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Comparative Efficacy of Kanamycin, Enrofloxacin, Moxifloxacin and Cefoperazone for the Treatment of Pneumonia in Buffaloes

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ABSTRACT

A study was conducted to evaluate the comparative efficacy of kanamycin, enrofloxacin, moxifloxacin and cefoperazone to treat pneumonia in buffaloes. During study period, a total of 28 buffaloes brought to VCC, LUVAS, Hisar with the history of fever, anorexia, nasal discharge, coughing and dyspnoea. Clinical examination revealed abnormal lung sounds during auscultation. All the buffaloes diagnosed with pneumonia were randomly divided into four equal groups viz. group I, II, III and IV. Animals of group I were treated with kanamycin @ 7.0 mg/kg b.wt., i/m, b.i.d., group II with enrofloxacin @ 5 mg/kg b.wt., i/m, o.d., group III with moxifloxacin @ 5 mg/kg b.wt., i/m, o.d. and group IV with cefoperazone@ 20 mg/kg b.wt., i/m, o.d., along with supportive therapy for 5 days. Clinical recovery was determined on the basis of remittance of clinical signs. The highest and earliest recovery was found in group II animals.

Keywords: Antibiotic, bovine respiratory disease, clinical efficacy

Bovine respiratory disease (BRD) is one of the most common cause of morbidity and mortality in cattle (Murray *et al*., 2017). It is one of the most economically important disease of feedlot cattle with an estimated total loss of more than 3 billion dollars per year globally (Watts and Sweeney, 2010). Significant economic losses in this condition are due to decreased weight gains, feed utilization, carcass quality and increased morbidity and mortality, prophylaxis and therapeutic cost (Urban-Chmiel and Grooms, 2012). The disease is characterized by fever, depression, loss of appetite and respiratory character change (Griffin *et al*., 2010).

It is a multi-factorial disease involving infectious agents, compromised host immune system and environmental factors (Grissett *et al*., 2015). Environmental stressors predispose cattle to viral and bacterial infection (Taylor *et al*., 2010). Among etiological agents bacteria are the most important. Most frequently associated bacteria with bovine respiratory disease (BRD) are *Mannheimia haemolytica, Pasteurella multocida, Histophilus somni* and *Mycoplasma bovis* (Griffin *et al*., 2010; Klima *et al*., 2014). Therefore, antibiotics play an important role in both therapeutic and control of BRD. Due to drug resistance and cost of antibiotic treatment selection of appropriate antibiotic is important.

A properly designed clinical trial of different antimicrobials is the most effective method to evaluate the efficacy against a particular disease (Jim *et al*., 1992). Therefore, the aim of present investigation is to compare the efficacy of kanamycin, enrofloxacin, moxifloxacin and cefoperazone in the treatment of pneumonia.

MATERIALS AND METHODS

Animals and clinical examination

A total of twenty eight buffaloes were brought to VCC, LUVAS for treatment and were examined thoroughly. It

was observed that all the animals exhibiting the clinical signs of inappetance/anorexia, nasal discharge, coughing, dyspnoea and abnormal lung sounds (crackles/wheezes/ pleuritic frictional rubs) on auscultation of thoracic area. Thoracic x-ray of all the animals was taken in lateral recumbency and interpreted.

Collection of blood samples

Five ml of blood was collected aseptically in EDTA coated sterile vials from jugular vein of the affected as well as healthy control group of animals for estimation of Haemoglobin (Hb), Packed Cell Volume (PCV), Total Leucocyte Count (TLC) and Differential Leucocyte Count (DLC) as per mothod of Jain (1986).

Culture sensitivity test

Nasal swabs taken from all the animals were subjected to culture and antibiotic sensitivity testing. Antibiotics were selected on the basis of *in vitro* sensitivity which was performed using the disk diffusion method (Quinn *et al*., 2004).

Line of treatment

Animals diagnosed with pneumonia were randomly divided in to 4 equal groups (group I, II, III and IV) having seven animals each. Moreover, seven healthy animals not showing respiratory signs were also taken as control. Animals of group I (n=7) were treated with kanamycin @ 7.0 mg/kg body weight i/m twice daily**,** animals of group II (n=7) were treated with enrofloxacin @ 5 mg/kg body weight i/m once daily**,** group III (n=7) animals were treated with moxifloxacin @ 5 mg/kg body weight i/m once daily and group IV (n=7) animals were treated with cefoperazone @ 20 mg/kg body weight i/m daily for 5 days. In addition to antibiotics, non-steroidal anti-inflammatory drugs (NSAIDs), steam inhalation, antioxidants, multivitamins, bronchodilators and appetizers were also given for faster recovery.

Statistical method

The data was analyzed statistically by DMRT using SPSS v20.0. Two-way ANOVA was applied for statistical significance.

