PASTEURELLA SPP.

AETIOLOGY

Classification of the causative agent

Pasteurella spp. are facultatively anaerobic, Gram-negative coccobacilli in the family *Pasteurellaceae*. There are several species of bacteria, with *P. multocida* being most clinically relevant to domestic and wildlife species. *P. multocida* is divided into three different subspecies: *P. multocida gallicida*, *P. multocida multocida*, and *P. multocida septica*. *P. multocida* subspecies may also be divided into five capsular serogroups (A-E) and sixteen somatic serotypes (1-16). B2 and E2 cause haemorrhagic septicaemia in addition to the possible pneumonia, enteritis, or septicaemia caused by the remainder of the capsular serogroups and somatic serotypes.

For the purpose of voluntary reporting on non OIE-listed disease in wildlife, "*Pasteurella* spp." refers to **infections in non-domestic species**. Information on infections of **haemorrhagic septicaemia in livestock** must be submitted through the mandatory reports for the OIE-listed diseases.

Resistance to physical and chemical action

Temperature: Killed in dry heat (165-170°C for 2 hours) and moist heat (121°C for 20 minutes)

pH: Optimal growth at pH 7.0-8.0

Chemicals/Disinfectants: Susceptible to 70% ethanol, glutaraldehyde, formaldehyde, 1% sodium hypochlorite, iodophors, peracetic acid, and phenolic disinfectants

Survival: Inactivated by UV light and gamma radiation; survives in distilled or ocean water for 14 days at 4°C and less than 24 hours at 37°C

EPIDEMIOLOGY

This is not an exhaustive list of all possible *Pasteurella* spp. or host animals susceptible to infection.

Hosts

- *P. canis*
  - Black-tailed marmosets (*Mico melanurus*)
  - Domestic canines (*Canis lupus familiaris*)
- *P. multocida*
  - Bats
    - *Eptesicus* spp.
    - *Myotis* spp.
    - *Pipistrellus* spp.
    - *Plecotus* spp.
    - *Vespertilio* spp.
  - Bighorn sheep (*Ovis canadensis*)
  - Birds
    - Lesser snow geese (*Chen chen caerulescens*) are thought to be a reservoir for this bacterial species
    - Order *Accipitriformes*

        - Order *Anseriformes*
        - Order *Columbiformes*
        - Order *Charadriiformes*
        - Order *Galliformes*
        - Order *Gruiformes*
        - Order *Passeriformes*
        - Order *Phoenicopteriformes*
        - Order *Sphenisciformes*
        - Order *Strigiformes*
    - Camels (*Camelus* spp.)
    - Domestic species
        - Cattle (*Bos taurus*)
        - Chickens (*Gallus gallus*)
        - Felines (*Felis catus*)
        - Goats (*Capra* spp.)
        - Rabbits (*Oryctolagus* spp.)
        - Sheep (*Ovis aries*)
        - Swine (*Sus scrofa domesticus*)
        - Turkeys (*Meleagris gallopavo*)
        - Water buffalo (*Bubalus bubalis*)
    - Elk (*Cervus elaphus*)
    - European brown hares (*Lepus europaeus*)
    - Fallow deer (*Dama dama*)
    - Non-human primates
        - Cebus monkeys (*Cebus albifrons*)
        - Chimpanzees (*Pan troglodytes*)
        - Macaques (*Macaca fascicularis* and *M. mulatta*)
        - South American owl monkeys (*Aotus trivirgatus*)
        - Squirrel monkeys (*Saimiri sciureus*)
    - Saiga (*Saiga tatarica*)
- *P. pneumotropica*
    - Rodents (order *Rodentia*)
- *P. testudinis*
    - Order *Testudines*
        - Gopher tortoises (*Gopherus* spp.)
        - Leopard tortoises (*Geochelonae pardalis*)
        - Pond turtles (*Clemmys marmorata*)
        - Red-ear turtles (*Chrysemis scripta elegans*)
        - Western box turtles (*Terrapene ornata*)

Transmission

- Inhalation of infectious particles and aerosols
- Ingestion of contaminated feed, infected carcasses, water, or soil
- Scratches or bites from an infected animal
- Contact with infected animals or mechanical vectors
    - Arthropods such as fleas, ticks, lice, and cockroaches
    - *P. multocida* has been shown to persist in the poultry tick (*Argas persicus*) for at least a month
    - Poultry mites (*Dermanyssus* spp.)

