Selected bacterial and mycotic infections of poultry

Summer term 2010
**Clostridia**

*Clostridia* are large, Gram positive, rod-shaped, toxin producing bacteria than are anaerobic and can produce endospores as a means of survival.

The are ubiquitous worldwide, being found in soil, dust, animals and insect larvae.

The **predisposition factors** include management, nutrition and environmental conditions.

Increasing restriction of the use in-feed antimicrobials in Europe and other regions has changes the status of *C. perfringens*-associated necrotic enteritis in poultry, especially in broilers.
Necrotic Enteritis
Necrotic Enteritis

An acute or chronic enterotoxemia seen in chickens, turkeys and ducks worldwide, caused by Clostridium perfringens and characterised by a fibrino-necrotic enteritis, usually of the mid- small intestine. Mortality may be 5-50%, usually around 10%. Infection occurs by faecal-oral transmission.

Spores of the causative organism are highly resistant. **Predisposing factors** include coccidiosis/coccidiasis, diet (high protein), in ducks possibly heavy strains, high viscosity diets (often associated with high rye and wheat inclusions in the diet), contaminated feed and/or water, other debilitating diseases.
Toxinotypes of *Clostridium perfringens*

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Necrotic Enteritis

**Signs**

- Depression.
- Ruffled feathers.
- Inappetance.
- Closed eyes.
- Immobility.
- Dark coloured diarrhoea.
Necrotic Enteritis

Necrotic enteritis appears suddenly in the affected flock. Apparently healthy birds may become acutely depressed and die within hours. Mortality is usually between two and ten percent, but may be as high as thirty percent in severe outbreaks. Losses due to reduced growth and feed conversion may be more costly than flock mortality.
Necrotic Enteritis

**Post-mortem lesions**

- Small intestine (usually middle to distal) thickened and distended.
- Intestinal mucosa with diptheritic membrane.
- Intestinal contents may be dark brown with necrotic material.
- Reflux of bile-stained liquid in the crop if upper small intestine affected.
- Affected birds tend to be dehydrated and to undergo rapid putrefaction.
Necrotic Enteritis
Necrotic Enteritis
Necrotic Enteritis
Cholangiohepatitis
Diagnosis

A presumptive diagnosis may be made based on flock history and gross lesions. Confirmation is on the observation of abundant rods in smears from affected tissues and a good response to specific medication, usually in less than 48 hours.
Lesion score of NE

Figure 1: Score = 1

Figure 2: Score = 2

Figure 3: Score = 3

Figure 4: Score = 4
Necrotic Enteritis

**Diagnosis specific**

**bacteriology**
- examination for *C. perfringens* on blood agar plates (anaerobic)

**histology**
- finding of aggregation of large Gram positive rod shaped bacteria surrounded by necrotic tissue

examination for coccidia
Necrotic Enteritis

**Prevention**

Penicillin in feed is preventive, high levels of most growth promotors and normal levels of ionophore anticoccidials also help.

Probiotics may limit multiplication of bacteria and toxin production. In many countries local regulations or market conditions prevent the routine use of many of these options.
Botulism

A condition of chickens, turkeys, ducks and other waterfowl occurring worldwide and caused by a bacterial toxin produced by *Clostridium botulinum* mainly types A / C.

The toxin is produced in decaying animal (usually carcases) and plant waste, and toxin-containing material (pond-mud, carcases, maggots) is consumed by the birds.

Toxin may also be produced by the bacteria in the caecum.

Morbidity is usually low but mortality is high.

The toxin and bacterial spores are relatively stable and may survive for some time in the environment.
Botulism

**Signs**

- Nervous signs, weakness, progressive flaccid paralysis of legs, wings then neck, then sudden death.
- Affected broilers tend to settle with eyes closed when not disturbed.
- A soiled beak, because it rests on the litter, is also quite typical.
Botulism

Post-mortem lesions

- Possibly no significant lesions.
- Mild enteritis if has been affected for some time.
- Feathers may be easily pulled (chicken only).
- Maggots or putrid ingesta may be found in the crop.
Botulism

Prevention

Preventing access to toxin, suspect food and stagnant ponds, especially in hot weather. The single most important measure is careful pick-up and removal of all dead birds on a daily basis. This will reduce the risk of botulism in the poultry.
**Organism**

