ORIGINAL ARTICLE

Effect of Turmeric on Mosquito Coil Induced Emphysema in Rat Lungs

Saira Jawed,[1] Rehana Rana,[2] Shazia Muazzum,[3] Sabiha Muhummad Haq[4]

ABSTRACT

Objective: To determine the preventive effect of turmeric on mosquito coil smoke induced emphysema in rat lungs.

Study Design: Randomized control trial.

Place and Duration of Study: The study was completed in six months duration in the department of Anatomy, Islamic International Medical College, Rawalpindi, in collaboration with National Institute of Health (NIH), Islamabad.

Materials & Methods: Twenty one adult male albino rats were divided into 3 equal groups. Control group X was kept in fresh air. Experimental Group M was exposed to Mosquito Coil smoke for eight weeks. Group T received oral turmeric 300mg/kg body weight and had a coil smoke exposure as well. All rats were dissected after 8 weeks and lung tissue was examined microscopically. The statistical significance of the results was calculated by applying Pearson chi square test and the obtained results were compared statistically.

Results: Marked emphysema was observed in the histological sections of rat lungs from experimental group M showing alveolar septal destruction and bullae formation in the lung tissues of all animals (100%) in group M. Emphysema was present in 1 out of 7 rats in group T thus group T showed a significant protection with only 15% of animals with emphysematous lungs.

Conclusions: Mosquito coil causes emphysema in the lung tissue and turmeric proves to be protective against this damage.

Key Words: *Turmeric, pulmonary emphysema, smoke*.

Introduction

"He who has health has hope and he who has hope has everything." But a tiny creature, named "mosquito" has always been spreading life threatening diseases like malaria and dengue fever specially in tropical and subtropical countries,[1] a major public health concern and a great hindrance to the socioeconomic development for the developing nations.[2] In the endeavor to protect himself, man has invented various means for protecting against mosquitoes. Repellency is a characteristic of the personal protection chemicals.[3] Mosquito coil repellents are widely used in domestic households to combat mosquito menace.[1,4] They are known to be an efficient mosquito repellent, are inexpensive and easy to use but produce smoke[3]. Coils being cheap are widely used in Asia. In 1996, WHO reported that the annual worldwide consumption of mosquito coils is estimated to be 29 billion pieces[4] and pollutant concentration from their emission is greater than the WHO standards.[5] They are burnt in closed rooms and are kept near the sleeping place to keep the mosquitoes at bay. Coils although effective against mosquitoes, cause indoor air pollution and users are exposed to them usually for the whole night (approximately 8 hours) and for several months every year[1], badly affecting various human organs like liver, testis and kidneys[6] specifically lungs and become a cause of debilitating respiratory disorders. Lung damage, even cancer has been shown to occur by exposure to the coil smoke. Studies have revealed that long term exposure to the coil smoke can induce asthma and persistent wheeze in children[7] and is

[1,4]*Department of Anatomy*
HBS Medical & Dental College, Islamabad
[2]*Department of Anatomy*
Islamic International Medical College
Riphah International University, Islamabad
[3]*Department of Anatomy*
Rawal Institute of Health Sciences, Islamabad
Correspondence:
Dr. Saira Jawed
Assistant Professor
Department of Anatomy
HBS Medical & Dental College, Islamabad
E-mail: sairajawed371@gmail.com
Funding Source: NIL; Conflict of Interest: NIL
Received: March 21, 2017; Revised: August 06, 2018
Accepted: September 02, 2018

teratogenic[8] most severe poisoning has been reported in infants. A chemical barrier is created by the airborne insecticide particles present inside and around the houses that prevents mosquitoes from entering. Coils that contain pyrethrins deter almost 45% to 80% mosquitoes and reduce their biting rat.[3] Burning the mosquito coil causes evaporation of insecticide and a large amount of sub micrometer particles and gaseous pollutants are released which reach the lower respiratory tract.[2] Release of particulate matter by burning 75-137 cigarettes equals that of burning one mosquito coil. Emission of formaldehyde from burning one coil is estimated to be as high as burning 51 cigarettes.[9]

