Review Article

Mycoplasma gallisepticum Infection, A Perpetual Problem

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Abstract | Respiratory diseases in poultry are the sum of the costliest problem plaguing today in the poultry industry due to high morbidity and mortality. Chronic respiratory disease (CRD) had a high prevalence rate in the last decade and thus established itself as a disease of the major economic importance of the poultry industry. The eradication of this contagious disease remains a challenge to the poultry industry that can be transmitted from infected birds to healthy ones by respiratory routes. The lack of proper isolation and diagnostic methods as well as improper use of antimicrobial therapy causes the treatment failure. Different types of antibiotics are used to treat it and different research use antibiotics of aminoglycoside group. For preventing the flock from infection separates the infected birds from healthy ones. Different treatments show average growth and good performance with the recovery of clinical signs, histopathological changes, mortality, and morbidity percentage. In this study, we represent a review with a descriptive analysis to identify the chronic respiratory poultry disease, method of prevention, their seasonal incidences, and the treatment by the use of good antibiotics and supportive therapy.

Keywords | Avian Mycoplasma; Broiler; Economic Significance; Histo-pathological Changes; Respiratory Disease; Transmission

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INTRODUCTION

In various regions of the world, poultry meat consumption elevates day by day owing to being the cheapest source of animal protein and poultry meat is becoming the consumer's first choice (Hess et al., 2001; Marangoni et al., 2015). Chicken meat is very nutritious with low content of fat, with more desirable unsaturated fatty acid according to other meat (Cavani et al., 2009; Dal Bosco et al., 2022). The production of poultry meat is possible when the health of birds will be good and according to need the demand for poultry meat will be fulfilled. Common respiratory diseases in poultry birds like CRD, infectious bronchitis (IB), infectious laryngotracheitis (ILT) etc. are very harmful to the health of birds and causes low production and high loss in the economy (Mugunthan & Mani Chandra, 2021;

Siddique et al., 2020). The poultry industry is the second largest industry of Pakistan that contributing 1.4% to the national GDP annually (Hussain et al. 2015; Liaqat 2018; David H. and Yoder Jr 2008; Arslan Ahmed, Akram, and Aslam 2018).

Among the major poultry disease, CRD in chicken is the most common respiratory disorder with the causative agent *Mycoplasma gallisepticum* (MG) and *M. synoviae* that cause a huge economical loss (Rehman et al., 2018; Shoaib, 2019). MG is the main pathogenic mycoplasma that causes reproductive and respiratory disease in poultry (Huang et al., 2021). Due to its highly aerobic character, MG is chiefly encountered in the upper respiratory tract of poultry birds (Büyüktanir et al., 2008). In avian, different microbes of genus *Bordetella* (*B. avium*), *Hemophilus*, *Pasturella* (*P. multocida, P. gslinsrum*) are also involved in the complexity of respiratory diseases (Gondal et al., 2015; Hafez, 2002). Birds of all ages are prone to Mycoplasma, but young birds of different breeds are more susceptible to this pathogen. Slow and stunted growth, low FCR, less egg production and quality of eggs is also affected by the MG attack and causes severe economic loss (N. M. Ferguson-Noel & Williams, 2015; Seifi & Shirzad, 2012).

CRD is most common during the summer (May to July) and in the winter (December to January) months. In summer CRD may be due to heat stress and poor availability of oxygen increased the susceptibility of CRD in birds. The different incidence rate of CRD in broilers is reported by different researchers among different seasons CRD is at the highest rate during summer according to winter and rainy season, while in Pakistan 21.1% incidence rate of CRD in broiler is observed during April to June month (Yunus et al., 2009). With other pathogens, concurrent infection of Mycoplasma is more common and reports of synergism of mycoplasma with other pathogens show great importance in poultry production (Mugunthan & Mani Chandra, 2021; Yiwen et al., 2021).

The basic purpose of this study is to help the clinical diagnosis, postmortem lesion, treatment of birds that are affected by the disease CRD, and ways to manage, different preventive measures to prevent the birds from this type of infectious disease. However, this study aims to perform a descriptive analysis to identify the respiratory poultry diseases, method of prevention, their seasonal incidence, and the treatment using antibiotics and supportive therapy.