➢ *Clostridium botulinum*

- Gram positive
- Obligate anaerobic bacillus
- Spores
  - Ubiquitous
  - Resistant to heat, light, drying and radiation
  - Specific conditions for germination
    - Anaerobic conditions
    - Warmth (10-50°C)
    - Mild alkalinity
Neurotoxins

- **Seven different types**: A through G
  - Different types affect different species
  - All cause flaccid paralysis
  - Only a few nanograms can cause illness
  - Binds neuromuscular junctions

- **Toxin**: Destroyed by boiling

- **Spores**: Higher temperatures to be inactivated
Birds and Poultry: Clinical Signs

- Occurs 12-48 hours after ingestion
- Droopy head
- Drowsy
- Wing and leg paralysis
  - Unable to hold their head up
  - Unable to use their wings or legs
- Eyelid paralysis
Birds and Poultry

- “Limber neck”
- Types C and E
- Good sentinel species

Sources:
- Decomposed vegetation or invertebrates
- Ingest toxin or invertebrates with toxin
- Contaminated feed or water of chickens
All avian species appear to be susceptible to staphylococcosis, which is common worldwide wherever poultry are reared. *Staphylococcus aureus* is usually the causative agent, but there is increasing evidence that other *Staphylococcus* species may also be involved (coagulase-positive and coagulase-negative).
Staphylococcosis

Staphylococci are associated with a wide variety of diseases in the chicken and turkey, and in other avian species.

These include septicaemia, arthritis and tendosynovitis, bacterial chondronecrosis and osteomyelitis, gangrenous dermatitis, yolk sac infection, subdermal abscesses (bumble foot), comb necrosis and often with cellulitis, endocarditis and granulomas.
Staphylococci

*Staphylococcus aureus*
coagulase-positive
coaagulase-negative

The disease condition can vary depending on where and how the bacteria enter the host; infections have been reported in the bones, joints, tendon sheaths, skin, sternal bursa, navel, yolk sac, liver, lungs, and eyelids. Septicemic infection has also been seen in laying chickens, with death occurring very quickly.
Staphylococci

Staphylococci

facultative anaerobes, catalase –positive

and grow readily on blood agar.

poultry strain of *S. aureus* usually show

α- or δ- hemolysis.
Staphylococcosis
Staphylococcosis
Staphylococcosis
Staphylococcosis

Differential diagnosis:
- *E. coli*
- salmonellas
- *Pasteurella multocida*
- *Mycoplasma synoviae*
- reoviruses
Staphylococciosis

Control

Bird in early stages of infection and disease may respond to treatment but those with well-established lesions are unlikely to respond.

*S. aureus* is inherently a rather resistant organism.

Antimicrobial sensitivity testing.
Avian Tuberculosis

A bacterial infection, caused by *Mycobacterium avium*, of poultry, game birds, cage birds etc. Morbidity and mortality are high. Transmission is via faecal excretion, ingestion, inhalation, offal and fomites. The disease has a slow course through a flock. The bacterium resists heat, cold, water, dryness, pH changes and many disinfectants.
Avian Tuberculosis

**Signs**

- Severe loss of weight with no loss of appetite.
- Pale comb.
- Diarrhoea.
- Lameness.
- Sporadic deaths.
Avian Tuberculosis

Post-mortem lesions

- Emaciation.
- Grey to yellow nodules attached to intestine.
- Granulomas in liver, spleen and many other tissues, even bone marrow.
Tubercular nodules in bone marrow.
Mycobacterium avium
Positive tuberculin test
Positive rapid blood agglutination.
Campylobacter Infection

Campylobacters are a significant cause of enteritis in man. Infected poultry are a potential reservoir of this zoonosis. *Campylobacter jejuni* is the commonest species found in poultry. All campylobacters are delicate organisms that survive for relatively short periods outside the host unless protected by organic material, biofilm or engulfed by protozoa.
Campylobacter jejuni

- Leading cause of bacterial diarrhea
- 2.4 million people each year
  - Children under 5 years old
  - Young adults (ages 15-29)
- Very few deaths
- Can lead to Guillain-Barré Syndrome
  - Leading cause of acute paralysis
  - Develops 2-4 weeks after *Campylobacter* infection (after diarrheal signs disappear)
Campylobacteriosis