Nature has always been kind and rightly labelled as a great physician and turmeric is a nature's gift for health. Curcumin(3-4%)[10] is the main bioactive component of turmeric. Turmeric holds a place of honor in traditional medicine of subcontinent for decades. It has been used as a food additive for centuries in Asia. Besides being the kitchen queen, it has been a center of attraction as a digestive aid, treatment for fever, inflammation, wounds, and infections as well as a remedy of various ailments including blood disorders. Thus it is a traditional herbal medicine.[11] In the present days, curcumin is proved to be a potent anti-inflammatory and anti-microbial agent.[12]

Certain studies have proved that curcumin has preventive effects against the tracheal responsiveness and lung pathology in asthmatic rats[13] ventilator-induced[14] and acute lung injury in rats.[15] An extensive literature search reveals that the local and international literature lacks in research with the same setup which could prove the effects of turmeric for prevention against histological alterations (damage) in lungs with allethrin based pyrethroids. Hence the study was conducted with the objective of determining the preventive effect of turmeric on mosquito coil smoke induced emphysema in rat lungs.

Material and Method

The randomized controlled experimental study was carried out in 6 months duration in the department of Anatomy, Islamic International Medical College, Rawalpindi, in collaboration with National Institute of Health (NIH), Islamabad, after an ethical approval from the Institutional Review Committee of Riphah International University. A total of 21 albino rats (*Sprague Dawley*), all healthy adult males weighing 250-300g were used for this study. Rats were purchased from the animal house of National Institute of Health (NIH) Islamabad. They were kept in a well ventilated room and were allowed to acclimatize for a week. The animals were kept in smoke exposure chambers at a temperature of 27±3ºC with a 12hr light/dark cycle with access to drinking water and standard laboratory diet *ad libitum.* They were exposed to mosquito coil smoke for 7 hours per day for 8 weeks. Animals were randomly divided into three groups and were kept in the same environmental conditions and received identical care. Group T was taken as control group. Experimental Group M was exposed to Mosquito Coil smoke for eight weeks. Group T received oral turmeric 300mg/kg body weight (through gastric gavage needle) and had a coil smoke exposure as well. All rats were sacrificed at the end of 8 weeks and left lungs were dissected out and preserved in the containers containing 10% formalin. Tissue processing and embedding was done in paraffin. Slides were prepared and stained with hematoxylin and eosin. Microscopic study was done first at low power, x10, and then at high power, x40 objective. Slides were studied for presence or absence of emphysema. Bullae formation and destruction of alveolar septa was taken as a criteria to label emphysema. The data obtained as presence or absence of emphysema in each rat was coded and entered in SPSS for analysis applying a Pearson Chi-Square test. P-value of <0.05 was taken as significant.

Results

The alveoli of the control group X showed normal honey comb like structure with well-formed alveolar wall. In experimental group T, which received turmeric along with inhalation of coil smoke, emphysema developed in only one rat; 6 out of 7 rats remained protected against the damaging effect of coil smoke in group T (fig 1A). Lung tissue of all the animals in group M, which received only coil smoke showed emphysema with alveolar septal destruction and bullae formation (figure 1B). Statistical analysis was performed by using SPSS version 21. Emphysema was taken as a dependent dichotomous nominal variable whereas coil smoke and curcumin were independent variables. Pearson chi square test

was applied. The data was entered by coding the presence and absence of emphysema. The statistical significance for the observed results was compared between the two experimental groups. Results showed alveolar septal destruction and emphysema with bullae formation in the lung tissues of all animals (100%) in group M (Fig 2). Emphysema was absent in 6 out of 7 rats in group T; thus group T showed a significant protection with only 15% of animals with emphysematous lungs. The difference was statistically significant with a p value of 0.000 that is <0.05. Difference of results can clearly be observed in graph (fig 2).

