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The Pharma Innovation

**ISSN (E): 2277- 7695**
**ISSN (P): 2349-8242**
**NAAS Rating: 5.23**
TPI 2021; SP-10(12): 85-88

www.thepharmajournal.com
Received: 16-10-2021
Accepted: 18-11-2021

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# A review on pulmonary affections in equines, diagnosis and treatment

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**Abstract**
In equine Secondary bacterial respiratory infections are primarily initiated by viral disease, because viral respiratory infections impair and destroy respiratory defense mechanisms. The most common organisms associated with pneumonia in horses are opportunistic bacteria originating from the resident microflora of the upper respiratory tract. Clinical evidence of a secondary bacterial infection includes mucopurulent nasal discharge, depression, persistent fever, abnormal lung sounds, hyperfibrinogenemia, and leukocytosis. Secondary bacterial disease may result in mucosal bacterial infections or may produce more serious invasive disease such as pneumonia and pleuropneumonia. *Streptococcus equi zooepidemicus* is the most common opportunistic pathogen of the equine lung, although *Actinobacillus equuli*, *Bordetella bronchiseptica*, *Escherichia coli*, *Pasteurella* spp, and *Pseudomonas aeruginosa* are frequently isolated. *S equi equi*, the causative agent of strangles is a primary bacterial pathogen of the upper respiratory tract and is capable of mucosal invasion without predisposing factors. *Rhodococcus equi* is a primary pathogen of the lower respiratory tract of foals and produces pulmonary consolidation and abscessation. *R equi* pneumonia has been reported with a compromised immune system.

**Keywords:** mucopurulent, hyperfibrinogenemia, abcessation

## Introduction
Pneumonia is one of the leading causes of morbidity and mortality in foals **(**Cohen, 1994) [6]. *Rhodococcus equi* (also known as *Prescottella equi* and *Rhodococcus hoagie*) and *Streptococcus equi* subspecies *zooepidemicus* (*S. zooepidemicus)* are the 2 most common causes of pneumonia in foals between 3 weeks and 5 months of age (Hoffman *et al.*, 1993) [13]. On radiographic examination of thoracic area presence of fluid in pleural spaces, pneumonic changes in lungs, pulmonary cyst may be observed. Ultrasonography is most useful for imaging and discriminating soft tissues and more readily available than radiography to the equine practitioner for the diagnosis of respiratory diseases (Roy *et al*., 2003) [24]. Equine herpesvirus-1 (EHV-1) infection is common in young horses throughout the world, resulting in respiratory disease, epidemic abortion, sporadic myelitis, or latent infections (Hussey *et al*., 2006) [14]. Nebulisation of antimicrobial agents causes increase drug concentrations in the lungs while minimising systemic concentrations and toxicity. Ceftiofur sodium is a third-generation cephalosporin approved for the treatment of lower respiratory tract infections caused by susceptible strains of *Streptococcus zooepidemicus* in horses (Fultz *et al.*, 2014) [9].

## Epidemiology of Pulmonary affections in equines
Arun *et al.* (1999) [1] conducted an epidemiological study of equine glanders in Turkish islands in the Sea of Marmara and 1128 horses were examined by using the intracutaneous mallein test. Thirty-five (31 per cent) developed an increase in rectal temperature and a swelling at the point of injection, ten of these horses were killed and glanders was confirmed in five cases by the presence of lesions and by the immunohistological demonstration of the causative agent, *Burkholderia mallei*. Seung *et al.* (2009) [26] conducted an epidemiological analysis of bacterial infections in upper respiratory tract in Seoul Race Park in equines and found the infectious upper respiratory disease (IURD) of Thoroughbred racehorses has been a frequent problem (29.6% of incidence) and bacterial strains (n=98) isolated from IURD horses included *Pseudomonas* spp., *Escherichia coli, Staphylococcus* spp., *Streptococcus equi* subspp. *equi* and *zooepidemicus*. Witkowski *et al.* (2016) [31] conducted a study on molecular epidemiology

