**COMPARATIVE EVALUATION OF MUPIROCIN AND FUSIDIC ACID AS A TOPICAL THERAPY ON STAPHYLOCOCCAL PODODERMATITIS IN DOGS**

**Abstract:** Topical therapy has gained more focus as it reduces the side effects and duration of the systemic drugs and provide a much more effective results by targeting affected areas. This study was conducted to evaluate comparative therapeutic efficacy of mupirocin and fusidic acid against Staphylococcal pododermatitis in dogs. During the study period, dogs presented to VCC, College of Veterinary Science and Animal Husbandry, Jabalpur (M.P.) were screened over six months period from May to October 2024. 12 confirmed cases were assigned in two different treatment groups with 6 dogs each. The two treatment groups were administered with mupirocin and fusidic acid. A significant decrease was seen by week 4 in both groups although the mean time-to-resolution of lesions was comparatively less in the group with mupirocin as the topical treatment.

**Keywords:** Pododermatitis, Dogs, Mupirocin, Fusidic acid

**Introduction:**

The skin is the largest organ of the body comprising of the 12-24% body weight and has haired and hairless portions. The histological structure differs according to the anatomical site and the species of the animal. The dorsal aspect of the body along with the lateral part of the limbs have densely haired area and thicker as compared to the ventral part mainly the abdomen and medial aspect of the thighs (Zachary, 2021). It provides protection by maintaining the boundary between the body and environment. In addition, it also has functions like regulating temperature, immune protection, providing pigments and sensory perception (Aiello and Moses, 2016).

Due to its surface area, it encounters many factors which can influence the healthy integument. The factors include exogenous factors (nutritional, microbial, chemical, physical, parasitic, actinic and allergic) and endogenous factors (immunologic, congenital, hereditary, hormonal, emotional, metabolic, age and internal disease) (Maxie, 2016). Due to the obvious nature of the lesions, skin disorders are one of the most apparent reasons for veterinarian appointment.

Dermatological complications are one of the most encountered and resolving them can be highly rewarding or frustrating for the veterinarian (Miller *et al.,* 2012). They are reported for 8 percent of the complaints in companion animal hospitals (Zahri *et al.,* 2024). The disorders of the skin may vary from acute, self-limiting issues to chronic or long-term problems requiring life-long treatment. It was observed that the condition of the skin worsens in hot and humid climate making them harder to manage (Thapa and Sarkar, 2018). Pododermatitis is the inflammation of paws including interdigital spaces, footpads, nail folds, nails, or their combination (Bajwa 2023). Interdigital erythema, pustules, papules, nodules, hemorrhagic bullae, fistulae, ulcers, alopecia, or swelling may appear in one or more paws (Bajwa, 2016).

The anatomical positioning of the paws, coupled with constant contact with environmental factors, predisposes them to secondary infections, rendering pododermatitis a particularly challenging and complex condition in veterinary dermatology. Additionally, the ongoing exposure to environmental elements contributes to the resistance of the infection to standard treatment protocols. The difficulty in restricting the animal's movement further exacerbates the condition, often leading to its chronicity and increased pain. Consequently, the management of most cases necessitates comprehensive therapeutic approaches to effectively address pododermatitis.

**Materials and Methods:**

A screening was conducted on the basis of history and presence of clinical signs indicative of canine pododermatitis on all dogs presented to the Veterinary Clinical Centre (VCC) at the College of Veterinary Science and Animal Husbandry, Jabalpur (M.P.), from May 2024 to October 2024. Therapeutic study was performed on twelve positive cases of Staphylococcal pododermatitis. Group A was treated with Ointment Fusidic acid 2% while Group B was treated with Ointment Mupirocin 2%, both applied topically twice a day for 28 days.

The clinical response scoring (CRS) was assigned to all dogs in the treatment group by subsequent follow up examinations on day ‘0’ (pre-treatment), day ‘14’ and day ‘28’ (post-treatment). Assessment of pruritus, pustule or nodules and crusts or papules was done according to method given by Marchegiani *et al.* (2019) with some modifications.

**Table no. 1: Scoring system for lesion assessment**

|  |  |  |  |
| --- | --- | --- | --- |
| Score | Pruritis | Pustule/nodules | Crust/papules |
| 0 | Absent | Absent | Absent |
| 1 | Minimal | Healing lesion | 1 small area |
| 2 | Mild | 1–2 primary lesions | 2 small areas |
| 3 | Moderate | 3–4 primary lesions | 3–4 more extensive areas |
| 4 | Severe | ≥5 primary lesions | ≥5 extensive areas |

**Note:** Small defined as ≤1 cm in diameter. Extensive lesions defined as >1 cm in diameter. The scoring of pruritis was done as follows: Absent – no itching, Minimal – occasional episodes (slightly more itchy than normal), Mild – more frequent (itchy only when idle), Moderate – regular episodes.