Etiology

The causative agent of CRD in poultry birds is *Mycoplasma gallisepticum* (MG) which belong to the *Mycoplasmataceae* family (Rehman et al., 2018). Mycoplasma is the smallest prokaryote that does not have a cell wall but these are surrounded by three layers of the cell membrane (Marouf et al., 2022). It can be detected in humans and animals with the ability to grow outside the host cell. The incubation period of mycoplasma in poultry is 16-21 days (Baker Siddique et al., 2012). It is an aerobic microbe, that lives in the upper respiratory tract and causes a chronic infection in the respiratory system of poultry (N. Ferguson-Noel et al., 2019; Liu et al., 2001).

This pathogen causes upper respiratory tract infection by damaging the air sacs causing air sacculitis and bedding for other pathogens (Hong et al., 2005; Seifi & Shirzad, 2012). Over 100 species of mycoplasma are known but the most significant effect in birds is shown by MG (Sawicka-Durkalec et al., 2021). In avian (primary host of Mycoplasma) more than 20 species of Mycoplasma have been derived, but MG is an important pathogen of poultry (Dhondt et al., 2005). Mycoplasma have distinctive characteristics like smallest, aerobic microbes, wall-less self-replicating microbes having flask shape appearance (Rottem, 2003). The strain of Newcastle and infectious bronchitis virus vaccine shows marked respiratory reactions in MG infected birds (David H. & Yoder Jr, 2008).

Clinical History

In broiler, CRD was the first time described in 1905, but later it was isolated from other birds like turkeys and domestic poultry birds (Thomas et al., 2008). In Pakistan, MG infection was the first time proved serologically in 1984 (Shah, 1984). In the Faisalabad division during 1991-1995 increased sero-prevalence of MG was recorded (Abbas et al., 2018). In the Pakistan poultry industry, a huge incidence of MG infection in poultry birds has been reported in the last decade (Ahmad et al., 2008; Mukhtar et al., 2012).

Sign and Symptoms

The birds show respiratory distress like difficulty in breathing and gargling sounds during breathing, wheezing, sneezing, coughing, swollen eye-lids, frothy exudate from the eye, ocular discharge, taking breathe by opening the mouth and embryonic mortality (Marouf et al., 2020). Poor productivity, slow and stunted growth and abnormal feathers also can be observed in the flock. The postmortem lesions of infected birds include hemorrhages in the trachea, exudate and caseous material in the lumen of trachea, mucus becomes thick and purulent, classical thick cloudy changes in air sacs, cloudy exudate in internal nostrils, conjunctiva sac and consolidated lungs (Levisohn & Kleven, 2000; Marois et al., 2008; Thomas et al., 2008).

Mode of Transmission

This microbe is transferred from infected to healthy birds by hatchery, feeding, carrier, housing, equipment's, vectors

and fomites (David H. & Yoder Jr, 2008). It can be transmitted by both horizontal (from infected to healthy birds by infectious aerosols and by the contamination of feed, water etc.) and vertical routes (by poultry eggs from infected breeder yolk to progeny) as shown in Figure 1 (Huang et al., 2021; Marois et al., 2008; Thomas et al., 2008).

The frequent use of antibiotics in the affected layer flock prevents the transmission of CRD to the next generation. There is a great risk to transfer mycoplasma in a highly-populated poultry area, and it is very difficult to maintain a flock free from infection (Lysnyansky et al., 2005).

