AVIAN MYCOPLASMOSIS

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Etiology and Classification

- Avian mycoplasmosis is caused by bacteria of the genus *Mycoplasma* (class Mollicutes)
- Many *Mycoplasma* species have been isolated from birds, but only a few are major poultry pathogens
- Four species are of major economic importance:
  - *M. gallisepticum* (MG) – chickens, turkeys
  - *M. synoviae* (MS) – chickens, turkeys
  - *M. meleagridis* (MM) – turkeys
  - *M. iowae* (MI) – turkeys
- Other species (e.g. *M. gallinarum*, *M. gallinaceum*, *M. pullorum*) are mostly non-pathogenic or opportunistic, but can complicate diagnosis; *M. anserisalpingitidis* is associated with genital disease in geese

Major Avian Mycoplasma Species and Their Clinical Significance

SPECIES	MAIN ASSOCIATION
• *M. gallisepticum*	• Chronic respiratory disease in chickens (CRD); infectious sinusitis in turkeys
• *M. synoviae*	• Often subclinical respiratory infection, infectious synovitis and tenosynovitis, eggshell abnormalities
•*M. meleagridis*	• Mainly turkey infection; vertical transmission, airsacculitis and reduced hatchability
• *M. iowae*	• Mainly turkey embryos; late embryonic mortality and reduced hatchability

Biological and Cultural Properties

- Mollicutes are among the smallest self-replicating prokaryotes, with a very small genome
- Lack a cell wall (the membrane contains sterols): pleomorphic, and not reliably classified as Gram-positive or Gram-negative
- Intrinsically resistant to β-lactam antibiotics and other agents that target the cell wall
- Fastidious: need complex, enriched media and grow slowly; embryonated chicken eggs can also be used for isolation
- Form characteristic “fried-egg” colonies on suitable agar media
- *M. gallisepticum* and *M. synoviae* agglutinate chicken and turkey erythrocytes – the basis of the haemagglutination inhibition (HI) test

Resistance to Environmental and Chemical Conditions

- Fragile outside the host; survival is limited and depends on temperature, moisture, organic material and the species
- Heat and drying reduce viability – survival is longer at lower temperatures
- Can survive for 1–3 days in chicken faeces and for a few days on feathers, clothing and equipment (fomites)
- Can survive in egg yolk for 6–18 weeks, which is important for vertical transmission
- Susceptible to commonly used disinfectants when applied correctly to clean surfaces; organic matter reduces their efficacy

Epidemiology and Transmission of Avian Mycoplasmosis

Susceptible hosts

- MG and MS: chickens and turkeys; other birds (e.g. game birds, wild finches) may also be infected
- MM and MI: primarily turkeys

Vertical transmission

- MG and MS: through infected hatching eggs
- MM: major route; infected semen may contaminate the reproductive tract and eggs
- MI: important in turkey flocks; may lead to embryo losses

Horizontal transmission

- MG and MS: direct contact, respiratory secretions and aerosols
- MM: aerosols in hatcheries; contaminated hands, clothing and equipment
- MI: spreads within flocks, although more slowly

Persistence and risk factors

- MG- and MS-infected birds may remain chronic carriers
- Stress, high stocking density, poor ventilation and concurrent infections increase disease expression and spread

Spread of MG and MS within a Flock

1. **Introduction**
   - Infected hatching eggs or introduction of infected birds
2. **Initial infection**
   - Some birds remain subclinical in the early stages, so infection may go unnoticed
3. **Horizontal spread**
   - Respiratory secretions and aerosols; contaminated people, equipment and vehicles
4. **Flock dissemination**
   - Spread accelerates under stress or with concurrent infections
5. **Persistence**
   - Infected birds may remain lifelong carriers; multi-age sites help maintain infection

Control point: early detection, breeder-flock monitoring and strict biosecurity prevent introduction and spread

Pathogenicity

- Pathogenicity varies with the species and strain of *Mycoplasma* and with host species and age
- Turkeys are more susceptible to MG than chickens
- The MG F strain is used as a live vaccine in chickens but may cause disease in turkeys
- Disease is usually multifactorial: environmental stress and co-infections (*E. coli*, respiratory viruses) increase severity
- MS often remains a subclinical upper respiratory infection; some strains spread systemically and cause synovitis or eggshell apex abnormalities
- MM and MI are mainly pathogenic for embryos and young poults
- When MG-containing exudate or broth culture is inoculated into the yolk of embryonated chicken eggs, embryos die within 5–7 days