**Therapeutic response evaluation**

The response of therapy will be evaluated on the basis of clinical response to the treatment. On the basis of gross dermatological score *i.e.,* sum of pruritus, pustules or nodules and crust or papules, an overall response to treatment will be assessed on a scale of 1 to 12.

**Table no. 2: Therapeutic response evaluation**

|  |  |
| --- | --- |
| Gross Score | Response to treatment |
| 0-4 | Excellent |
| 5-8 | Moderate |
| 9-12 | Mild |

**Statistical analysis**

The therapeutic response evaluation scores of each group were statistically analysed by Kruskal-Wallis test for between days and Mann-Whitney U test for between groups as per the standard procedure IBM SPSS computer software version 25.0.

**Results and Discussion:**

The total of 12 dogs which were taken into the study were randomly divided into two groups, Group A and Group B. All the dogs had similar clinical scoring of 9 to 11 on day ‘0’ were only considered. Upon detailed history taking, no significant difference in sex, age, breed was observed. *Staphylococcus* spp. was isolated as the primary bacterial isolate in all cases.

From the start of the study period, statistically significant different improvement was observed between days in both the groups. The time required for clinical resolution was 2.3 weeks in Group B and 3.8 weeks in Group A. The mean rank of the gross dermatological score of the therapeutic response were evaluated in different treatment groups, Group A and Group B are depicted in table 3 and 4. The mean rank of gross score was significantly different on day 0, day 14 and day 28 within group. However, the mean rank between group did not vary significantly on day 0 and day 14, but significant difference was observed on day 28 between group. The statistical analysis revealed that there was significant decrease on day 0, day 14 and day 28.

In treatment Group B which was treated with Ointment Mupirocin 2% topically, the mean rank of the gross dermatological score on day 28 was 4.50 and all the dogs taken into this group showed excellent response to the treatment. Mupirocin is also known as pseudomonic acid A, a short-chain fatty acid and the primary fermentation metabolite of Pseudomonas fluorescent. Mupirocin is thought to exert its antimicrobial effect by inhibiting isoleucyl-tRNA synthetase, which disrupts bacterial protein synthesis and leads to cell death. This mechanism occurs because mupirocin's protein side chain resembles the bacterial isoleucyl-tRNA binding site, allowing mupirocin to bind there. This disrupts bacterial isoleucyl-tRNA, depleting cellular levels of charged tRNA and halting protein and RNA synthesis, ultimately leading to bacterial cell death, especially at higher mupirocin concentrations. Mupirocin showed bacteriostatic activity against gram-positive bacteria like Staphylococcus and MRSA strains and may become bactericidal in higher concentration (Werner and Russell, 1999). The present study corroborates with Guaguere (1996) who stated that 2% mupirocin acts as bactericidal within 24-48 hours after application. It mainly acts against Staphylococcus aureus. They also reported that mupirocin requires 10 minutes contact for activation and works best when applied twice daily.

In Group A, the mean rank observed was 8.50 and the response to treatment of 5 dogs was excellent and moderate in 1 dog. Fusidic acid is a bacteriostatic antimicrobial agent derived from the fungus Fusidium coccineum. It has a steroid-like structure which has demonstrated efficacy against coagulase-positive Staphylococci. Fusidic acid inhibits protein synthesis by attaching itself to elongation factor G (EF-G) and blocking its release from the ribosome during translocation (González-López *et al.,* 2024). This present study was in favour with the findings of Frosini *et al.* (2017) who reported that fusidic acid must be used for the treatment of canine surface and superficial pyoderma caused by bacteria susceptible to fusidic acid, but not deep pyoderma. Werner and Russell (1999) noted that therapeutic levels of fusidic acid were achieved in the epidermis within a few hours of application and are maintained with twice-daily dosing.

The observations of the present study correlates to the research done by Loeffler *et al.* (2008) who reported that mupirocin and fusidic acid were 94.11% and 86.21% effective respectively aganist *Staphylococcus aureus*.

