

ORIGINAL ARTICLE

In Vitro Survival of Scabies Mites

ARIFULLAH MAJ¹, MUHAMMAD ADEEL SIDDIQUE², LT. COL. MAJID HUSSAIN³¹TMO Dermatology, Combined Military Hospital, Abbottabad^{2,3}Dermatology, Combined Military Hospital, AbbottabadCorrespondence author: Arifullah, Maj, Email: drarifullah123@gmail.com, Cell: 03202233240

ABSTRACT

Background: The correct treatment and management of scabies is expensive and time-consuming, and may have a negative impact on patients and their families. The aim of the current study was to investigate the effects of permethrin 5% cream on scabies mites, and explore mite survival times outside the human body

Patients and Methods: This was Quasi Experimental Study, carried out the Department of Dermatology, Combined Military Hospital, Abbottabad, Pakistan, from March 2022 to August 2022. A total of 60 scabies mites were taken from 60 patients reporting at OPD during the study period.

A total of 60 petri dishes were divided in to two groups, 30 petri dishes coated with permethrin 5% cream were in the treatment group while 30 plain petri dishes were included in the control group. One scabies mite was placed in each dish. Observation was made at baseline and then 3, 4, 5, 6, 7, 8 and 12 hours from baseline.

Death of the mite was decided when all the leg movements were ceased.

Results: The results of the study showed that after 8 hours 60% of the scabies mites survived in treatment group while 70% survived in control group. After 12 hours, 16.66% of mites in the treatment group and 60% in the control group were survived. (p-value= 0.019)

Practical implication: The purpose of this study was not only to treat the patient but also to take measures to ensure that the prevalence is stopped from individual to individual, as clothes and bed linen also contains the mites and surrounding environment also needs proper management. The aim of our study was to find survival time of scabies mites present in our Pakistani population in vitro to the effects of 5% permethrin cream, which is the most widely used treatment in Pakistan for scabies mites. This will help to advice the patients accordingly for exact application time required for the drug and the time when the mites are actually died.

Conclusion: Based on these results, we suggest that 5% permethrin topical cream needs to be left on body for at least 12 hours before patient wash it off.

Keyword: In Vitro Survival, Scabies, Permethrin, Mal-Nutrition, Immigration, Dementia, Families

INTRODUCTION

Scabies is a common parasitic infestation of the skin which is intensely itching and caused by a mite called *Sarcoptes scabiei* var. *hominis* also previously named *Acarus scabie*. It is spread by living/visiting at overcrowded places and through sexual contacts. Poor hygiene, mal-nutrition, homelessness, immigration and dementia also causes it.⁽¹⁾ Scabies is a global health concern as revealed by data collected from different parts of the world. Approximate prevalence of scabies in Europe is reported as 2%, while approximate number of effected patients globally is about 200 million.⁽²⁾

Treatment must be started early, as if delayed, mites are multiplied daily, progressing from a typical form to an atypical or heavier infestation called crusted scabies. It may become cause of some serious complications like systemic sepsis and post-streptococcal glomerulonephritis due to secondary bacterial infections. This makes the earlier treatment especially important for economically poor nations like Pakistan.^(3,4,5,6)

This parasite is present in skin at the stratum corneum level. The development starts from egg to larva, then protonymph to tritonymph and finally develops as adult mite. There are averagely 10-15 mites at the skin of infected patient that burrows in epidermis. Average of eggs by pregnant females is 2-3 that are added per day at the skin. Incubation time is estimated from 3 to 6 weeks which ends up into manifestation of the symptoms in shape of skin itches that worsen at night. Webs of fingers, wrists, buttocks, genitals, axilla and areola are the preferred places for these mites.⁽⁷⁾

Diagnosis of scabies is usually made on the basis of history and examination. Further confirmation is made by using microscopic identification where mites, its eggs and fecal pellets are visible and can be extruded. On clinical examination nodules, papules and scratch marks are visible. Nodular scabies, crusted scabies and bullous scabies are visible there on the skin.

Dermoscopy helps to assess the mite burrows for scabies present in the skin. A might is visible in a dark brown colored triangular structure and can be easily extracted from its place.