Pathogenesis of Avian Mycoplasmosis

Common mechanisms (all species)

- No cell wall: close attachment to host cell membranes (cytadherence) via adhesins
- Colonize mucosal surfaces and depend on the host for nutrients
- Antigenic variation of surface proteins helps evade the immune response
- Chronic infection and carrier state
- Severity increases with stress and co-infections (*E. coli*, respiratory viruses)

Species-specific pathogenesis

- **MG:** adhesion to respiratory epithelium → ciliostasis, impaired mucociliary clearance → tracheitis, sinusitis, airsacculitis
- **MS:** upper respiratory colonization, often subclinical; some strains spread via blood to synovia and tendon sheaths (synovitis) or affect the eggshell apex
- **MM:** transmitted via semen and eggs; embryo and poult infection, airsacculitis, skeletal abnormalities
- **MI:** mainly vertical; late embryonic death in turkeys; mechanism less well defined

Clinical Signs of Avian Mycoplasmosis

Mycoplasma gallisepticum (MG)

- Sneezing, coughing and respiratory rales
- Nasal discharge and conjunctivitis
- Swollen infraorbital sinuses, particularly in turkeys
- Reduced feed efficiency and growth performance
- Decreased egg production in layers and breeders

Mycoplasma synoviae (MS)

- Frequently subclinical respiratory infection
- Lameness and swollen joints in infectious synovitis
- Eggshell apex abnormalities in some laying flocks

Clinical severity is influenced by host species and age, strain virulence, environmental stress and air quality, and concurrent respiratory infections (particularly E. coli and respiratory viruses).

Clinical Signs of Avian Mycoplasmosis

Mycoplasma meleagridis (MM)

- Primarily affects turkeys
- Airsacculitis in poults, reduced hatchability and poor growth
- Vertical transmission through infected eggs and semen is important

*Mycoplasma iowae (*MI*)*

- Primarily associated with turkey embryos and young poults
- Late embryonic mortality and reduced hatchability
- Skeletal abnormalities and poor growth may occur in affected poults

Clinical and Necropsy Findings in MG Infection

Uncomplicated Infection

- Catarrhal inflammation of the conjunctiva, nasal passages, sinuses and trachea
- Mild to moderate respiratory signs
- Mild airsacculitis may occur

Complicated Infection

- Marked thickening and turbidity of the air sacs with exudative material
- Fibrinous pericarditis and perihepatitis, particularly with secondary *E. coli* infection
- Increased carcass condemnation and mortality in severe cases

Necropsy Findings in MS, MM and MI Infections

M. synoviae (MS)

- Respiratory form: mild airsacculitis, often without marked signs
- Synovitis and tenosynovitis: swollen hock joints and foot pads with viscous, creamy to grey exudate in joints and tendon sheaths
- In systemic cases: enlarged spleen and liver, pale swollen kidneys

M. meleagridis (MM) and *M. iowae* (MI)

- MM: airsacculitis in poults; skeletal abnormalities and poor growth
- MI: late-stage dead embryos and poor hatchability
- Lesions are not specific – laboratory confirmation (PCR, culture) is required

Mycoplasma Co-infections in Respiratory Disease

- *Mycoplasma* alone often causes mild disease; severe cases usually involve other agents and poor environment ("complicated CRD")
- *Mycoplasma* + *E. coli*: the classic combination – fibrinous airsacculitis, perihepatitis, pericarditis
- *Mycoplasma* + viruses (adenovirus, reovirus): more severe and prolonged respiratory disease
- *Mycoplasma* + *Avibacterium paragallinarum* (infectious coryza): severe upper respiratory disease
- Viruses + *E. coli*: IBV + *E. coli*, NDV + *E. coli*, AmPV + *E. coli*
- Live NDV vaccine + *Mycoplasma* + *E. coli*: severe vaccine reactions and airsacculitis

IBV: infectious bronchitis virus; NDV: Newcastle disease virus; AmPV: avian metapneumovirus

Economic importance of Avian Mycoplasmosis

- Reduced body weight gain and impaired feed conversion efficiency in broilers
- Increased respiratory disease severity due to secondary infections
- Increased carcass condemnation at processing, particularly in complicated cases with airsacculitis
- Reduced egg production in layer and breeder flocks
- Reduced hatchability and increased embryonic or early-life losses in affected breeding flocks
- Additional costs associated with diagnosis, vaccination, medication, biosecurity, and flock management

