Study of Influencing Effects of UV on the Lung After Infected with Bacteria Pseudomonas Aeruginosa

Zuhoor Abd Al-latif[1*], Qahtan Abdulqader[2], Bassim Abdullah Jassim[3]

Abstract

Ultraviolet radiation has many uses in the field of medicine and treatment, so it has been identified as an important factor in treating or reducing the severity of bacterial infection. The ultraviolet rays have effect on the mice infected with the bacteria Pseudomonas aeruginosa, and how the rays worked on killing the bacteria. The study focused on the tissue structures of lung, after treated with the UV. It's caused acute defects in tissue structures of lung, of treated white mail mice. After the end of experimental period, the blood samples collecting, then the animals sacrificed for histological study, The current result showed normal alveolar wall with prominent epithelial layer that lining the inner surface of alveoli, the result noted prominent bloody congestions between of alveoli, most tissue sections of lung were normally after treated, but noted some lesions of emphysema The tissue section of lung in this group appeared the positive role of UV rays in treated the pathological lesions the result noted the lung parenchyma was normal in structure except some of blood congestion in different location of lung parenchyma, the figure showed little infiltration cells which situated between the lesions of blood congestions these results have better histological structures compared with infected group, but something similar to control group.

Key Words: Ultraviolet Light, Lung, Mice Animals, Pseudomonas Aeruginosa.

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Introduction

UV light has a wavelength of 100 to 400 nm and belongs to the electromagnetic spectrum between visible light and x-rays. The sun, lasers, tanning beds, and a variety of medical tools, such as dental polymerizing equipment, are all sources of UV radiation. UV radiation is used to control infection in medical operating rooms. UV light is used to sanitize operating rooms and surgical tools, lowering the risk of surgical wound contamination and infection after surgery (Kodoth and Jones, 2015).

UV radiation is one of the most harmful abiotic factors for microbes at both the community and cellular levels, influencing microbial diversity and community structure dynamics, as well as damaging non-essential macromolecules like lipids, DNA, and proteins. Bacteria, particularly extremophiles that live in harsh environments and are constantly exposed to harmful UV radiation, have evolved various strategies to cope with UV stress, relying primarily on efficient DNA repair mechanisms and/or active defense against UV-induced oxidative stress, and as a result, their proteome must be tightly regulated. (Pérez *et al.*, 2017).

UVC light has long been known to be extremely germicidal, but it has yet to be fully explored as an infection therapeutic. The potential of UVC light for infection prevention in severely contaminated superficial cutaneous wounds was examined in this study.

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In vitro investigations showed that the dangerous bacteria Pseudomonas aeruginosa and Staphylococcus aureus were inactivated at UVC light exposures far lower than those required to inactivate mammalian keratinocytes (Dai *et al.*, 2012). Pseudomonas aeruginosa is the most pathogenic strain of the pseudomonas genus in humans (Daneshvar *et al.*, 2018).

Pseudomonas aeruginosa is a Gram-negative opportunistic bacteria that produces a wide range of virulence factors and causes devastating infections in trauma and burn patients. We previously demonstrated that P. aeruginosa development in blood from badly burned or trauma patients changed the expression of a number of genes (Beasley *et al.*, 2020). The mouse is an excellent model organism for studying human infectious illnesses. Despite certain differences, mice and humans have similar immune systems and are frequently exposed to the same or similar infections (Buer and Balling, 2003). Furthermore, mouse models offer the benefit of utilizing animals that are affordable to purchase and keep, allowing for the conduct of experiments with sufficient sample sizes to provide statistically significant results (Dai *et al.*, 2012).