Sources

- Raw or undercooked poultry
- Non-chlorinated water
- Raw milk
- Infected animal or human feces
  - Poultry, cattle, puppies, kittens, pet birds

Clinical signs in humans

- Diarrhea, abdominal cramps, fever, nausea
- Duration: 2-5 days
Diagnosis

Isolation of the organism from caecal contents, cloacal swabs or composite faeces. The organism is sensitive to air so swabs should be collected into transport medium and other samples placed in airtight containers with minimal airspace. Samples should be tested as quickly as possible after collection.
**Prevention**

In principle, housed poultry can be maintained free of *Campylobacter* infection by consistent application of excellent biosecurity. Key aspects of this include effective sanitation of drinking water, sourcing of water from high quality supplies, avoidance of contact with pets and other farmed species, good hand hygiene by stockmen, and changing of overalls and boots on entering bird areas.
Salmonellosis

- Gram negative bacteria
- Many serotypes can cause disease
- *S. enteritidis* and *typhimurium*
  - 41% of all human cases
  - Most common species in U.S.
- 1.4 million cases annually
  - 580 deaths
Salmonellosis

- **Sources**
  - Raw poultry and eggs
  - Raw milk
  - Raw beef
  - Unwashed fruit, alfalfa sprouts
  - Reptile pets: Snakes, turtles, lizards

- **Signs**
  - Onset: 12-72 hours
  - Diarrhea, fever, cramps
  - Duration: 4-7 days
On Farm Strategies

- Testing and removal for *Salmonella*
  - Serologic, fecal culture, hide culture

- Vaccinating
  - Many serotypes
  - Varying effectiveness

- Minimize rodents, wild birds

- Isolation of new animals
Avian chlamydophilosis

Terms

Psittacosis – first recognized in parrots

Ornithosis – describe disease in other birds, including poultry
The Organism

- *Chlamydophila psittaci*
- Obligate intracellular bacteria
- Elementary body
  - Infectious
  - Survive for months in
- Reticulate body
  - Non-infectious
Chlamydothila elementary body

Lung cell

Chlamydothila entering cell

Reticulate body becomes elementary body and is released to reinfect other cells

Replication

Elementary body becomes reticulate body
New Taxonomic Classification

- **Genus Chlamydia**
  - C. trachomatis
  - C. muridarum
  - C. suis

- **Genus Chlamydophila**
  - C. abortus
  - C. felis
  - C. pecorum
  - C. pneumoniae
  - C. caviae
  - C. psittaci
The Organism

- Resistant to drying
  - Remains infectious for months
  - Remains viable on surfaces for 2-3 weeks
  - Survives in turkey carcass for >1 yr.
History

- **1879**
  - First recognized human outbreak
  - 7 people in contact with sick parrots

- **1929-1930**
  - 750 human cases
    - 20% mortality
  - Large scale importation of infected birds from Argentina

- **1935**
  - Wild psittacines in Australia
Populations at Risk

- Lab workers
- Veterinarians
- Avian quarantine workers
- Zoo workers
- Farmers
- Pregnant women
- Bird fanciers (pigeon fanciers too)
- Bird owners
- Pet shop employees
- Poultry slaughter and processing workers
- Wildlife rehab workers
Transmission to Humans

- **Inhalation**
  - Dried infective droppings
  - Secretions or dust from feathers
- **Mouth-to-beak**
- **Direct contact**
  - Handling plumage or tissues infected birds
- **Person-to-person transmission**
  - Not proven
  - Venereal transmission reported
Clinical Signs

- May also see
  - Myocarditis, endocarditis
  - Arthritis, lethargy, hepatitis, epistaxis
  - Placentitis, fetal death
  - Encephalitis, jaundice, respiratory failure
  - Thrombocytopenia, coma, arthralgia
Disease in Humans

Psittacosis
Human Disease: Psittacosis

- Incubation period: 1-4 weeks
- Range
  - Inapparent infection
  - Systemic infection with pneumonia
    - Pneumonia 30-60 years of age
- Common signs – abrupt onset
  - Fever, chills, headache, malaise, myalgia, sore throat, cough, dyspnea, splenomegaly, rash
45 year old male, rail station worker with Chlamydial pneumonia
Diagnosis

