

Efficacy of Tissue Tolerable Plasma (TTP) against *Ixodes ricinus*

Wirksamkeit von Tissue Tolerable Plasma (TTP) gegen *Ixodes ricinus*

Abstract

The efficacy of Tissue Tolerable Plasma (TTP) against ticks was tested, as data from the literature has demonstrated its efficacy against other acari.

The study was carried out by using the KINPen09 (Argon as carrier gas) on *Ixodes ricinus* (n=24).

Treatment times of 1 and 3 minutes led to a reversible inactivation of the ticks. After 5 min of treatment, they died.

Thanks to the acaricidal effect of TPP, a new treatment strategy using the KINPen09 for tick-infested pets is now available.

Keywords: Tissue Tolerable Plasma, TTP, argon plasma, KINPen09, acaricidal efficacy

Claudia Bender¹
Axel Kramer¹

1 Institute of Hygiene and
Environmental Medicine,
University Medicine,
Greifswald, Germany

Zusammenfassung

Da Tissue Tolerable Plasma (TTP) gegen bestimmte Milbenarten wirksam ist, sollte die Wirksamkeit gegen Zecken untersucht werden.

Die Untersuchungen wurden mit dem KINPen09 (Trägergas Argon) an *Ixodes ricinus* (n=24) durchgeführt.

Behandlungszeiten von 1 und 3 min führten zu einer reversiblen Inaktivierung. Nach 5 min waren die Zecken irreversibel abgetötet.

Auf Grund der acariziden Wirkung von TTP eröffnet sich eine neue Behandlungsstrategie für von Zecken befallene Haustiere mit dem KINPen09.

Schlüsselwörter: Tissue Tolerable Plasma, TTP, Argonplasma, KINPen09, acarizide Wirkung

Introduction

It was shown that Tissue Tolerable Plasma (TTP) generated by the KINPen09 was able to inactivate and/or kill the human-relevant parasite *Demodex follicularum*, which belongs to the subclass of acari [1]. Therefore, testing the efficacy of TTP against ticks on their main representative *Ixodes ricinus* is justifiable, because ticks are characterized by their broad range of hosts and they are responsible for the transmission of several infectious diseases, such as the animal and human pathogens causing Lyme disease, ehrlichiosis, and babesiosis. The inactivation of ticks by plasma is convenient, where mechanical removal is often problematic in cases of difficult access to certain anatomic structures, e.g., the auditory canal or interdigital space of dogs or cats, or if the tick is too small to be pulled out with tweezers etc. In the latter case, one should not wait for the tick to enlarge by aspiring enough to blood to be seized, because it is likely that the transmission of pathogens increases with time.

Materials and methods

For the study, 24 vital sheep ticks (*Ixodes ricinus*) in different stages of aspiration were mechanically removed from cats and dogs by twisting the ticks out after fixation with plastic forceps.

The KINPen09 was used as the plasma source [2]. The argon (Ar) gas flow was set to 5 slm (standard liters per minute). The application times were 1 min, 3 min and 5 min. To apply the plasma, the visible tip of the plasma jet was placed at the tick's chelicerae (mouthparts).

The observation period for all ticks was 5–7 days. The endpoint of observation was determined as fetor of beginning decay or visible shrinkage as a sign of desiccation. Both criteria were considered as signs of the tick's death.

Results

A treatment time of 1 min led to a reversible inactivation of the ticks (n=6). After initial immobilization, however, the ticks resumed motility after 0.5 to 5 h. A post-treatment of another 3 min led to a constant immobilized state.

An initial treatment time of 3 min led to persistent inactivation for some of the ticks (n=5). However, other ticks (n=4) became mobile again within 24 h.

A treatment time of 5 min led to persistent inactivation of all ticks (n=9) within the observation period.

Discussion

With the KINPen09, an irreversible inactivation of *Ixodes ricinus* was reached with a treatment time of 5 min. Even if the host's adjacent skin is accidentally exposed to the plasma, there is no risk of damage, because the much more sensitive chorioallantois membrane of a fertilized, incubated chicken egg tolerates the same plasma source up to 40 s [3], [4]. Furthermore, the treatment of chronic wounds with the KINPen09 [5], [6] has been shown to be successful until complete healing is attained, without any side effects [7].

