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Management of methicillin resistant *Staphylococcus aureus* in canine dermal infection in Mizoram

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Abstract

Staphylococcus aureus infections show high rates of morbidity and mortality which can cause metastatic or complicated infections such as sepsis or infective endocarditis. Over the year's MRSA has become a major nosocomial pathogen, highly prevalent throughout the world which has a serious health and global issue and may be transmitted *via* direct contact with contaminated surfaces. MRSA is responsible for most of the global health care related to *S. aureus* bacteraemia and compared with Methicillin sensitive *S. aureus*. MRSA infection is related with poorer clinical condition. A total of 22 numbers of MRSA infections were found in Mizoram among the 100 samples from dogs. MRSA positive dogs were treated with three antibiotics *viz.* doxycycline, clindamycin and sulfisoxazole according to zone of inhibition on antibiotic sensitivity test. Clinical score was decreased on day 21 after giving treatment with antibiotics along with supportive therapy. Among these antibiotics doxycycline was showing highest sensitivity.

Keywords: Canine, dermal, MRSA, antibiotics, Mizoram

Introduction

Methicillin resistance is a frightening condition for treatment since it causes resistance to beta-lactam antibiotics including cephalosporin and other antibiotics. Antibiotics have been prescribed for colds, flu, and other viral infections from its discovery. Since the beginning of antimicrobial drug use in the treatment, *staphylococci* have evolved in response to the presence of antimicrobial drugs in biological systems. This evolution has involved the amplification and proliferation of epidemiologically successful strains of pathogenic *Staphylococci* and gaining of antimicrobial drug resistance mechanisms across human and animal population. Antimicrobial resistance has been recognized within all *Staphylococcus* spp. from which humans and domestic animals can develop infection. *Staphylococci* of low pathogenic potential may serve as reservoirs for their transmission to species of greater pathogenic potential (Morris *et al.*, 2017) [8]. MRSA in clinical practice is the most significant problem observed nowadays and the incidences of MRSA infections were increasing day by day. Many reports on vancomycin resistance in MRSA isolates have also been recorded. Currently a well-known antibiotic belonging to the oxazolidinone class of compounds which is linezolid and daptomycin which is a new cyclic lipo-peptide, were considered the drugs of choice for the treatment of MRSA infections (Mahajan *et al.*, 2013) [7]. The reports of MRSA in companion animals are raising public health concerns. A study by Aires-de-Sousa (2017) [1] concluded that, some cases of transmission of MRSA between food-chain and companion animals or humans, and several MRSA clones of human origin were adapted to new animal hosts finally by losing useless virulence factors or getting new mobile genetic elements.

Materials and Methods

Samples were collected from 100 dogs with dermal infection. *Staphylococcus aureus* was diagnosed by isolation, differential diagnosis and by confirmatory kit test. MRSA was confirmed by antibiotic sensitivity test (ABST) using Methicillin disc as per the Kirby-Bauer disk diffusion method. The results were interpreted according to guidelines providing by HIMEDIA (antimicrobial susceptibility test discs) manual as per the standard European Committee on Antimicrobial Susceptibility Testing (EUCAST). Five antibiotics from veterinary interest were tested: methicillin, cefotaxime, sulfisoxazole, clindamycin, and doxycycline, for all *S. aureus* positive samples (Table 1).

Among these antibiotics, sulfisoxazole, clindamycin, and doxycycline were selected for treatment study based on their sensitiveness in ABST.

Table 1: Antibiotic sensitivity test for Methicillin resistant *S. aureus* infected animals by disc diffusion test

Antimicrobial agent	Sensitive		Intermediate		Resistant	
	No.	%	No.	%	No.	%
Methicillin (MET) (5 mcg)	0	0	0	0	22	100
Cefotaxime (CTX) (30 mcg)	3	13.63	17	77.27	2	9.09
Sulfisoxazole (SF) (300mcg)	13	59.09	7	31.81	2	9.09
Clindamycin (CD) 2 mcg	12	54.54	4	18.18	6	27.27
Doxycycline (DO) 30 mcg	19	86.36	0	0	3	13.63

The dogs diagnosed with MRSA infection were randomly grouped into three groups *viz.* Group I, Group II and Group III each having maximum six animals. For comparison, six apparently healthy dogs will be selected as Group IV (Control group) (Table 2).

Table 2: Efficacy of antibiotics for Methicillin resistant *Staphylococcus aureus* dermal infection in dogs based on clinical score.