In addition tests that may help includes burrow ink test and video Dermoscopy. Furthermore,

PCR/ELISA, and specific IgE to diagnose major mite components are also utilized.^(7,8,9)

The drugs used in the treatment of scabies are permethrin, ivermectin, crotamiton, benzyl benzoate and lindane.⁽¹⁰⁾

Among these treatments, 5% permethrin is considered most effective and with lesser side effects. Studies have reported its efficacy up to 96.9%.¹¹The efficacy of permethrin is however reported to be decreasing especially in the 3rd world due to resistance.⁽¹²⁾

Permethrin 5% cream is in use since years. The reports in 1994 documented that permethrin killed mites within 1 hour in vitro but in year 2000, 35% mites reported to remain alive even after 3 hours.⁽¹³⁾ Resistance to all scabicides is increasing over the years resulting in possible complications, high health care cost and related social stigmas. Hence the World Health Organization (WHO) has included scabies in the list of tropical diseases which are relatively neglected.⁽¹⁴⁾

The goal of the treatment is not only to treat the patient but also to take measures to ensure that transmission is stopped from individual to individual and from environment, as clothes and bed linen also contains the mites and surrounding environment also needs proper management.

The goal of our study was to find survival time of scabies mites present in our Pakistani population in vitro to the effects of 5% permethrin cream, which is the most widely used treatment in Pakistan for scabies mites.

This will help to advice the patients accordingly for exact application time required for the drug and the time when the mites are actually died.

METHODS

This was a Quasi experimental study conducted at the Department of Dermatology, Combined Military Hospital, Abbottabad, Pakistan, from March 2022 to August 2022.

To find the in vitro survival time of scabies mites, a total of 60 scabies mites were taken from 60 patients reporting at OPD during the study period with complaint of scabies.

Mites were collected manually from the lesions using a sterilized paper pin. Only adult mites were selected and it was ensured that mites don't get any physical damage during transfer from patient to petri dish and their vitality was re checked after transferring to petri dish.

For our the study, a total of 60 petri dishes were divided in to two groups, 30 petri dishes coated with permethrin 5% cream were in the treatment group while 30 plain petri dishes were included in the control group. One scabies mite was placed in each dish. Observation was made at baseline and then 3, 4, 5, 6, 7, 8 and 12 hours from baseline.

Observation was made by dermatologist for each of the petri dish under microscope.

Death was confirmed upon the cease of all leg movements.

During the study, the average room temperature was 25 °C, and the relative humidity was 39%.

All the Data was analyzed by using SPSS version 25. The qualitative variables like in vitro survival of mites were calculated by taking frequency and percentage. Comparison between treatment group and control group was made by Chi-square test. A p-value of ≤ 0.05 was considered as significant.

RESULTS

Age range of the patients from whom the mites were taken for this study was from 18 to 51 years with Mean \pm SD calculated was 30.216 \pm 10.52 years. Duration of disease was from 2 to 6 months

with Mean \pm SD 4.05 \pm 1.39 months. Mean age and duration of disease in treatment group and control group are shown in Table-I.

Table-1: Mean \pm SD of patients according to age and duration of disease in both groups.n=60

Demographics	Treatment Group Mean \pm SD (n=30)	Control Group Mean \pm SD (n=30)
Age (years)	28.52 \pm 10.22	32.24 \pm 11.18
Duration of Disease (months)	3.92 \pm 1.35	4.12 \pm 1.45

Frequency and percentage of both the genders in these two groups are shown in Table II.

Table-2: Frequency and percentage of patients as per gender in both groups. n=60

Gender	Treatment Group n=30 n (%)	Control Group n=30 n (%)
Male	14 (46.66%)	13 (43.33%)
Female	16 (53.33%)	17 (56.66%)
Total	30 (100%)	30 (100%)

Observation taken at 0,3,4,5,6,7,8 hours for survival of mites, there was no significant difference in the number of survived mites between treatment group as after 8 hours 60% of the scabies mites survived in treatment group while 70% survived in control group, however, at observation taken at 12 hours there appeared significant difference between two groups as only 5 mites were survived in treatment group while still 18 mites were survived in the control group. (p-value= 0.019) as shown in Table-III.