Sources

- Naturally present in the environment
- Contaminated feed and infected carcasses
- Oral and respiratory secretions
- Mechanical vectors

Occurrence

Pasteurella spp. have a worldwide distribution in several different animal species. *P. multocida* is often isolated from wild avians in North America and clusters in flyaways. Epizootics due to *P. multocida* serotype 1 in waterfowl from western and central states (Texas, California, and Nebraska) have been reported. In these outbreaks, lesser snow geese (*Chen chen caerulescens*), white-fronted geese (*Anser albifrons*), mallards (*Anas platyrhynchos*), and northern pintails (*Anas acuta*) are predominantly affected. In the United States and Canada, lesser snow geese are thought to be carriers of *P. multocida* since outbreaks are associated with their migratory routes throughout North America. Pasteurellosis in European wildfowl has occurred in partridges (family *Phasianidae*), doves (family *Columbidae*), crows (*Corvus* spp.), pheasants (*Phasianus colchicus*), and sparrows (family *Passeridae*). *P. multocida* capsular type F is believed to have caused corvid respiratory disease (CRD) outbreaks in rooks (*Corvus frugilegus*) in the United Kingdom for the past twenty years.

Multiple die-offs in bighorn sheep (*Ovis canadensis*) populations have occurred due to *P. multocida* infection, often due to contact with domestic sheep or goats. Large die-offs of the critically endangered saiga have occurred throughout recent history, primarily during calving season in Kazakhstan, and were most likely due to pasteurellosis. Notable mortality events occurred in 1974, 1981, 1983, 1988, 2011-2013, and 2015; the 2015 outbreak was specifically caused by *P. multocida* serotype B. In 1986-1987, a *P. multocida* outbreak caused a large die-off of elk in a herd in the National Elk Refuge, Wyoming, United States.

P. testudinis in reptiles is mostly associated with captive species. A black-tailed marmoset was attacked by a dog and became infected with *P. canis* in Mato Grosso, Brazil, thereby demonstrating the possibility of transmission of the bacteria from domestic species to wildlife in urban settings. Most cases of pasteurellosis in nonhuman primates occur in captive settings such as zoos. Recently, *P. multocida* capsular type A was isolated from chimpanzees in Taï National Forest, Côte d'Ivoire.

For more recent, detailed information on the occurrence of this disease worldwide, see the OIE World Animal Health Information System - Wild (WAHIS-Wild) Interface [http://www.oie.int/wahis_2/public/wahidwild.php/Index].

DIAGNOSIS

P. multocida can be found in normal oral and pharyngeal flora. Once it reaches the lungs, the immune response to *P. multocida*'s lipopolysaccharide (LPS) causes fibrin deposition and inflammation. Serotype A has the ability to evade phagocytosis.

Cats harbor *Pasteurella* spp. in their oral flora and are a source of infection for birds and bats; animals have been found with *P. multocida*-infected bite wounds. The most common species that affect bats include: *P. multocida*, *P. pneumotropica*, and *Pasteurella* species B. A mortality event in Wisconsin, United States occurred during which about 100 big brown bats (*Eptesicus fuscus*) were infected with and perished from *P. multocida* over the course of four weeks.

P. multocida infection in avian species, particularly in waterfowl, is known as "avian cholera" or "fowl cholera". Certain species experience higher mortality rates from infection than others, such as swans (*Cygnus* spp.) and coots (*Fulica* spp.). Serotypes 1, 3, and 4 are most pathogenic, and type A is the most virulent.

Pasteurellosis in turtles can be associated with *Mycoplasma* or viral infections in zoos due to the stress of captivity.

Clinical signs associated with pasteurellosis in bighorn sheep may be exacerbated by difficult environmental conditions, secondary infections, and stress.