Group & Antibiotic	Day 0	Day 14	Day 21	P value
Group I: Doxycycline	18.66±1.38 ^{bB}	12.00±0.73 ^{aB}	9.33±0.33 ^{aAB}	0.00**
Group II: Clindamycin	18.00±0.73 ^{bB}	12.16±0.47 ^{bB}	10.16±0.4 ^{aB}	0.00**
Group III: Sulfisoxazole	16.00±0.96 ^{bB}	11.33±0.61 ^{aB}	9.5±0.34 ^{aAB}	0.00**
Group IV: Healthy	9.00±0.00 ^A	9.00±0.00 ^A	9.00±0.00 ^A	
P value	0.00**	0.01**	0.09 ^{NS}	

(Superscript lower-case letters (a, b, c) indicate significant differences among day wise and superscript capital letters (A, B) indicate significant differences among group wise. Significant ($p \leq 0.05$), ** highly significant ($p \leq 0.01$) NS non-significant)

Results and Discussion

Among the 100 screened samples from dermal infections of canines, 22 samples were found Methicillin resistant *Staphylococcus aureus*. Faires *et al.* (2010) [4] identified the highest prevalence of MRSA infections from the ears (otitis) and skin (pyoderma), where dogs are often treated with β -lactams. The details of results are given in Table 2. Among different antibiotics, highest sensitivity was found for doxycycline. Bhamri and Kim (2009) [2] observed that oral antibiotics belonging to tetracyclines including doxycycline and minocycline are very effective in the treatment of Community acquired MRSA. Less sensitivity found for cefotaxime and this might be due to excessive use of cephalosporin group of drugs for treatment of dog. Salgado-Caxito *et al.* (2021) [10] in their studies observed that extensive use of antibiotics including cephalosporins is a major cause of development of antimicrobial resistance in dogs.

According to Haenni *et al.* (2017) [5] 35.7% isolates were macrolides resistant isolates, and 53.6% isolates were amino glycosides resistant that were collected from MRSA infections in dogs. Loffler *et al.* (2010) [6] recorded that; 18% isolates were resistant for clindamycin in MRSA infections in dogs. Boost *et al.* (2007) [3], opined that; 28.8% and 13.6% of canine isolates with *S. aureus* infection were resistant for tetracycline and clindamycin, respectively. But Rubin and

Chirino-Trejo (2011), observed that 78% samples from canine were showing resistance for clindamycin against MRSA.

For therapeutic regimen antibiotics were chosen by zone of inhibition by antibiotic sensitivity test. According to zone of inhibition, doxycycline was showing highest sensitivity. After doxycycline, sulfisoxazole was having highest sensitivity and after that clindamycin shows higher sensitivity. As a supportive therapy, chlorhexidine spray (4%), Miconazole ointment, chlorhexidine shampoo, povidone iodine was used as per as clinical symptoms.

There was high significant difference between group I, group II and Group III with control group IV ($p \leq 0.01$) on day 0. After treatment on day 14 still there was significant difference between the groups. But on day 21 it was showing that there was no significant difference ($p \leq 0.05$) between groups I, group II, group III and Group IV. On day wise there was highly significant difference ($p \leq 0.01$) between day 0, day 14 and day 21 for group I, group II, and Group III. Clinical scores were found constantly in decreasing state in group I, group II, and group III on day 14 and day 21 after treatment and it was showing highly significant difference after 21 days of treatment.

Antibiotic treatment according to culture and antibiotic sensitivity test improved the MRSA infection in dogs in Mizoram (Fig. 1 & Fig. 2). According to Tomlin *et al.* (1999) [11] MRSA positive dogs were treated with oral antibiotics included amoxicillin-clavulanate, clindamycin, ciprofloxacin, cephalexin, enrofloxacin, metronidazole, and trimethoprim-sulphadiazine. According to Morris *et al.* (2017) [8] systemic antimicrobial therapy according to antibiotic susceptibility testing was resolved the MRSA infection in dogs.



Fig 1: MRSA positive Saint Bernard female dog, aged 3 years treated at TVCC, CVSc & AH, Selesih, Aizawl

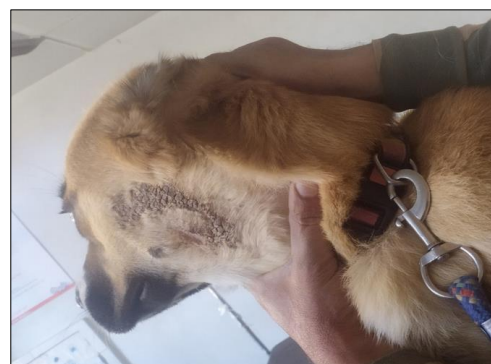


Fig 2: MRSA positive Saint Bernard dog, aged 3 years treated and cured at TVCC, CVSc & AH, Selesih, Aizawl

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Animal Ethics

This study was conducted with the approval of Institutional Animal Ethics Committee (IAEC), College of veterinary sciences and Animal Husbandry, Central Agricultural University, Slesih, Aizawl, Mizoram-796015 vide Approval reference number –CVSC/CAU/IAEC/20-21/P-15.

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