The germicidal efficacy of far UVC light was tested by exposing bacteria to the light on a surface or in suspension. A key route for influenza transmission. Aerosol transmission is how a virus spreads.(Arora, Murar and Dhumale, 2015). UV light (200–400 nm), which accounts for a significant portion of solar energy, is separated into three sub-groups based on wavelengths. UVA (400–320 nm), UVB (320–290 nm), and UVC (290–200 nm) are the three wavelengths. The acute consequences of UV radiation in humans include sunburn, photosensitivity responses, and immunosuppression (Altinaş *et al.*, 2007). Mice are an excellent model organism for studying human infectious illnesses. Despite certain differences, mice and humans have similar immune systems and are frequently exposed to the same or similar infections. 1 The mouse is an excellent model for the study of human infectious disease, we argue in this review (Buer and Balling, 2003). Chronic infections, on the other hand, can last for years within the host, as in chronic cystic fibrosis lung infections.

Aim of Study

To determined the positive role of UV rays in treated the bacterial infection.

Material and Method

White mice with a lifespan of 2 to 3 months and a weight of 25 to 30 grams were used in this investigation. These healthy mice were created at the University of Muthanna's sciences college. These mice were kept in plastic cages with metal lids with dimensions of (21x31x31 cm), which were placed to maintain good hygiene. Throughout the experiment, the temperature of the environment, as well as the temperature of the animals, stayed at 28 degrees Celsius in both the control and ultraviolet radiation exposure groups. Sawdust was replenished weekly, and the animals were fed protein, soybeam, com, and wheat at 10%, 20%, and 20%, respectively. Water was available to us during the experiment.

Experimental Design

Forty male white mice which divided male white mice which divided in to four groups (A,B,C,D) each group composed of ten animals, A group consider as Negative control. B group as positive control, which infected with bacteria only, while the last two groups (C,D) as treated groups by UV rays after infected with Bacteria (figure 1).

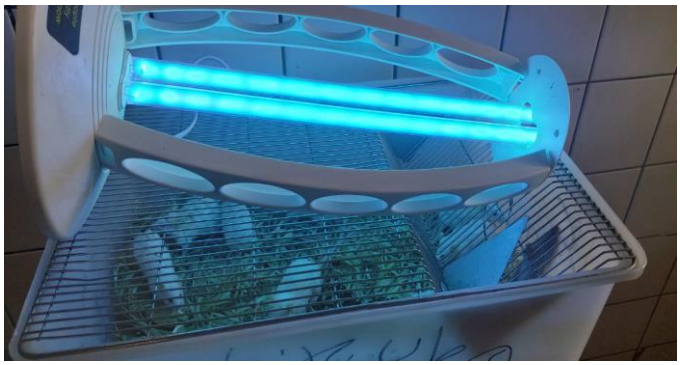

Figure 1. Experimental animals that exposure to UV rays radiation

Preparation of Histological Slide

The tissues samples.. fixed in formalin solution for 48 h. after that dehydrated the

Samples in graduated levels of ethanol, cleared in xylene, and embedded in. paraffin wax for cutting, the tissue section. have 5-µm in thickness, placed on glass slides, and stained with. Hematoxylin and eosin stain for light microscopic Examination (Luna, G. (1968)).

Preparation of Bacteria

In college of science, and purified and tested with the help of the microbiology lab Nine test tubes were prepared by putting 9ml of distilled water for with each the help of a syringe, we drew 1ml of pure bacteria and put it in the first tube of the nine tubes to carry out the dilution process. A stock solution of (10^{-1}) concentration were prepared Then we drew 1ml from the first test tube (10-1) and put it in the second tube and write (10^{-2}) on it, and so the process is pseudomonas auroginosa bacteria were prepared by collecting samples from infected people repeated until we get (10^{-9}), and with this we get the dilution. The diluted bacteria with 10^{-4} was prepared.

Results and Discussion

The results of the control group noted the tissue section of the lung has pneumocyte with irregular nuclei. The lung has different branches of the bronchial tree line by respiratory epithelia. The result of the lung appeared to have elastic fibers distributed between the different branches of the bronchial tree. The lower branches of bronchial tree-lined by different types of epithelia started with simple cuboidal epithelia, and in lower branches of the bronchial tree have simple squamous epithelia, (Fig. 2).