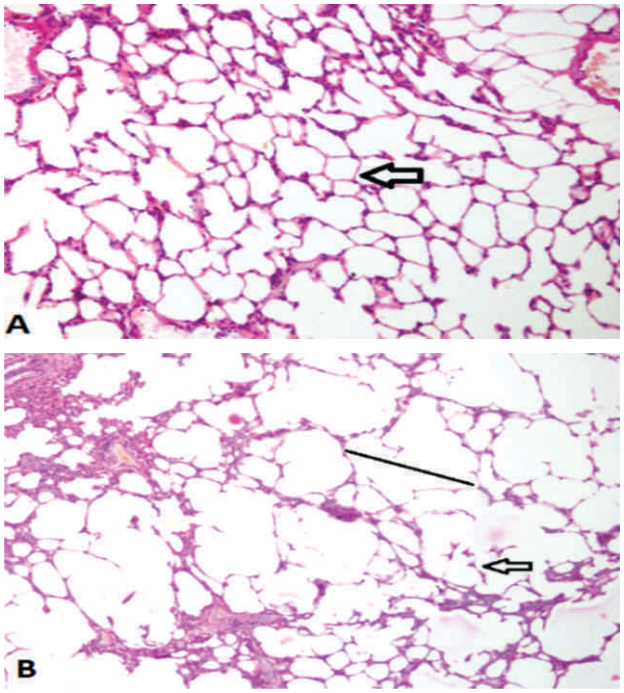

Fig 1: (A) lung of rat in Group T showing preserved alveolar structure having honey comb appearance (arrow). (B) lung of rat in group M showing destroyed alveoli (arrow) and increased alveolar space or emphysema (double arrow).

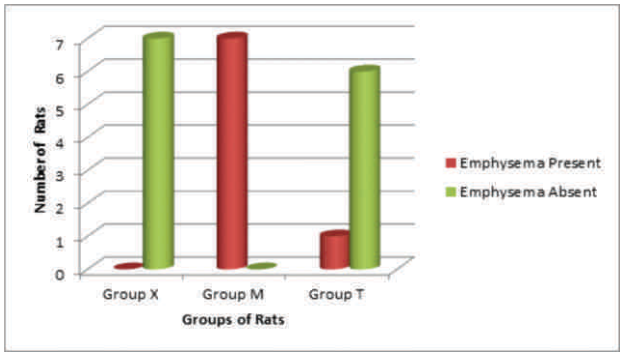

Fig 2: Graph showing frequency of emphysematous change in group X, M and T

Discussion

Emphysema is an abnormal, persistent expansion of the respiratory portion of the lung, distal to the terminal bronchioles resulting from tissue destruction.[16,17] In the lungs of all (100%) rats in group M, alveolar wall destruction and foci of collapsed alveoli with subsequent dilatation of contiguous alveolar spaces and formation of large irregular spaces (emphysematous change) was seen. Pathogenesis of emphysema involves imbalance between elastase and anti-elastases and an imbalance between oxidants (free radicals) and antioxidants. Elastase and oxidants are derived from neutrophils and macrophage[18] which were widespread in the rats of group M. The finding can be attributed to the injury of lung tissue by oxidants released by smoke exposure. Cigarette smoke is chemotactic to neutrophils and macrophages[18] elastolytic and proteolytic enzymes, released by macrophages, have destructive effects on lung airways.[19,20] Same phenomenon may be implied in mosquito coil smoke exposure because the burning of coil releases similar chemicals in even higher concentration as compared to cigarette smoke.[9] Emphysematous change has also been observed by Franks in a smoke related study.[21] After an exposure period of 16 weeks, smoke induced emphysema has also been observed in the lungs of rats by Ji-Hyun Lee in a study done in South Korea.[22] Pulmonary emphysema has also been induced by cigarette smoke in an experimental study on rats conducted in Canada to evaluate the role of neutrophils and macrophage released elastolytic enzymes in the progression of emphysema.[23] A recent study shows deranged lung function parameters in school children due to pyrethroid exposure.[24] Emphysema has also been observed in mice after an exposure to coil smoke for 120 days[25] while in our study the histological alterations have been observed in rats in a 40 days exposure period.

