with raised margins. The peduncular subcutis and underlying connective tissue was hemorrhagic. Trachea and bronchi contained abundant foam. The mediastinum was emphysematous. The right atrial surface was irregular with pale pitted regions and reddened raised regions. Minimal fluid was present in the pericardial sac. Along the heart base and the coronary sulcus, and extending onto the epicardium, there were enlarged and tortuous blood vessels. There were streaks and plaques of smooth, grey, endocardium along the surfaces of the left and right ventricles. Minimal fluid was in the abdomen. The liver had rounded edges with irregular, depressed areas along its surface. Along the hepatic surface, there were multiple, 1-2mm diameter, white foci. Located along the esophageal mucosa immediately caudal to the larynx and extending to the thoracic esophagus, there were multiple and discrete, linear and elliptical ulcers, which had raised, curled margins. In the second compartment of the stomach, there were multiple and discrete, black ulcers. The first compartment contained fish. The intestine contained bright to dark green, semi-fluidic to semi-solid digesta and fecal material.

Measurements:
- Snout to melon: 6cm
- Snout to angle of mouth: 23.5cm
- Snout to blowhole: 50cm
- Snout to center of eye: 37.25cm
- Snout to anterior insertion of the dorsal ridge: 145cm
- Snout to tip of dorsal ridge: 176cm
- Snout to fluke notch: 312cm
- Snout to anterior insertion of flipper: 78cm
- Snout to caudal end of ventral groove: 54cm
- Snout to center of genital aperture: 183cm
- Snout to center of anus: 223cm
- Flipp length: 41.5cm
- Flippet width (maximum): 26cm
- Fluke width: 77.5cm
- Dorsal fin height: not measured
- Girth, axillary: 134cm
- Girth, maximum (17cm caudal to axilla): 151cm
- Girth at level of anus: 80cm
- Blubber thickness (dorsal): 3cm
- Blubber thickness (lateral at mid-length): 3.5cm
- Blubber thickness (ventral at mid-length): 3cm

HISTOPATHOLOGY:
Histologic sections of the following tissues were evaluated on slides A-AZ: SKIN and BLUBBER of the FLUKE, ROSTRUM, PEDUNCLE, AND RIGHT DORSAL THORACIC WALL, SKELETAL MUSCLE of the RIGHT AND LEFT EPAXIAL MUSCLES, DIAPHRAGM, ESOPHAGUS, STOMACH (FIRST, SECOND, AND THIRD COMPARTMENTS), SMALL INTESTINE, LARGE INTESTINE, LIVER, ADRENAL GLAND, SPLEEN, LUNG, HEART, AORTA, PANCREAS, BRAIN, and EYES including LENSES.

SKIN AND BLUBBER, FLUKE (SLIDE A): [1] epidermal ulcer, focal, severe, with necrotizing, suppurative, dermatitis and panniculitis, thrombosis, hemorrhage, edema, and bacteria; [2] hydropic and spongiotic change, superficial epidermis, multifocal, moderate, with lightly proteinaceous edema
SKIN AND BLUBBER, ROSTRUM (SLIDE B): epidermal ulcer, focal, severe, with superficial collagen lysis, thrombosis, edema, congestion, and spotty hemorrhage
SKIN AND BLUBBER, RIGHT DORSAL THORACIC WALL (SLIDE C): [1] hydropic and spongiotic change, superficial epidermis, multifocal, moderate, with lightly proteinaceous edema; [2] panniculitis, granulomatous, multifocal, moderate, with mild congestion, hemorrhage, and intrahistiocytic pigmented lipid residues
SKELETAL MUSCLE AND FASCIA, RIGHT EPAXIAL (SLIDES E & F): edema, diffuse, marked, with hemorrhage
SKELETAL MUSCLE AND FASCIA, LEFT EPAXIAL (SLIDES G & H): edema, diffuse, marked, with hemorrhage
ESOPHAGUS (SLIDE L): [1] ulcers, focal, marked, with granulation tissue and minimal superficial suppurrative inflammation; [2] hydropic change, mucosal epithelium, diffuse, marked
ESOPHAGUS (SLIDE M): ulcers, multifocal, marked, with collagen lysis, suppurrative inflammation, and thrombosis
ESOPHAGUS, PERI-LARYNGEAL including GLANDS & MUCOSA ASSOCIATED LYMPHOID TISSUE (SLIDE N): ulcers, multifocal, marked, with suppurrative inflammation, edema, congestion, and granulation tissue
LIVER (SLIDES Z, AA, AB, & AJ): biliary epithelial hyperplasia and fibrosis, multifocal, moderate, with minimal to mild, lymphocytic, histiocytic portal infiltrates
LEFT EYE (SLIDE AP): keratitis, lymphocytic, histiocytic, chronic, focal, mild, with marked neovascularization
BRAIN (SLIDES AR, AU-AY): meningoencephalitis, lymphocytic, histiocytic, perivascular, multifocal, minimal

SPECIAL STAINS:
TWORT'S TISSUE GRAM STAIN. SLIDE A. SKIN, FLUKE: The surface of the ulcer has mats of densely arranged, faintly gram-negative, rod-shaped bacteria.
SLIDE B. SKIN, BEAK: No bacteria are identified in representative sections.
SLIDE Q. INTESTINE: Low numbers of gram-negative rods are present within luminal debris on the surface of villi.

WARTHIN-STARRY SILVER STAIN. SLIDES O-Q. STOMACH (FIRST & SECOND COMPARTMENTS) & INTESTINE: No definitive bacteria are identified within representative sections.

PRUSSIAN BLUE HISTOCHEMICAL REACTION FOR IRON. SLIDE AB. LIVER: Hepatocytes throughout the section have brown granules within their cytoplasm, which are not reactive.

VERHOEFF-VAN GIESON'S STAIN FOR COLLAGEN AND ELASTIN. SLIDES AI-AK, AZ. HEART: The grey endocardium seen grossly is moderately to markedly expanded up to three times its typical width by abundant but varying amounts of collagen which separate and disrupt elastin. Along the epicardial surface, there are prominent medium-diameter blood vessels with abundant elastin within their walls. Between these blood vessels are densely arranged bundles of collagen which are interrupted by low numbers of small diameter blood vessels, occasional nerves, and elastin.

ZIEHL-NEELSEN ACID-Fast STAIN. SLIDE C. SKIN, RIGHT DORSAL THORACIC WALL: No acid-fast bacteria are identified within representative sections.
SLIDE Q. INTESTINE: No acid-fast organisms are identified within representative sections.

GROCOTT'S METHENAMINE SILVER STAIN. SLIDE C. SKIN, RIGHT DORSAL THORACIC WALL: No fungal hyphae or yeasts are identified in representative sections.
PERIODIC ACID-SCHIFF STAIN. SLIDE Q. INTESTINE: Macrophages forming aggregates within submucosal lymphoid tissue, interpreted as tingible-body macrophages, occasionally contain PAS-reactive material within their cytoplasm.

WOLBACH GIEMSA STAIN. SLIDE Q. INTESTINE: The material within the cytoplasm of macrophages aggregated within submucosal lymphoid tissue does not stain as a bacterium, fungus, or protist.

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