Diagnosis

Direct detection (agent)

- Samples: trachea, air sac, lung and sinus exudate; tracheal, choanal and cloacal swabs
- Semen and egg follicles; dead-in-shell embryos and chicks that pipped but did not hatch
- Methods: PCR (rapid, species-specific) and culture/isolation (slow, special media)

Indirect detection (antibodies)

- Serum: rapid serum plate agglutination (SPA) for screening; ELISA and haemagglutination inhibition (HI) for confirmation
- Vaccinated flocks are seropositive; cross-reactions occur – confirm questionable results by HI or PCR

Differential Diagnosis

In chickens

- Viral respiratory diseases: infectious bronchitis, Newcastle disease, avian metapneumovirus, infectious laryngotracheitis
- Infectious coryza and fowl cholera
- MG should be differentiated from MS; for MS synovitis, consider viral arthritis (reovirus) and staphylococcal arthritis

In turkeys

- Fowl cholera (*Pasteurella multocida*), chlamydiosis, cryptosporidiosis, vitamin A deficiency, MG/MS infections

Hatchery problems (MM, MI)

- Poor hatchability has many causes (nutrition, bacterial contamination, incubation faults)

Mycoplasma Control Program

- **Source control:** obtain chicks and poults from MG- and MS-free breeder flocks; avoid birds of unknown infection status
- **Monitoring:** regular serological and/or molecular testing of breeder flocks
- **Biosecurity:** strict hygiene and disinfection; control movement of birds, personnel, equipment and vehicles
- **Flock management:** all-in/all-out, avoid mixing ages, good ventilation, suitable stocking density, control of concurrent infections
- **Hatching eggs:** egg dipping or heat treatment can reduce vertical transmission (where permitted)
- **Infected breeder flocks:** test-and-cull or depopulation
- **Vaccination:** select the vaccine and programme according to flock type, local epidemiology and regulations

Mycoplasma Vaccines

- **Inactivated MG vaccines:** reduce clinical signs and egg production losses but do not prevent infection
- **Live MG vaccines:**
  - F strain: mild in chickens but retains some virulence; can spread and may cause disease in turkeys
  - 6/85: very mild, low transmissibility to contact birds
  - ts-11: temperature-sensitive attenuated strain; persists in the flock
- **Vector vaccines** (e.g. fowlpox–MG) are available in some markets
- **MS vaccination:** MS-H is a live, temperature-sensitive vaccine used in some countries

Vaccination supplements, but does not replace, biosecurity and infection-free breeding stock

Treatment

- Antimicrobials can reduce clinical signs and production losses, but do not reliably eliminate the infection – treated birds may remain carriers
- Treatment works best when started early, together with improved management and environment
- Secondary infections, particularly *E. coli*, may require additional treatment
- Select drugs by susceptibility testing where possible; resistance to some classes has been reported
- Use must comply with approved indications, national regulations and withdrawal periods; use antimicrobials prudently

Antibiotics Used for *Mycoplasma* Infection

- **Macrolides:** tylosin, tilmicosin
- **Tetracyclines:** oxytetracycline, doxycycline
- **Pleuromutilins:** tiamulin
- **Fluoroquinolones:** enrofloxacin and related agents (use is restricted in many countries)
- **Lincosamides:** lincomycin, alone or combined with spectinomycin

Mycoplasmas lack a cell wall and are intrinsically resistant to β-lactam antibiotics (penicillins, cephalosporins)

Key Points

- Avian mycoplasmosis is an economically important disease of poultry
- MG: chronic respiratory disease in chickens and infectious sinusitis in turkeys; MS: subclinical respiratory infection, synovitis, eggshell apex abnormalities; MM and MI: turkey embryos and poults
- Mycoplasmas lack a cell wall: they are fastidious in culture and resistant to β-lactams
- Vertical and horizontal transmission, and carrier birds, maintain infection in production systems
- Signs and lesions are suggestive; confirmation requires PCR, culture and/or serology
- Antimicrobials alleviate disease but do not reliably eliminate infection
- Control relies on infection-free breeding stock, biosecurity, monitoring and vaccination where appropriate