Clinical recovery

The comparative antibiotic response and cure rate was determined on the basis of time taken for the remission of clinical signs *viz*., rectal temperature, respiratory and pulse rate, status of appetite (inappetence/anorexia), nasal discharge, coughing, dyspnoea and auscultation of thoracic area for abnormal lung sounds in all the four treatment groups. Clinical evaluation of all animals were done pre-treatment (day 0) and post treatment (day 5).

RESULTS AND DISCUSSION

On anamnesis and clinical examination, all the affected animals were having high rectal temperature, elevated respiration rate and pulse rate, anorexia/inappetance, serous to muco-purulent nasal discharge, coughing, dyspnoea and abnormal lung sounds such as crackles, wheezes, pleuritic frictional rub (Table 1 and Table 3). Similar findings were consistently observed by various researchers (Collie, 1992; Griffin *et al.*, 2010; Urban – Chmiel and Grooms, 2012; Love *et al.*, 2014).

No significant difference in mean of vital parameters was found within the row while mean pulse rate of group II, III and IV differs significantly at 0 and 5th day within the column (Table 1). X ray examination of thoracic area of affected animals revealed pneumonic changes including two types of radiographic pattern namely alveolar in twenty two animals followed by interstitial pattern in six animals.

Results of hematological studies (Table 2) in respiratory disease of buffaloes revealed high PCV, TLC, neutrophils, whereas low lymphocytes, monocytes and eosinophils; which were coming towards normal range after treatment. *In vitro* ranking of antibiotic sensitivity towards isolated bacteria included in this study was 1st, 2nd, 3rd and 4th for enrofloxacin, cefoperazone, moxifloxacin and kanamycin, respectively.

Among four groups, maximum cure rate (85.71%) was observed in group II which can be attributed to higher bioavailability of fluoroquinolones in lung tissue (Scheer and de Jong, 1997; McKellar *et al.*, 1998) and in bronchial secretions (Friis, 1993).

In groups I and III, cure rate was 71.42%; while it was lowest (57.14%) in group IV (Table 4). Similar to present study Lekeux and Art (1988) also explained the higher

Table 1: Changes in vital clinical parameters (mean±S.E.) of buffaloes affected with respiratory disease in response to treatment (n=7)

Vital Parameters		Healthy Control	Group I (Kanamycin treated)	Group II (Enrofloxacin treated)	Group III (Moxifloxacin treated)	Group IV (Cefoperazone treated)
Temperature (°F)	0 d	101.45 ± 0.23	102.41 ± 0.70	102.27 ± 0.34	101.96 ± 0.53	102.04 ± 0.28
	5th d	101.22 ± 0.29	101.18 ± 0.26	101.52 ± 0.17	101.37 ± 0.32	101.60 ± 0.27
Respiratory rate (per min)	0 d	19.28 ± 2.35	38.85 ± 8.08	32.57 ± 7.10	28.42 ± 7.05	27.57 ± 3.69
	5th d	20.64 ± 1.67	25.14 ± 2.93	21.42 ± 3.48	20.71± 5.07	20.71 ± 3.06
Pulse rate (per min)	0 d	56.57 ± 3.57	67.85 ± 5.47	70.14b ± 4.36	68.42b ± 1.63	64.00b ± 2.12
	5th d	57.22 ± 2.74	59.14 ± 2.26	61.14a ± 2.21	56.00a ± 1.23	55.14a ± 1.63

Means bearing different superscripts (a, b) differ significantly ($p < 0.05$) in column for each parameter.

Table 2: Changes in haematological parameters (mean ± S.E.) in buffaloes affected with respiratory disease in response to treatments (n = 7)