Clinical diagnosis

P. multocida infection in fallow deer manifests as a head and neck swelling that may extend to the shoulders and sternum. Septicaemia in these animals presents as depression, fever, orifice haemorrhage, and head and neck oedema. Sudden death is the primary clinical sign of saiga involved in widespread *P. multocida* mortality events.

If infected via the respiratory tract, European brown hares may develop conjunctivitis, pneumonia, oculonasal discharge, and snuffling. *P. multocida* may also present as otitis and torticollis. In female hares, vaginal discharge can occur due to uterine infection. Bite wounds develop into subcutaneous abscesses accompanied by swelling.

P. multocida outbreaks in the United Kingdom have caused dyspnoea, weakness, air sacculitis, and pneumonia in rooks. *P. multocida* infection in birds may generally cause depression, anorexia, conjunctivitis, mucoid oral discharge, diarrhoea, dyspnoea, tachypnoea, ruffled feathers, and torticollis.

Pasteurellosis in turtles causes respiratory distress, nasal discharge, and septicaemia. Clinical signs of *P. multocida* infection in chimpanzees include respiratory distress and air sacculitis. Clinical signs of pasteurellosis in bats include septicaemia, wound infections, abscesses, and pneumonia.

Lesions

- Bats
    - Pleuritis
    - Pericarditis, epicarditis, myocarditis
    - Necrosis of liver and spleen
    - Nephritis
- Bighorn sheep
    - Adhesion and consolidation of lung lobes
    - Haemorrhagic, necrotic, suppurative, and/or fibrinous bronchopneumonia
    - Macrophage accumulation in lung tissue
- Birds
    - Mucoid enteritis with necrotic-diphtheritic plaques
    - Mucoid inflammation of upper respiratory tract
        - Accompanied by cytoplasmic vacuolation, mucopurulent exudate, cilia loss, and desquamation
    - Lung parenchyma may contain pockets of accumulated bacteria surrounded by neutrophils
    - Petechial haemorrhages on heart surface
    - Focal necrosis of liver and other organs
- Elk
    - Ecchymotic endocardial haemorrhages
    - Enlarged, congested lymph nodes
    - Suppurative lymphadenitis
    - Petechial haemorrhages on lungs, coronary fat, and diaphragm
    - Splenomegaly
- Fallow deer
    - Head and neck
        - Gelatinous subcutaneous oedema
        - Multifocal petechial haemorrhages
    - Upper respiratory tract oedema with fibrinopurulent or mucoid exudate and necrosis of mucosae
    - Fibrinous pneumonia with pleuritis in cranioventral lung lobes
    - Haemorrhages present in lymph nodes, spleen, and lungs
- Saiga
    - Haemorrhagic septicaemia
        - Oedematous subcutaneous and muscular swelling of neck and submandibular region

        - Petechiae and ecchymoses of tissues and serosa
- Tortoises
    - Ascites
    - Perianal, intestinal wall, and pulmonary oedema

Differential diagnoses

- Bats
    - *Enterococcus* spp.
    - *Escherichia coli*
    - *Salmonella* spp.
- Bighorn sheep
    - *Mannhaemia haemolytica*
    - *Mycoplasma ovipneumoniae*
    - Retrovirus interstitial pneumonia
    - *Trueperella pyogenes*
- Birds
    - *Erysipelothrix rhusiopathiae*
    - *Escherichia coli*
    - *Ornithobacterium rhinotracheale*
    - *Salmonella enterica*
- European brown hares
    - Pneumonia
        - *Mannheimia haemolytica*
    - Torticollis
        - *Encephalitozoon cuniculi*
        - *Psoroptes cuniculi*
- Fallow deer
    - *Bibersteinia trehalosi*
    - *Mannheimia haemolytica*
- Saiga
    - *Mannheimia haemolytica*
- Tortoises
    - Herpesviruses
    - *Mycoplasma* spp.