A recent study has proved that Curcumin has preventive effects against the tracheal responsiveness and lung pathology in asthmatic rats.[13] It has also shown its efficacy during ventilator-induced lung injury in rats by inhibiting the oxidative stress and inflammatory response.[14] A study proves that if the chemical stability of curcumin is improved than it shows incredible property of preventing the

acute lung injury in rats.[15] However, literature lacks in proving the protective effects of turmeric against the lung injury induced by allethrin based coil smoke. Group T had remarkable preservation of lung tissue in which only 15% of animals showed emphysematous change. Turmeric has shown to prevent the emphysematous changes induced by cigarette smoke.[23] Turmeric contains curcuminoids which are antioxidant and therefore can protect against the development of emphysema. As a potent immunomodulatory agent it can attenuate the activation of T cells, B cells, macrophages, neutrophils and natural killer cells.[26] and thus the tissue destructing enzymes released by these cells. It also affects the release of inflammatory cytokines.[27],therefore, can possibly protect the lung tissue from the histological alterations induced by coil smoke in the rat lungs.

Inhaling toxic chemicals daily is inevitable these days especially in the underdeveloped countries, where combustion of biomass and synthetic materials like mosquito coils are used as the main mode of prevention from the mosquitoes because of the fear of contracting lethal diseases like dengue fever and malaria. Turmeric supplementation in the diet could possibly protect lungs against environmental pollutants especially pyrethroids.

Because of the limited duration, effect of prolonged exposure of pyrethroids on lungs and the preventive effects of turmeric on other body organs could not be studied. Further human based studies of prolonged duration are recommended.

Conclusion

The present study clearly demonstrates that mosquito coil smoke adversely affects the lungs and induces histological damage causing emphysema and turmeric prevents it.

Therefore alternative ways like nets and herbal products should be used to protect oneself from mosquitoes. Exposure to the toxic repelling agents should be avoided by human population. Turmeric has protective properties and saves the lung tissue from toxic effects of pyrethroids and can be used as a dietary supplement for preventing against environmental pollutants.

REFERENCES

1. Phal DA. A comparative study of elemental analysis in mosquito repellent coil and cigarette smoke. Int J Pharm Biol Sci. 2011;1(4):462–7.
2. Deepa VK, Premarajan KC, Kar SS. Pattern, costs and socio-demographic determinants of personal protection measures against mosquitoes in rural and urban communities of Trivandrum district of Kerala. Age (Omaha). 2012;410(419):829.
3. Ogoma SB, Moore SJ, Maia MF. A systematic review of mosquito coils and passive emanators: Defining recommendations for spatial repellency testing methodologies. Parasites and Vectors. 2012;5(1):287.
4. Shu-Chen C, Ruey-Hong W, Li-Jie S, Ming-Chih C, Huei L. Exposure to mosquito coil smoke may be a risk factor for lung cancer in Taiwan. J Epidemiol. 2008;18(1):19–25.
5. Wang L, Zheng X, Stevanovic S, Xiang Z, Liu J, Shi H, et al. Characterizing pollutant emissions from mosquito repellents incenses and implications in risk assessment of human health. Chemosphere [Internet]. 2018;191:962–70. Available from: http://www.sciencedirect.com/science/article/pii/S0045653517315138
6. Taiwo VO, Nwagbara ND, Suleiman R, Angbashim JE, Zarma MJ. Clinical signs and organ pathology in rats exposed to graded doses of pyrethroids-containing mosquito coil smoke and aerosolized insecticidal sprays. African J Biomed Res. 2008;11(1):97–104.
7. Tarasub N, Tarasub C, Ayutthaya WDN. Protective role of curcumin on cadmium-induced nephrotoxicity in rats. J Environ Chem Ecotoxicol. 2011;3(2):17–24.
8. Upadhyay J, Rana M, Juyal V, Rana A, Bisht SS. Effect of pesticide exposure on the Female Rats and their pups throughout their Gestation Period. Res J Pharm Technol. 2017;10(8):2535–7.
9. Liu W, Zhang J, Hashim JH, Jalaludin J, Hashim Z, Goldstein BD. Mosquito coil emissions and health implications. Environ Health Perspect. 2003;111(12):1454.
10. Niazi JU, Poonia P, Gupta V, Kaur N. Pharmacotherapeutics of curcuma longa-A potent patent. IJPPR. 2010;1:24–30.
11. Lal J. Turmeric, curcumin and our life: a review. Bull Env Pharmacol Life Sci. 2012;1(7):11–7.
12. Sakurai R, Li Y, Torday JS, Rehan VK. Curcumin augments lung maturation, preventing neonatal lung injury by inhibiting TGF-β signaling. Am J Physiol - Lung Cell Mol Physiol [Internet]. 2011;301(5):L721--L730. Available from: http://ajplung.physiology.org/content/301/5/L721
13. Shakeri F, Roshan NM, Kaveh M, Eftekhar N, Boskabady MH. Curcumin affects tracheal responsiveness and lung pathology in asthmatic rats. Pharmacol Reports [Internet]. 2018; Available from: http://www.sciencedirect.com/science/article/pii/S1734114018300021
14. Wang X, An X, Wang X, Bao C, Li J, Yang D, et al. Curcumin ameliorated ventilator-induced lung injury in rats. Biomed Pharmacother [Internet]. 2018;98:754–61. Available from: http://www.sciencedirect.com/science/article/pii/S0753332217351466
15. Zhang Y, Liang D, Dong L, Ge X, Xu F, Chen W, et al. Anti-inflammatory effects of novel curcumin analogs in experimental acute lung injury. Respir Res [Internet]. 2015 Mar;16(1):43. Available from: https://doi.org/10.1186