Biochemical Parameters		Healthy Control	Group I (Kanamycin treated	Group II (Enrofloxacin treated)	Group III (Moxifloxacin treated)	Group IV (Cefoperazone treated)
Hb (g/dl)	0 d	11.75 ± 0.92	11.81^{a} ± 0.73	9.47^{a} ± 0.98	10.41^{a} ± 0.81	10.91^{a} ± 1.00
	5th d	12.02 ± 0.56	12.82^{b} ± 0.50	10.97^{b} ± 0.72	11.88^{b} ± 0.64	12.44^{b} ± 0.67
PCV (%)	0 d	36.00 ± 2.54	37.42^{a} ± 1.67	32.28 ± 2.98	37.85 ± 3.07	37.85 ± 2.95
	5th d	38.22 ± 1.74	41.00^{b} ± 0.97	36.85 ± 2.21	38.85 ± 1.94	39.14 ± 2.49
TLC (10^3/µl)	0 d	8.55 ± 0.79	10.23 ± 0.92	9.18 ± 1.42	9.51 ± 2.07	10.01 ± 1.48
	5th d	8.20 ± 0.93	9.05 ± 0.64	8.85 ± 1.10	9.15 ± 1.28	9.86 ± 1.68
N (%)	0 d	37.71^{X} ± 2.26	66.00^{bY} ± 2.96	49.57^{b} ± 5.47	65.42^{bY} ± 5.91	64.14^{bY} ± 6.55
	5th d	39.24 ± 2.88	42.85^{a} ± 2.71	40.42^{a} ± 2.84	47.42^{a} ± 4.46	43.57^{a} ± 3.38
L (%)	0 d	57.28^{Z} ± 2.74	31.42^{aX} ± 2.86	47.71^{aYZ} ± 5.02	32.71^{aX} ± 5.92	34.85^{aXY} ± 6.47
	5th d	55.35 ± 3.11	54.71^{b} ± 2.76	57.14^{b} ± 2.67	50.42^{b} ± 4.49	53.71^{b} ± 3.51
M (%)	0 d	3.14^{Y} ± 0.73	1.85^{XY} ± 0.59	2.00^{XY} ± 0.72	1.57^{XY} ± 0.57	0.71^{aX} ± 0.28
	5th d	3.00^{Y} ± 0.27	1.14^{X} ± 0.34	1.28^{X} ± 0.42	1.00^{X} ± 0.30	1.57^{bXY} ± 0.29
E (%)	0 d	1.85^{Y} ± 0.55	0.71^{X} ± 0.18	0.79^{X} ± 0.22	0.34^{aX} ± 0.14	0.48^{aX} ± 0.27
	5th d	1.80 ± 0.29	1.28 ± 0.47	1.14 ± 0.26	1.14^{b} ± 0.26	1.14^{b} ± 0.26

Means bearing different superscripts (a, b) differ significantly ($p < 0.05$) in column for each parameter; Means bearing different superscripts (X, Y, Z) differ significantly ($p < 0.05$) in row for each parameter.

Table 3: Changes in clinical status of buffaloes affected with respiratory disease in response to treatment (n=7)

Clinical signs and Symptoms		Healthy Control	Group I (Kanamycin Treated		Group II (Enrofloxacin treated)		Group III (Moxifloxacin treated)		Group IV (Cefoperazone treated)	
Inappetance/ Anorexia	0 d	Nil	7 (+++)	0 (-)	7 (+++)	0 (-)	7 (+++)	0 (-)	6 (+++)	1 (-)
	5th d	Nil	3 (+)	4 (-)	1 (++)	6 (-)	2 (++)	5(-)	2 (++)	5 (-)
Nasal discharge	0 d	Nil	5 (+++)	2 (-)	5 (+++)	2 (-)	6 (+++)	1 (-)	4 (+++)	3 (-)
	5th d	Nil	1 (+)	6 (-)	0 (-)	7 (-)	2 (+)	5 (-)	1 (++)	6 (-)

Coughing	0 d	Nil	4 (+++)	3 (-)	5 (+++)	2 (-)	4 (+++)	3 (-)	4 (+++)	3(-)
	5th d	Nil	1 (++)	6 (-)	0 (-)	7 (-)	1 (++)	6 (-)	1 (++)	6 (-)
Dyspnoea	0 d	Nil	5 (+++)	2 (-)	5 (+++)	2 (-)	4 (+++)	3 (-)	6 (+++)	1 (-)
	5th d	Nil	1 (++)	6 (-)	1 (+)	6 (-)	2 (+)	5 (-)	2 (+)	5 (-)
Abnormal lung auscultation	0 d	Nil	7(+++)	0 (-)	7(+++)	0 (-)	6(+++)	1 (-)	7(+++)	0 (-)
	5th d	Nil	2(+)	5 (-)	1(+)	6 (-)	2(+)	5 (-)	1(++)	6 (-)

Figures in parenthesis indicate severity of the parameter (+++ severe, ++ moderate, + mild, - absent).

Table 4: Clinical cure rate of buffaloes affected with respiratory disease

Treatment response	Group I (Kanamycin treated)	Group II (Enrofloxacin treated)	Group III (Moxifloxacin treated)	Group IV (Cefoperazone treated)
Total animals treated	7	7	7	7
Recovered	5 (71.42%)	6 (85.71%)	5 (71.42%)	4 (57.14%)
Not responded	2 (28.57%)	1 (14.28%)	2 (28.57%)	3 (42.85%)

clinical efficacy of enrofloxacin (@ 5 mg/kg b.wt.) on shipping fever pneumonia. Abutarbush *et al.* (2012) also recorded lower case fatality rate using fluoroquinolones (enrofloxacin) compared to cephalosporin (ceftiofur sodium). In contrast to the present findings lower cure rate (70.2%) of enrofloxacin was observed by Robb *et al.* (2007) against bovine respiratory disease in calves.

CONCLUSION

Enrofloxacin was found most effective antimicrobial drug as compared to cefoperazone, moxifloxacin and kanamycin in the therapeutic management of clinical respiratory disease in buffaloes.

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