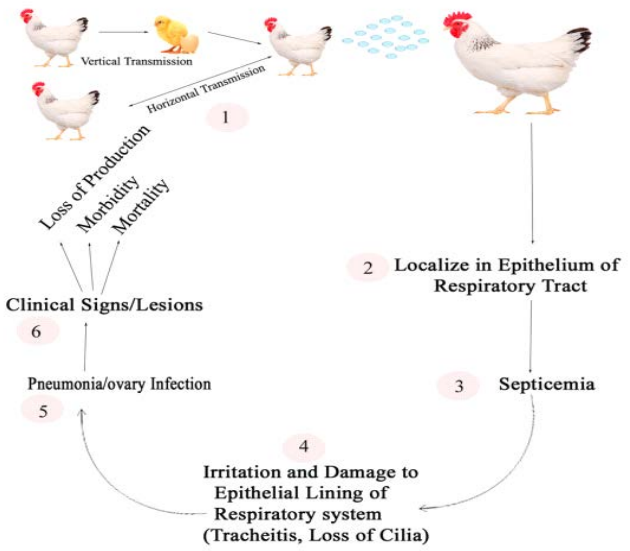

Figure 1: Pathogenesis of *Mycoplasma gallisepticum* (Huang et al., 2021; Marois et al., 2008; Thomas et al., 2008)

Diagnoses

In an emergency, CRD can only be identified following the onset of the symptoms. Based on clinical symptoms such as stunted growth, low feed conservation ratio and postmortem lesion confirmed it as CRD. In post-mortem air sac and intestinal lesion, the score is very helpful for diagnoses of CRD and it was recorded by the method (Nascimento et al., 2005). Postmortem of infected poultry birds shows hemorrhagic lesion and mucopurulent exudates in the trachea, trachitis, sinusitis, bronchitis and nasal discharge (Levisohn & Kleven, 2000; Nascimento et al., 2005).

For the diagnosing of CRD different laboratory test like rapid serum plate (RSP), enzyme-linked immunosorbent assay (ELISA), and fluorescent antibody technique etc. has been approved by the national poultry improvement plan of the USA (Cummins et al., 1990; Marouf et al., 2022). In the field, rapid slide plate agglutination test (SPAT) or enzyme-linked immunosorbent assay (ELISA) is helpful to diagnose MG infection in poultry (Sarkar et al., 2005). Hence PCR is a more convenient easy technique to diagnose CRD (Abdel Halium et al., 2019; Ahmed et al., 2007; Xu et al., 2003). The MG infection can be detected via in-vitro culture and DNA based polymerase chain reaction (PCR) (David H. & Yoder Jr, 2008; Muhammad et al., 2017; Rauf et al., 2013). By cultivation, Mycoplasma can be diagnosed but it is expensive, laborious and time-consuming. But by the culturing overgrowth of non-pathogenic mycoplasma is mostly seen and no growth of Mycoplasma is mostly seen by the cultivation in a laboratory (El-Ghany, 2008; Garcia et al., 1995; Siddique et al., 2020). According to different researchers, the rate of MG among different types of birds was recorded 50-60% as shown in Table 1.

Table 1: Infection Rate of MG

Infection % of MG	References
56.2%	(Marouf et al., 2020)
47.7%	(El-Ghany, 2008)
67.5%	(Abd El-Gawad, 2005)
79.8%	(Rauf et al., 2013)

Treatment of CRD

CRD is caused by the bacteria mycoplasma, so different types of antibiotics are helpful to treat it. Due to lack of cell wall, mycoplasma is not susceptible to cell wall synthesis inhibitor antibiotics such as penicillin etc., but susceptible to several classes of antibiotics like fluoroquinolone, tetracycline, erythromycin and others (Bradbury, 2005; Zakeri, 2010).

Different studies show different therapies, but commonly used drugs are aminoglycosides and Oxytetracycline group. In vitro sensitivity test by the use of different antibiotics for treatment of mycoplasma in poultry and proved that antibiotics of macrolide group like tylosin have a great effect on mycoplasma (Morrow et al., 2020; W. H. et al., 2012).

The use of tylosin injection in eggs that were affected by mycoplasma hatched and all the chicks were clear from infection. CRD was completely eradicated from the layer farm by the agglutination test and proper use of tylosin and proved no reaction of CRD in the second generation (Lysnyansky et al., 2005; Morrow et al., 2020).