**Table 3: Mean rank of gross score between days of dogs affected with Staphylococcal pododermatitis**

|  |  |  |  |
| --- | --- | --- | --- |
| Groups | Interval | H value | p value |
| Day 0 | Day 14 | Day 28 |
| Group A | 15.08 | 8.59 | 4.92 | 11.396\* | 0.003 |
| Group B | 15.5 | 8.5 | 4.42 | 13.517\* | 0.001 |

\* - Significant at p<0.05

**Table 4: Mean rank of gross score between group of dogs affected with Staphylococcal pododermatitis**

|  |  |
| --- | --- |
| Groups | Interval |
| Day 0 | Day 14 | Day 28 |
| Group A | 6.42 | 7.67 | 8.5 |
| Group B | 6.58 | 5.33 | 4.5 |
| U value | 17.50NS | 11.00NS | 6.00\* |
| p value | 1.935 | 0.254 | 0.032 |

\* - Significant at p<0.05, NS – Non significant

**Conclusion:**

The present study clearly shows that both mupirocin as well as fusidic acid are indeed effective topical therapies especially for the management of Staphylococcal pododermatitis in dogs. However, mupirocin 2% ointment exhibited superior clinical efficacy. Mupirocin accomplished a faster resolution of lesions and a greater improvement in dermatological scores by the conclusion of the 28-day treatment period in comparison to fusidic acid. Based on the data, mupirocin's special mechanism of action, which involves disrupting bacterial protein production, may result in faster and more complete improvement from Staphlococcal infections on dog's feet, potentially promoting better well-being and shorter caring period. Hence, mupirocin 2% ointment might be regarded as a favoured option for the topical handling of canine Staphylococcal pododermatitis.

**COMPETING INTERESTS DISCLAIMER:**

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript. – TO THE BEST OF MY RECOLLECTION, NO AI HAS BEEN USED

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

**References:**

1. Aiello, S.E. and Moses, M.A. (2016). The Merck Veterinary Manual, 11th Edn., Merck and Co., Inc., New Jersey, USA, 837 p.
2. Bajwa, J. (2016). Canine pododermatitis. The Canadian Veterinary Journal, 57(9): 991-993.
3. Bajwa, J. (2023). Canine pododermatitis: A complex, multifactorial condition. The Canadian Veterinary Journal, 64(5): 489-492.
4. Feijo, F.M.C., Souza, N.D. and Ramadinha, R.H.R. (1998). A study of the yeast Malassezia pachydermatis by examination of skin cytology in the dog. Brazilian Journal of Veterinary Medicine, 20(2): 66-68.
5. Frosini, S.M., Bond, R., Loeffler, A. and Larner, J. (2017). Opportunities for topical antimicrobial therapy: permeation of canine skin by fusidic acid. BMC Veterinary Research, 13(345): 1-8.
6. González-López, A., Larsson, D.S., Koripella, R.K., Cain, B.N., Chavez, M.G., Hergenrother, P.J., Sanyal, S. and Selmer, M. (2024). Structures of the *Staphylococcus aureus* ribosome inhibited by fusidic acid and fusidic acid cyclopentane. *Scientific reports*, 14(1): 14253.
7. Guaguere, E. (1996). Topical treatment of canine and feline pyoderma. Veterinary Dermatology, 7(3): 145-151.
8. Loeffler, A., Baines, S.J., Toleman, M.S., Felmingham, D., Milsom, S. K., Edwards, E.A. and Lloyd, D.H. (2008). In vitro activity of fusidic acid and mupirocin against coagulase-positive staphylococci from pets. Journal of Antimicrobial Chemotherapy, 62(6): 1301-1304.
9. Maxie, M.G. (2016). Jubb, Kennedy and Palmer’s Pathology of Domestic Animals, 6th Edn., Elsevier, St. Louis, Missouri,509 p.
10. Marchegiani, A., Spaterna, A., Cerquetella, M., Tambella, A.M., Fruganti, A. and Paterson, S. (2019). Fluorescence biomodulation in the management of canine interdigital pyoderma cases: a prospective, single‐blinded, randomized and controlled clinical study. Veterinary Dermatology, 30(5): 371-e109.
11. Miller, W.H., Griffin, C.E. and Campbell, K.L. (2012). Muller and Kirk's Small Animal Dermatology, 7th Edn., Elsevier., St. Louis, Missouri, 185 p.
12. Thapa, G. and S. Sarkar (2018) Occurrence of canine skin disorder and its haemato-biochemical alterations. International Journal of Current Microbiology and Applied Sciences, 7(12): 15-16.
13. Werner, A.H. and Russell, A.D. (1999). Mupirocin, fusidic acid and bacitracin: activity, action and clinical uses of three topical antibiotics. Veterinary Dermatology, 10(3): 225-240.
14. Zachary, J.F. (2021). Pathologic Basis of Veterinary Disease, 7th Edn., Elsevier, St. Louis, Missouri, 1009 p.
15. Zahri, A., Bouslikhane, M., El Mazini, S., Lemrani, M., El Berbri, I., Abouelkaram, M. A., Thomas, B. and Bourquia, M. (2024). Survey on dermatological disorders of dogs during 2020-2022 in Rabat, Morocco. World's Veterinary Journal, 14 (3): 449-460.