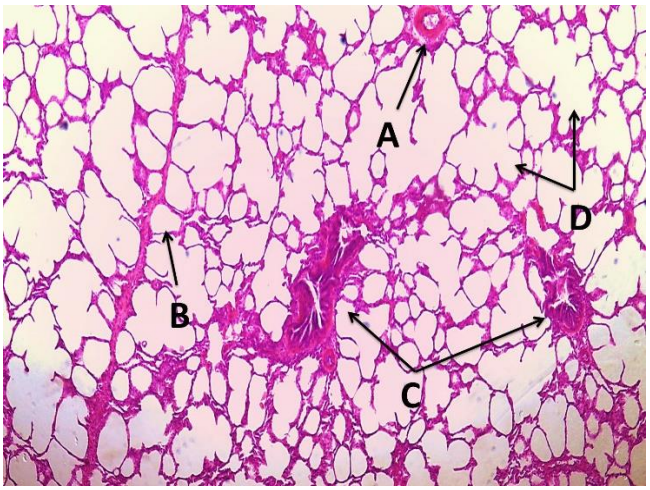

Figure 2. Cross section of lung in the control group showed: A- blood vessel, B-alveoli, C- parts of bronchial tree, D-alveolar sac. H&E stain X 20

The tissue result of lung after infected with bacteria, Showed sever hemorrhage and blood congestions among the lung parenchyma so noted cystic dilation filled with blood, abnormal inflammatory cells have wide distributed among the lung parenchyma. Most alveoli were abnormal in shape and have prominent degeneration in their wall, most alveoli were filled with fluid and other alveoli fill with blood, the lung parenchyma have wide elongated cysts filled with blood, the main blood vessels were sever congested with blood, so the results showed completely alveolar distraction in many regions of lung parenchyma (Figure 3). The pathological role of bacteria which lead to these histological changes which appeared as prominent lesions in different location of lung. These results were maybe because of the high virulence of infected bacteria, the results were agreement with (Skerrett *et al.*, 2007) which noted the pathogen lead to Cystic Fibrosis (CF) in patients. These results agreement with (Alhazmi, 2015), which referred to the main tissue changes because of Pseudomonas aeruginosa, were cystic fibrosis, which effected the lung function. Lung diseases caused by *P.aeruginosa* are a leading cause of death and lead to chronic inflammation, and damaging the epithelial cells surface.

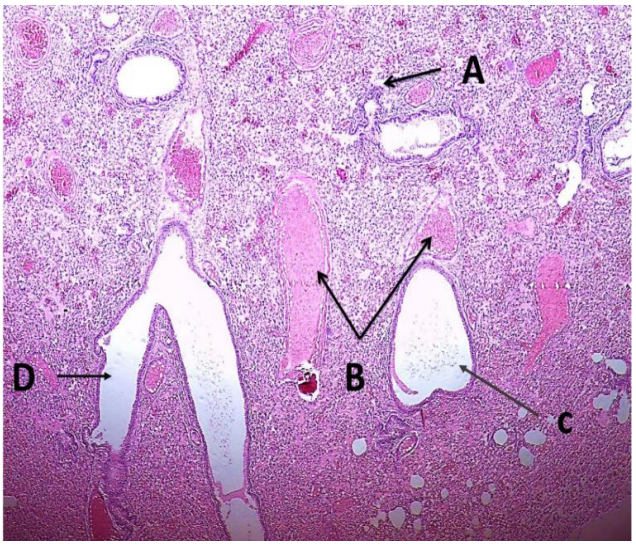

Figure 3. Cross section of lung after infected with bacteria showed: A- Alveolar wall destruction, B-blood hemorrhage C-cystic dilation D-elongated. H&E stain X4