of *Rhodococcus equi* in slaughtered swine, cattle and horses in Poland and a total of 1028 lymph node samples were collected in 3 slaughterhouses from carcasses in 2011 and 2012 and found that *R. equi* was isolated from 26.6% (105/395) swine, 1.3% (3/234) bovine healthy submaxillary lymph nodes and in horses, 0.5% (1/198) samples of middle tracheobronchial lymph node. All bovine and most of swine isolates (98.1%) were *vap-B* positive. 87.9% of swine isolates carried 95-kb type 5 plasmid, 3.7% type 1. Single horse isolate was *vap-A* positive and carried plasmid VAPA 85-kb type I. Stasiak *et al.* (2018) [27] reported the prevalence of *equine herpes virus* infections in polish horses is 448/540 (83%) with 77.2% (EHV-2), followed by 47%(EHV-5) and 0.4%(EHV-4) when examined by virus- specific real time PCR assays. Laing *et al.* (2018) [15] conducted an study on Sero-epidemiology of respiratory pathogens in the working horses of Ethiopia mainly targeting equine influenza virus (EIV), equine herpesviruses-1 (EHV-1) and -4 (EHV-4), equine rhinitis viruses A (ERAV) and B (ERBV), equine arteritis virus (EAV) and *Streptococcus equi subspecies equi* (*S. equi*) and found that antibodies towards *S. equi*, were most prevalent (8%, 33/350),antibodies to EAV were confirmed in one animal (0.3%) and low antibody titres to EHV-1/4 and ERA/BV.

Gajarlwar *et al.* (2020) [10] conducted a study on prevalence of upper respiratory tract affections in thoroughbred horses through resting endoscopy**.** A total of 166 endoscopic examinations were performed on 119 racing horses and found that 49 out of 119 were indicative of upper respiratory tract afflictions which categorized as Dorsal displacement of soft palate (9;18.36%), Guttural pouch affections (8;16.32%), Recurrent laryngeal neuropathy grade-2 (7;14.28%), Recurrent laryngeal neuropathy grade-4 (5;10.20%), Recurrent laryngeal neuropathy grade-3 (4;8.16%), Sinusitis (4;8.16%), Pharyngeal lymphoid hyperplasia (4;8.16%), Laryngitis (3;6.12%), Pharyngitis (3;6.12%), Arytenoid chondritis (1;2.04%) and Epiglottic entrapment (1;2.04%).

**Clinical signs and symptoms of pulmonary affections**

Burrell *et al*. (1996) [5] conducted a longitudinal study of respiratory disease in racehorses to assess its relative associations with different infectious agents and environmental conditions and it was found that Coughing, a specific but insensitive measure of lower respiratory tract disease (specificity 84%, sensitivity 38%), also lower airway disease was closely associated with infection with *Streptococcus zooepidemicus*. It was also found that *equine herpesvirus* seroconversions and *S. pneumoniae* infections were independently associated with the development of nasal discharge. Peters *et al.* (2003) [20] conducted a study on diagnosis of Idiopathic Systemic Granulomatous Disease with Encephalitis in a 14-year-old standardbred mare with clinically suspected acute bronchitis with nervous signs. Necropsy revealed systemic granulomatous inflammation and vasculitis involving the lungs, thoracic lymph nodes, ribs, and live, subacute bilateral encephalitis and malacia predominately affecting the white matter. It was concluded that an immune mediated agent were causative factors. Greenwald *et al*. (2011) [11] conducted a case study on zoonotic concern of pulmonary tuberculosis caused by *Mycobacterium tuberculosis* in a horse and found that multiple tuberculoid granulomas communicating with the bronchiolar lumen, pleural effusion, and a granulomatous lymphadenitis involving mediastinal and tracheobronchial lymph nodes were in lungs. Four of 20 animal handlers at the farm were positive for tuberculous infection, indicating a possibility of interspecies transmission of *M. tuberculosis.* Fenner *et al.* (2009) [7] conducted a study to review the associated clinical signs, associated morbidities and outcomes of horses treated for Paranasal sinus cysts (PSC) in 37 horses and found that thirty-one horses were presented with nasal discharge, facial swelling (n=25) and epiphora (n=19). Concomitant tissue destruction (n=31), local nerve damage causing headshaking (n=6) and unilateral blindness (n=1) by Radiography and computed tomography examination. Twenty-two horses (78.6%) fully cured, four (14.3%) partially cured and two (7.1%) not responding to treatment out of twenty-eight horses. Salem *et al.* (2017) [25] conducted a study to investigate the clinical, serum biochemical, mineral and thyroid hormones alterations in association with strangles infection on Seventeen foals and found that most consistent clinical signs were mucopurulent nasal discharge and abscessation in submandibular and retropharyngeal lymph nodes. Neelam *et al.* (2018) [19] reported a case of foal with history of fever (103.2ºF), inappetence, depression, mucopurulent nasal discharge, enlarged lymph nodes of the throat region and labored breathing. The animal was treated with inj. ceftriaxone. and Lugol's Iodine (five per cent). Recovery occurred after six days of treatment. Rossi *et al.* (2019) [23] conducted a study on *Equine rhinitis A virus* (ERAV), which caused respiratory disease among standard bred racehorses' population in southern Ontario and observed clinical signs over a 41-day period. It was characterized by mucopurulent discharge (100%), intermittent cough (37.7%) and ocular discharge (62.3%). Fever (>38.5 $^{0}$C). Seroconversions to *ERAV* among cases were 75.