Table-3: Mite survival time in vitro, in the permethrin treatment group and the control group (without permethrin). n=60

Time (Hours)	0	3	4	5	6	7	8	12	p-value at 12
Number of mites survived in treatment group n (%)	30 (100)	28 (93.33)	27 (90)	24 (80)	21 (70)	19 (63.33)	18 (60)	5 (16.66)	0.019
Number of mites survived in Control Group n (%)	30 (100)	29 (96.66)	27 (90)	26 (86.66)	26 (86.66)	22 (73.33%)	21 (70)	18 (60)	

DISCUSSION

Scabies is an emerging global health concern. Reports from several countries have shown increased incidence of scabies infestations but more reliable data is still needed. As per revealed from reports, these mites may survive out of the human body for up to 24 to 36 hours. Low temperatures and humidity favors their longer survival.^(15,16) So besides the patient's treatment, it is said that the cloths and bedroom items must be isolated at room temperature for at least 48 hours to ensure killings of these mites.⁽¹⁷⁾

Different therapeutic options for scabies include treatments such as permethrin, ivermectin, crotamiton, benzyl benzoate and lindane. Most of the treatments available are topical modalities. Among these, topical first line treatment with 5% permethrin is most widely used in Pakistan. This is due to fact that 5% permethrin is studied as the most effective treatment with lesser side effects. Permethrin belongs to synthetic parathyroids which act by modulating sodium channels. Permethrin act on the neuronal voltage-sensitive sodium channels, responsible for the generating action potentials in the excitable cells.^(18,19)

Aggarwal G in their single blinded controlled study in 2014 reported in 100 clinically diagnosed cases of scabies that Permethrin proves the efficacy of 89.1% for complete clearing of scabietic lesions at 4 week interval.⁽²⁰⁾

In an in vivo study conducted in 2018, a higher recovery (87.2%) was reported among adults from scabies infestation with permethrin 5% cream, applied once daily for two consecutive days. This was in comparison with a single dose application where recovery was relatively low (61.8%). They also repeated the treatment after 7–10 days.⁽²¹⁾

Akbar N and Iftikhar N reported in a study done in Pakistan in 2016 that 84.5% mites were dead in vitro in the glass slide applied with 5% permethrin for the treatment of ordinary scabies.⁽²²⁾ Khalil S and co-authors mentioned in their review that there are no reported publications which can confirm clinical resistance of permethrin in humans, however, there are anecdotal reports mentioning this concern. They, in their guidelines for treating ordinary scabies suggested applying permethrin once for 8 to 14 hours.⁽¹⁴⁾

Pallesen K. et al reported in their study that 65% of mites survived after 8 hours in the 0.5% permethrin group while 75% of mites survived in the control group after this time. At the observation taken at 12 hours, 25% of mites in the 0.5% permethrin group and 60% of mites in the control group were still alive. It was suggested to apply the cream on the skin for 8 to 12 hours before washing out from the body. They explained the reasons for some treatment failures in shape of inappropriate applications and reinfestation of mites from living environment.⁽²³⁾

The results of our study are also in line with above study done by Pallesen K. et al. In our study planned to find survival time of scabies mite in vitro to the effects of 5% permethrin cream, observation taken at 0,3,4,5,6,7,8 hours there was no significant difference in the number of survived mites between treatment group and control group. However at observation taken at 12 hours there appeared significant difference between two groups as only 5 (16.66%) mites were survived in treatment group while still 18 (60%) mites were survived in the control group. (p-value= 0.019) Based on these results, we suggest that 5% permethrin topical cream needs to be left on body for at least 12 hours before patient wash it off.

In view of all the data discussed above, it is suggested to apply the cream for two consecutive days. Treatment is then to be repeated after 7 days to ensure complete recovery. Moreover, 15% of the mites survived in the treatment group even after 12 hours, so we can estimate that some patients may experience treatment failure even if they have completely followed the treatment guidelines for the use of 5% permethrin cream.

The primary goal of management of scabies mites is also to take all steps to stop transmitting them from environment. The mites do not survive outside the body for longer periods and are killed in next 3 days. So the bedding, clothes and towels under use of patients and family members are advised to be put in plastic bags for next 3-4 days. It is also advised to wash the bedding and clothing under use in hot water up to at least 60°C followed by machine dried.¹⁴

Further studies with in vitro and in vivo environments may help to better guide the patients regarding treatment guidelines.

CONCLUSION

Our study results showed that there is no significant effect on mite survival with 5% topical permethrin after 8 hours, while significant efficacy was observed after 12 hours. Based on these results, we suggest that 5% permethrin topical cream needs to be left on body for at least 12 hours before patient wash it off.

For all the infested items, it is advised to isolate them at least for 3-4 days to ensure complete clearance from the mites.

Acknowledgements: The services of paramedic staff of the department while data collection and filling are acknowledged.