Prevention and control

In many countries, a control program for MG is based on the maintenance of infection-free commercial breeding stock by biosecurity, treatment, and vaccination. Many types of measures and procedures should be done in the shed that helps to prevent the outcomes of any types of pathogens that are harmful to birds because they caused different types of disease. It is said that "prevention is better than cure". Before the arrival of birds, good management issues should be addressed and ensure that birds are free from MG and sterilize all the equipment and other things

used in the shed with the disinfectant. Birds must be kept in a hygienic environment that helps to prevent the occurrence of any disease. If the respiratory disease occurs in the flock, then management and feeding should be improved, to reduce the crowding of birds and dust in the poultry house. CRD can be controlled by the proper antibiotic use and keeping the fertile egg in heat at 114.8°F for 12-14 hours for prevention in the next generation. The dust has a great role in the entry of E. coli and Mycoplasma inside the birds by the respiratory route and then E.coli come as secondary bacteria and causes severe infection (Peebles et al., 2015; Umar et al., 2016). Give good and freshwater to the birds and give proper attention to the possibility of aflatoxin and orchatoxin in the feed of birds because it causes immunosuppression and precipitation of disease. If birds are vaccinated by the live strain for the prevention of CRD then this strain remains active for the whole life of birds (Noormohammadi, 2021).

Different types of vaccination by F strain, K-strain, MS-H strain, Ts-11 and 6/85 strain helps to prevent the prevalence of disease in birds (N. M. Ferguson-Noel & Williams, 2015; Liu et al., 2001). Diseases are transferred by the horizontal (from infected to healthy birds) and vertical routes (from breeder egg to the new chicks) but vertical transmission is a major issue in poultry (Thomas et al., 2008). So, try to breakup this transmission by using eggs in hatchery that are free from any type of pathogen and if a bird show any abnormality in shed then isolate the abnormal birds and treat these bird after proper and early clinical diagnoses. High level of biosecurity of breeder flock, routine monitoring of serological test and immediate slaughter of infected birds helps to prevent the prevalence of infection (Shah, 1984).

Vaccination of Mycoplasma

In different countries of the world, five types of live strain MG are available; F strain, K strain, MS-H strain, 6/85 and ts-11 but the use of these live vaccines are not permitted in all countries (N. M. Ferguson-Noel & Williams, 2015; Liu et al., 2001). Australia and U.S.A. was the first time originated TS-11 and 6/85 live strain vaccine of CRD (Ferraz & Danelli, 2003). A single dose of F-strain is helpful to protect birds against MG (Ley, 2003). Vaccinal F-strain of MG is proved a unique strain due to the strongly immunogenic epitope. It is considered that F-strain is low to moderate transmissibility and virulence (Kleven, 1981) but F-strain can induce respiratory signs in the broiler (Ricketts et al., 2017). In the whole life of the flock, this strain remains active in the upper tract of poultry birds (Kleven, 1981). Different types of routes including intraocular, intranasal and spray are used to administer the F-strain of a vaccine. Chicken that is immunized by the MG Bactrian with adjuvant carrageenan (ICGN) were resistant to air sacculitis on challenged test in case of CRD.

CONCLUSION

The poultry sector is playing a great contribution in the uplifting economy and livelihood of people of Pakistan, by providing secure income source and expanding fast in the world. In backyard areas, people rear poultry birds at home and earn money by selling eggs, meat etc. It is possible only when we have healthy bird setup. This study shows the high prevalence rate of CRD in adult broiler birds. For extending the poultry industry, CRD remains a consistent challenge. Proper identification and preparation for the prevention of the outcome of major poultry disease according to seasonal incidence can help to minimize the outcome of disease in birds. Further according to many researchers, *Mycoplasmosis* control is generally based on the removal of infected birds from the flock. Vaccinations and medications are also part of the control strategy. Increase in the poultry industries, very close poultry farms, rearing of mixed avian species and presence of the wild birds in close premises; have made the control of this disease very difficult. Strict biosecurity measures and a proper hygienic environment is helpful for the prevention of birds from the attack of different microbe infection. Before adding the poultry birds to the flock, they should be tested, and breeding stock should be purchased from a certified infection-free source. Many researchers also convey the idea to repeat the testing and culling of carrier birds to eliminate the infection from the flock.

AUTHOR CONTRIBUTIONS

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