Laboratory diagnosis

Samples

For isolation of agent

- Cerebral spinal fluid (if animal is septicaemic)
- Lung
- Liver
- Spleen
- Kidney
- Intestines
- Swab of wound

Serological tests

- Serum
- Whole blood

Procedures

Identification of the agent

- Impression smear of liver using Giemsa or Wright's stain
- Inoculate and incubate trypticase soy, blood, or dextrose starch agar plates overnight at 35-37°C
    - Colonies grow up to 2 mm in diameter, are smooth to mucoid, round, and clear to grey
    - Pathogenic *P. multocida* strains are encapsulated and grow as smooth, iridescent colonies on blood agar
- Immunofluorescent microscopy
- In-situ hybridization (ISH)
- Polymerase chain reaction (PCR)

Serological tests

- Serology is generally used to assess *Pasteurella* spp. infection in a population or to detect a vaccine response
- Disk diffusion test
- Antibody capture enzyme-linked immunosorbent assay (ELISA)
- Rapid whole blood agglutination
- Serum plate agglutination

For more detailed information regarding laboratory diagnostic methodologies, please refer to Chapter 3.4.10 *Haemorrhagic septicaemia* in the latest edition of the OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals.

PREVENTION AND CONTROL

Sanitary prophylaxis

- Rodents are known carriers of *P. multocida*; rodent control is important to prevent bacterial spread on livestock operations and in zoos.
    - Bait, trap, and remove rodents
    - Destroy rodent nests
    - Remove rodent faeces
- Inspect meat for *P. multocida* lesions before feeding to carnivores or raptors, or utilising as bait while hunting.
- Bird-proof poultry housing to prevent interaction with wild birds.
- Utilise proper biosecurity practices on poultry operations, such as sanitising trucks between farm visits, promptly removing carcasses, disinfecting tools and instruments between uses, disinfecting bird houses, wearing personal protective equipment, and changing clothes and shoes when entering and exiting poultry facilities.
- Regularly sanitize and keep areas around bird feeders clean to prevent spread of *P. multocida* among wild avian species.
- Prevent waterfowl gatherings by placing wire grids over water sources, build fencing around ponds, avoid feeding waterfowl, xeriscaping, reducing wetland habitat on property, or utilising hazing techniques such as chasing away birds with vehicles or on foot.
- Utilise fencing for domestic sheep herds to prevent interaction between bighorn and domestic sheep.
- Do not graze domestic sheep in pastures that are frequented by bighorn sheep.

Medical prophylaxis

- Vaccines are available for protection against *P. multocida* in swine and cattle.
- A study was conducted to protect lambs from bronchopneumonia in a flock of wild bighorn sheep using a bovine *M. haemolytica*/*P. multocida* vaccine and an experimental *M. haemolytica*/*P. trehalosi* combination vaccine.
    - Ewes were vaccinated; lambs were not protected against disease and its severity was not reduced.

- *P. multocida* vaccines are available for use in commercial poultry facilities, but are infrequently administered to wild birds.

POTENTIAL IMPACTS OF DISEASE AGENT BEYOND CLINICAL ILLNESS

Risks to public health

- Few cases of *Pasteurella* spp. transmission to humans from wildlife have been reported.
- Infection in humans is mostly associated with domestic canine and feline bites or scratches.

Risks to agriculture

- *Pasteurella* spp. can infect a number of domestic agricultural species and cause a variety of ailments, including septicaemia, pneumonia, mastitis, encephalitis, peritonitis, abscesses, and wound infections.
- *P. multocida* (serotypes B:2 and E:2) is a cause of haemorrhagic septicaemia in domestic cattle and buffalo, particularly in Asia and Africa.
- Bovine pasteurellosis is commonly induced under conditions of stress, and *P. multocida* capsular serogroup A is associated with the bovine respiratory disease complex.
- *P. multocida* in domestic swine (*Sus scrofa domesticus*) most commonly causes atrophic rhinitis and pneumonia.
- *P. multocida* serogroup A (A:1, A:3, and A:4 serotypes appear to be most common) is a cause of major economic hardship on poultry farms.
    - Serotype F is a concern in domestic turkeys.
- *Pasteurella* infection has been reported in rabbitries.

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The OIE will periodically update the OIE Technical Disease Cards. Please send relevant new references and proposed modifications to the OIE Science Department (scientific.dept@oie.int). Last updated 2020. Written by Samantha Gieger and Erin Furmaga with assistance from the USGS National Wildlife Health Center.