Conflict of Interest: No

REFERENCES

- Hicks MI, Elston DM. Scabies. *Dermatol Ther.* 2009;22:79-92.
- Williams C, Fuller LC. Why does scabies treatment fail? *Br J Dermatol.* 2019; 180: 710–11.
- Heukelbach J, Mazigo HD, Ugbomoiko US. Impact of scabies in resource-poor communities. *Curr Opin Infect Dis.* 2013;26:127-32.
- Hay RJ, Steer AC, Engelman D, Walton S. Scabies in the developing world—its prevalence, complications, and management. *Clin Microbiol Infect.* 2012;18:313-23.
- Le Cleach L, Chosidow O. Commentary on "Interventions for treating scabies". *Evid Based Child Health.* 2011;6:1865-6.
- Christine KC, John R, Steven JS. Scabies surveillance, prevention and control. *Ann Long Term Care.* 2009;17:31-5.
- Chandler DJ, Fuller LC. A review of scabies: an infestation more than skin deep. *Dermatology.* 2018; 13:1–12.
- Micali G, Lacarrubba F, Verzi AE, Nasca MR. Low-cost equipment for diagnosis and management of endemic scabies outbreaks in underserved populations. *Clin Infect Dis.* 2015;60:327-9.
- Leung V, Miller M. Detection of scabies: A systematic review of diagnostic methods. *Can J Infect Dis Med Microbiol.* 2011;22:143-6.
- Le Cleach L, Chosidow O. Commentary on "Interventions for treating scabies". *Evid Based Child Health.* 2011;6:1865-6.
- Ranjesh MR, Naghili B, Goldust M, Rezaee E. The efficacy of permethrin 5% vs. oral ivermectin for the treatment of scabies. *Ann Parasitol.* 2012;59:189-94.
- Lokuge B, Kocczynski A, Woltmann A, Alvoen F, Connors C, Guyula T et al. Crusted scabies in remote Australia, a new way forward: lessons and outcomes from the East Arnhem Scabies Control Program. *Med J Aust.* 2014;200:644-8.
- Walton SF, Myerscough MR, Currie BJ. Studies in vitro on the relative efficacy of current acaricides for *Sarcoptes scabiei* var. *hominis*. *Transactions of the Royal Society of Tropical Medicine and Hygiene.* 2000;94(1):92–6.
- Khalil S, Abbas O, Kibbi AG, Kurban M. Scabies in the age of increasing drug resistance. *PLoS Negl Trop Dis.* 2017 Nov 30;11(11):e0005920.
- Salavastru CM, Chosidow O, Boffa MJ et al. European guideline for the management of scabies. *J Eur Acad Dermatol Venereol* 2017; 31: 1248–53.
- Arlian LG, Runyan RA, Achar S et al. Survival and infectivity of *Sarcoptes scabiei* var. *canis* and var. *hominis*. *J Am Acad Dermatol* 2017; 11: 210–15.
- Arlian LG, Morgan M. A review of *Sarcoptes scabiei*: past, present and future. *Parasit Vectors* 2017; 10: 297.
- Dong K, Du Y, Rinkevich F, Nomura Y, Xu P, Wang L et al. Molecular biology of insect sodium channels and pyrethroid resistance. *Insect Biochem Mol Biol.* 2014;50:1-17.
- Fischer K, Holt D, Currie B, Kemp D. Scabies: Important clinical consequences explained by new molecular studies. *Adv Parasitol.* 2012;79:339-73.
- Aggarwal G, Rathore PK. Comparative study to test efficacy of topical permethrin and oral ivermectin in the management of scabies—a prospective randomized, single blinded controlled study. *Nat J Integ Res Med.* 2014;5:57-60.
- Veraldi S, De Micheli P, Schianchi R et al. A new treatment regimen with permethrin in scabies. *G Ital Dermatol Venereol.* 2018; 153: 491–3.
- Akbar N, Iftikhar N. Comparison of in vitro susceptibility of *Sarcoptes scabiei* var. *hominis* to topical 5% permethrin and topical 1% ivermectin. *J of Pak Assoc of Dermatol.* 2016;26 (2):99-106.
- Pallesen K, Lassen JA, Munk NT, Hartmeyer GN, Hvid L, Bygum A. In vitro survival of scabies mites. *Clin Exp Dermatol.* 2020 Aug;45(6):712-715.