The tissue section of lung after treated with UV rays showed normal alveolar wall with prominent epithelial layer that lining the inner surface of alveoli, the result noted prominent bloody congestions between of alveoli, most tissue sections of lung were normally after treated, but noted some lesions of emphysema. The histological result of lung showed the epithelial layer that lining the bronchial tree was isolated form underling connective tissue in many bronchi, so the result noted abnormal aggregation of inflammatory cells beside the effected bronchioles in addition to

abnormal cystic dilation that filled with fluid. These result disagreement with (Newman *et al.*, 2014) according to these data, x-irradiation transiently depresses intrinsic pulmonary bactericidal activity at 2-3 weeks after exposure and accounts at least in part for the enhanced susceptibility to respiratory infection, and Physical removal of bacteria was not affected by x-irradiation. In addition, neither ultrastructural nor histological abnormalities were found. The tissue section of lung in this group appeared the positive role of UV rays in treated the pathological lesions the result noted the lung parenchyma was normal in structure except some of blood congestion in different location of lung parenchyma, the figure showed little infiltration cells which situated between the lesions of blood congestions these results have better histological structures compared with infected group, but something similar to control group (Figure 3).

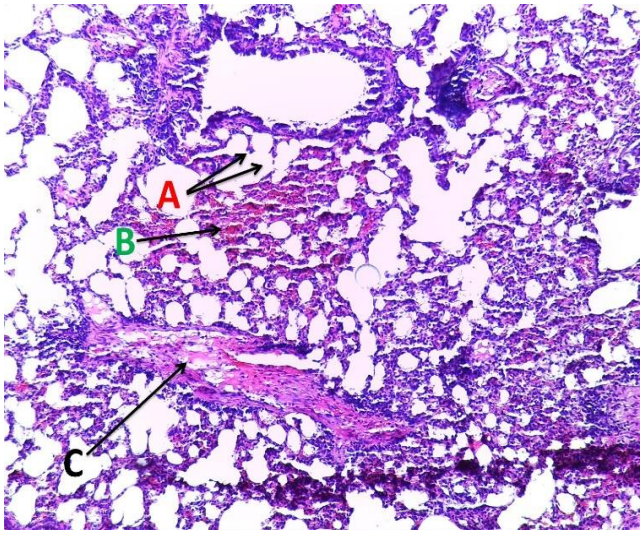

Figure 4. Cross section of lung after infected and treated with UV Rays: showed: A- Alveolar wall destruction, B- blood hemorrhage, C- blood congestion. H&E stain X10.

Table 1. Effect of bacterial (10^{-4}) bacterial (10^{-5}) during Ultraviolet radiation for two hour on some blood traits of mice (means ± standard error)

Treatment	LYM	PLT	HGB	RBC	WBC
Control	2.20±0.09 b	951.20±38.88 b	11.36±0.86 a	7.22±1.06	3.16±0.07
T1	2.07±0.01 b	2538.00±21.93a	9.15±0.08a b	5.48±0.04	3.04±0.14
T2	3.80±0.50 ab	1267.50±453.73b	7.22±1.79b	4.90±1.49	3.80±0.50
T3	7.32±0.79 a	1323.25±28.47b	9.00±0.66a b	6.80±0.50	7.32±0.79
T4	2.50±0.37 a	1537.00±472.48b	10.40±1.24 ab	6.80±0.50	2.61±0.41
T5	3.93±1.27 a	624.25±47.66 b	6.55±0.18a b	6.80±0.50	3.85±0.45
Sig.	0.05	0.05	0.05	N.S	N.S

Control, **T1**; UV 2h without Bacteria. **T2**; UV 2 h+ Bacteria 10^{-4}. **T3**; UV 2h+ Bacteria 10^{-5}. **T4**; Without UV Bacteria 10^{-4}. **T5**; Without UV Bacteria 10^{-5}

Conclusion

We conclude that the ultraviolet rays stimulated the immune system, killed bacteria. and raised white blood cells to produce a largest amount of WBC and the effects of phygosoticty.

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