**Diagnostic ultrasonography and radiography of pulmonary affections**

Berry *et al.* (1991) [4] conducted a study on thoracic radiograph of nineteen horses affected with silicosis with history of varying degrees of clinical signs like chronic weight loss, exercise intolerance, and respiratory distress. They found an abnormal, structured interstitial pulmonary pattern on thoracic radiographs of each horse. The interstitial pulmonary changes were classified as miliary (13), reticulonodular (4), or linear interstitial (2), and were best visualized dorsally and caudodorsally. Bakos *et al.* (2001) [2] conducted a study to demonstrate the diagnostic value of thoracic radiography in lower respiratory diseases of 40 horses included 13 cases of chronic obstructive pulmonary disease (COPD), 9 of chronic bronchitis, 5 of acute bronchitis, 10 of acute pneumonia, 2 of subacute pneumonia and 1 of pulmonary oedema. They found that pleural effusion was observed in a horse suffering from pneumonia, Interstitial pattern (simple or mixed) was observed in 19 cases referring to interstitial pulmonary disease and bronchial pattern (usually mixed with interstitial pattern) was noticed in 7 cases of COPD, 6 of chronic bronchitis and 2 of subacute pneumonia. Lester and Lester (2001) [17] and Bedenice *et al.* (2003) [3] reported reduced survival of foals with more severe radiographic changes in the caudodorsal lung where these changes were generally more frequent. Bedenice *et al* (2003) [3] reported the combined involvement caudodorsal and caudoventral lung in most of the foals (63%), though the involvement of the cranioventral lung alone seems to be least common. Gross *et al.* (2004) [12] reported that *equine influenza* affecting the upper respiratory tract can be diagnosed

ultrasonographical and reported mild lung consolidation and peripheral pulmonary irregularities in 11 (69%) of 16 of the horses. Greenwald *et al*. (2011) [11] conducted a case study on zoonotic concern of pulmonary tuberculosis in a horse and ultrasonographical revealed severe bilateral pleural and pericardial effusion, radio graphically showed a dense bronchi interstitial pattern. Barton *et al.* (2018) conducted a study to evaluate influence of bronchoalveolar lavage on thoracic radiography on Fifty-three horses which were classified as healthy controls (n=12), severe equine asthma (recurrent airway obstruction, n=12) or mild-to-moderate equine asthma (inflammatory airway disease, n=21) and found that BAL increases the interstitial opacity of caudoventral and caudodorsal on thoracic radiographs. Lehna *et al.* (2019) [16] concluded a study on 330 foals affected with R equi to determine the usage of antibiotics in later course of disease over a period of from 2008 to 2011.They were found that percentage of foals that died from pneumonia or R equi infections did not differ significantly between 2008-2011 and 2012-2016 (0.4% vs 0.6% respectively; P=6). It was concluded that antibiotic treatment of foals with smaller lesions, has significantly decreased the number of foals being treated without a significant increase in mortality from R equi pneumonia. Punsmann *et al.* (2021) [21] conducted a study eighteen foals affected with acute interstitial pneumonia. On thoracic radiography, it was found that. Comet tail scores in foals with AIP were significantly higher ($p < 0.0001$) than in control foals. Interrater agreement for the assessment of radiographs was none to moderate ($\kappa = 0.07$-$0.65$) for pattern recognition and weak to moderate ($\kappa = 0.58$-$0.62$) for subjective scoring. Intrarater agreement varied from minimal to strong ($\kappa = 0.30$-$0.80$) for pattern recognition but was strong ($\kappa = 0.83$) for subjective scoring. It was concluded that, the diagnostic value of thoracic ultrasound in foals with AIP was high due to good conformity with post mortem findings and evaluation of thoracic radiographs showed high variability in inter- and intra-agreement.