Conclusion

The results demonstrate the acaricidal effect of plasma and introduce a whole new treatment strategy for tick-infested pets.

Notes

Competing interests

The authors declare that they have no competing interests.

Acknowledgements

This work was realized within the framework of the multidisciplinary research cooperation "Campus PlasmaMed", particularly within the project "PlasmaDent". The authors acknowledge that this work was supported by a grant from the German Ministry of Education and Research (BMBF, grant no. 13N9779).

References

1. Daeschlein G, Scholz S, Arnold A, von Woedtke T, Kindel E, Niggemeier M, Weltmann KD, Jünger M. In vitro activity of atmospheric pressure plasma jet (appj) plasma against clinical isolates of demodex folliculorum. *IEEE Trans Plasma Sci.* 2010;38(10):2969-73. DOI: 10.1109/TPS.2010.2061870

2. Weltmann KD, Kindel E, Brandenburg R, Meyer C, Bussiahn R, Wilke C, von Woedtke T. Atmospheric pressure plasma jet for medical therapy: plasma parameters and risk estimation. *Contrib Plasma Phys.* 2009 Nov;49(9):631-40. DOI: 10.1002/ctpp.200910067
3. Bender C, Matthes R, Kindel E, Kramer A, Lademann J, Weltmann KD, Eisenbeiß W, Hübner NO. The irritation potential of nonthermal atmospheric pressure plasma in the HET-CAM. *Plasma Process Polym.* 2010 Mar 22;7(3-4):318-26. DOI: 10.1002/ppap.200900119
4. Bender C, Partecke LI, Kindel E, Döring F, Lademann J, Heidecke CD, Kramer A, Hübner NO. The modified HET-CAM as a model for the assessment of the inflammatory response to tissue tolerable plasma. *Toxicol In Vitro.* 2011 Mar;25(2):530-7. DOI: 10.1016/j.tiv.2010.11.012.
5. Kramer A, Bender C, Assadian O, Ekkernkamp A, Hartmann B, Heidecke CD, Hinz P, Koban I, Masur K, Matthes R, Metelmann HR, Partecke LI, Reuter S, Sckell A, Weltmann KD, Lademann J. Physikalisches kaltes Atmosphärendruckplasma als aussichtsreiche Option zur Behandlung chronischer Wunden. *Hyg Med.* 2013;38(5):186–91.
6. Kramer A, Lademann J, Bender C, Sckell A, Hartmann B, Münch S, Hinz P, Ekkernkamp A, Matthes R, Koban I, Partecke LI, Heidecke CD, Masur K, Reuter S, Weltmann KD, Koch S, Assadian O. Suitability of tissue tolerable plasmas (TTP) for the management of chronic wounds. *Clin Plasma Med.* 2013 Jun; 1(1):11–8. DOI: 10.1016/j.cpm.2013.03.002
7. Bender C, Hübner NO, Weltmann KD, Scharf C, Kramer A. Tissue tolerable plasma and polihexanide: Are synergistic effects possible to promote healing of chronic wounds? In vivo and in vitro results. In: Machala Z, Hendsel K, Akishev Y, editors. *Plasma for Bio-Decontamination, Medicine and Food Security.* Dordrecht: Springer; 2012. p. 312-34. (NATO Science for Peace and Security Series – A: Chemistry and Biology). DOI: 10.1007/978-94-007-2852-3_25

Corresponding author:

Dr. rer. med. Claudia Bender
Institute of Hygiene and Environmental Medicine,
University Medicine Greifswald, Walther-Rathenau-Str.
49 a, 17489 Greifswald, Germany, Phone:
+49-(0)3834-515542, Fax: +49-(0)3834-515541
bender@tierarztpraxis-karrin.de

Please cite as

Bender C, Kramer A. Efficacy of Tissue Tolerable Plasma (TTP) against *Ixodes ricinus*. *GMS Hyg Infect Control.* 2014;9(1):Doc04. DOI: 10.3205/dgkh000224, URN: urn:nbn:de:0183-dgkh0002246

This article is freely available from

<http://www.egms.de/en/journals/dgkh/2014-9/dgkh000224.shtml>

Published: 2014-03-07

Copyright

©2014 Bender et al. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by-nc-nd/3.0/deed.en>). You are free: to Share – to copy, distribute and transmit the work, provided the original author and source are credited.