/s12931-015-0199-1

16. Riede U-N, Werner M. Color Atlas of Pathology: Pathologic Principles, Associated Diseases, Sequelae. Thieme; 2004.
17. Klatt EC. Robbins and Cotran Atlas of Pathology [Internet]. Elsevier Saunders; 2015. (Robbins Pathology Series). Available from: https://books.google.com.pk/books?id=K_ptBgAAQBAJ
18. Goljan EF. Rapid Review Pathology [Internet]. Elsevier; 2018. (Rapid Review Series). Available from: https://books.google.com.pk/books?id=qlQatAEACAAJ
19. Taraseviciene-Stewart L, Voelkel NF. Molecular pathogenesis of emphysema. Vol. 118, The Journal of Clinical Investigation. 2008. p. 394–402.
20. Strate BWA Van Der, Postma DS, Brandsma C, Melgert BN, Luinge MA, Geerlings M, et al. Cigarette Smoke – induced Emphysema A Role for the B Cell ? (16).
21. Franks TJ, Galvin JR. Smoking-related "interstitial" lung disease. Arch Pathol Lab Med. 2014;139(8):974–7.
22. Lee J-H, Lee D-S, Kim E-K, Choe K-H, Oh Y-M, Shim T-S, et al. Simvastatin inhibits cigarette smoking--induced emphysema and pulmonary hypertension in rat lungs. Am J Respir Crit Care Med. 2005;172(8):987–93.
23. Ofulue AF, Ko M, Abboud RT. Time course of neutrophil and macrophage elastinolytic activities in cigarette smoke-induced emphysema. Am J Physiol - Lung Cell Mol Physiol [Internet]. 1998;275(6):L1134--L1144. Available from: http://ajplung.physiology.org/content/275/6/L1134
24. Rathore P, Sheikh S, Ruqaya, Lathiya N. Effect of insecticides (pyrethroids) on lung function parameters in school children. Pakistan J Physiol [Internet]. 2017 Mar 31;13(1 SE-Original Article). Available from: http://www.pjp.pps.org.pk/index.php/PJP/article/view/261
25. Abdulla Al-Mamun M, Ataur Rahman M, Habibur Rahman M, Hoque KMF, Ferdousi Z, Matin MN, et al. Biochemical and histological alterations induced by the smoke of allethrin based mosquito coil on mice model. BMC Clin Pathol [Internet]. 2017 Aug;17(1):19. Available from: https://doi.org/10.1186/s12907-017-0057-9
26. Moghaddam SJ, Barta P, Mirabolfathinejad SG, Ammar-Aouchiche Z, Garza NT, Vo TT, et al. Curcumin inhibits COPD-like airway inflammation and lung cancer progression in mice. Carcinogenesis. 2009;30(11):1949–56.
27. Sciberras JN, Galloway SDR, Fenech A, Grech G, Farrugia C, Duca D, et al. The effect of turmeric (Curcumin) supplementation on cytokine and inflammatory marker responses following 2 hours of endurance cycling. J Int Soc Sports Nutr. 2015;12(1):5.