**Therapy and prognosis of pulmonary affected equines**

Folz *et al.* (1992) [8] conducted a study for determination of efficacy of ceftiofur drug in comparison of ampicillin drug in fifty-five (55) horses. Clinical improvement was recorded for 92.9% of the patients treated with ceftiofur and 92.6% of the animal's receiving ampicillin. Complete recovery/cure was noted for 78.6% of the ceftiofur patients and 59.3% of the horses treated with ampicillin. It was concluded that ceftiofur sodium is an effective and safe treatment for respiratory infections in horses. Morresey (2008) [18] conducted a case study on 1-day-old foal which was presented with history of meconium aspiration after birth showing increased respiratory rate and effort, hypoxemia and thoracic radiographs showed a widespread, diffuse pulmonary interstitial infiltrate. Nebulization therapy using jet small volume nebulizer was started as follows: ceftiofur (1 mg/kg, q 6 h; antimicrobial coverage), dexamethasone (0.01 mg/kg, q 12 h; anti-inflammatory), N-acetylcysteine (4 mg/kg, q 6 h; mucolytic), and albuterol sulphate (0.025 mg/kg, q 6 h; bronchodilation) for 4 days. Respiratory rate and effort were appropriate with hypoxemia resolved at 48 h and marked decreases in the interstitial infiltrate thoracic radiographs at 5 days. Venner *et al*. (2007) [28] conducted a study to evaluate the effect of azithromycin as a preventive medication for pulmonary abscesses in forty-five foals in two groups on a German Warmblood breeding farm. Twenty-five foals were given azithromycin (10 mg/ kg) orally once daily for 4 weeks. The prevalence of pulmonary abscesses was similar in the control groups (31/45 foals), and in the azithromycin group (15/25 foals) and was concluded that the application of azithromycin for 28 days post-natal does not reduce the prevalence of pulmonary abscesses in foals. Wetzig *et al.* (2019) [30] conducted a study to evaluate whether azithromycin combined with doxycycline was effective for the treatment of bronchopneumonia in foals and non-inferior to the combination of azithromycin and rifampin at a farm breeding Warmblood horses in Germany and it was concluded that proportion of foals that recovered was significantly higher for foals treated with azithromycin-doxycycline (80 of 81) or azithromycin-rifampin (81 of 81) compared with that of control foals (57 of 78) and the difference in the percentage of efficacy of azithromycin-rifampin vs azithromycin-doxycycline was 1.2% (90% CI = −0.78% to 3.5%). Votion *et al.* (1997) [29] conducted a study to compare quantitative (dose deposited) and qualitative (regional distribution) deposition of an aerosol in the equine lungs, using either a ultrasonic nebuliser (UN) currently used in human medicine or a high pressure jet nebuliser (JN) especially developed for the equine species and found that there was not much difference between the 2 systems concerning the activity released from the nebuliser proportionally to the initial loaded dose (mean +/- s.d. 45.95 +/- 4.93% for the UN vs. 46.47 +/- 8.49% for the JN) on quantitative estimation. Similarly, there was not much significant difference in size of aerosol deposition image between the 2 nebulisers. In conclusion, both nebulisers may be used for aerosol therapy in the equine species. Rhodes *et al.* (1982) [22] conducted a study on six-month-old Morgan colt with nebulization therapy at Iowa State Clinics with history of coughing, labored breathing, and bilateral nasal discharge. On physical examination, increased bronchovesicular sounds over the entire lung field and expiratory wheeze was heard over the tracheal bifurcation on auscultation. CBC values were within normal limits and fecal examination revealed *Oxyuris equi*, *Parascaris equorum* and strongyle-type eggs. Bronchopneumonia was the tentative diagnosis on radiographic examination. The colt was started on chloramphenicol at a dosage of 25 mg/kg B.I.D and Fenbendazole at dosage of 7mg/kg. The foal was nebulized 15 minutes twice a day with help of jet-type nebulizer ingredients included: 10cc of Mucomyst~b 20 cc of Bronkosol~c 10 cc of gentamicin and 50 cc of saline having for 10 days and the mucopurulent nasal secretions subsided with clear lung sounds after end of the first week.

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