- **Confirmed case**
  - Clinical signs + laboratory results
    - Culture
    - 4-fold rise in titer
    - IgM detected by MIF

- **Probable case**
  - Linked epidemiologically to confirmed case of Psittacosis
  - Single titer $\geq 1:32$
Differential Diagnosis

- *Coxiella burnetii* (Q fever)
- *Legionella*
- *Chlamydia pneumoniae*
- *Mycoplasma pneumoniae*
- *Influenza*
- *Tularemia*
Treatment and Prognosis

- **With treatment**
  - 1-5% case-fatality rate
  - Tetracyclines are drug of choice
  - Remission of symptoms
    - Usually in 48-72 hours
  - Relapse possible

- **Without treatment**
  - May resolve in few weeks-months
  - 10-40% case-fatality rate
Fig. 2. The species *Cp. psittaci* with six known avian serovars (A, B, C, D, E and F) are transmissible to human and other animals and two mammalian serovars (M96 i WC) (VLAHOVIC et al., 2001b)
Fig. 1. Zoonotic potential of chlamydial pathogens
(COST, 2002; LONGBOTTOM and COULTER, 2003)
Avian Species Affected

- Isolated from over 100 avian species
  - Psittacines
    - Especially cockatiels and parakeets
  - Egrets, gulls, ratites
  - Pigeons, doves, mynah birds, sparrows
  - Turkeys, ducks
    - Rarely chickens
Clinical Signs in Turkey, Duck & Pigeon

- Depression
- Ruffled feathers
- Weakness
- Inappetence
- Nasal discharge
- Respiratory distress

- Yellow-green diarrhea
- Conjunctivitis
- Decreased egg production
- Ataxia-pigeons
- Trembling-ducks
Diagnosis

- Diagnosis difficult
- Case definitions
  - Confirmed, probable, suspect
- Single test may not be adequate
  - Combination testing recommended
- Proper sample collection techniques critical for accurate results
- Consult an experienced avian veterinarian
Diagnosis

- Pathologic diagnosis
- Culture
- Antibody tests
  - CF, EBA
- Antigen Tests
- ELISA, IFA, PCR
- RIM
Aspergillosis

A fungal infectious disease, caused by *Aspergillus fumigatus*, in which the typical sign is gasping for breath, especially in young chicks. Sometimes the same organism causes eye lesions or chronic lesions in older birds.
Aspergillosis

It affects chickens, turkeys, ducks, penguins, game birds, waterfowl, etc, worldwide.

The infection has an incubation period of 2-5 days.

Morbidity is usually low, but may be as high as 12%.

Mortality among young affected birds is 5-50%.

Transmission is by inhalation exposure to an environment with a high spore count; there is usually little bird-to-bird transmission. Spores are highly resistant to disinfectants.
Aspergillosis

Signs

- **Acute form:**
  - Inappetance.
  - Weakness.
  - Silent gasping.
  - Rapid breathing.
  - Thirst.
  - Drowsiness.
  - Nervous signs (rare).

- **Chronic Forms:**
  - Ocular discharge (ocular form only).
  - Wasting.
Aspergillosis

Post-mortem lesions

- Yellow to grey nodules or plaques in lungs, air sacs, trachea, plaques in peritoneal cavity, may have greenish surface.
- Conjunctivitis/keratitis.
- Brain lesions may be seen in some birds with nervous signs.
Multiple nodules in the liver of 3 weeks old poult, due to aspergillosis.
Mycotic granuloma in cerebelum.
Aspergillosis

**Diagnosis**

This is usually based on the signs and lesions and microscopic examination for the fungus, preferably after digestion in 10% potassium hydroxide. It may be confirmed by isolation of the fungus, typically by putting small pieces of affected tissue on Sabouraud agar. Growth occurs in 24-48 hours and colonies are powdery green/blue in appearance.

Differentiate from excessive exposure to formalin or vaccinal reactions in day olds and from heat stress in older birds.
Aspergillosis

**Treatment**

Usually none. Environmental spraying with effective antifungal antiseptic may help reduce challenge. Amphotericin B and Nystatin have been used in high-value birds.

**Prevention**

Dry, good quality litter and feed, hygiene.