

COMPARISON BETWEEN THE EFFECT OF ACETIC ACID AND SALICYLIC ACID IN DIFFERENT CONCENTRATIONS ON *PSEUDOMONAS AERUGINOSA* ISOLATED FROM BURN WOUND INFECTION⁺

Intissar Mahmoud Juma *

Hana'a Salman Yass*
Jaberi**

Farah Hisham Al-

Abstract

In the burn unit, burn wounds are never sterile and bacterial contamination of the burn wound occurs almost soon after thermal injury so the early diagnosis of burn wound infection is important to minimize morbidity and mortality.

In general, the study was done on (70) patients hospitalized in different times. Swab samples were taken from the patients and the sensitivity to different antimicrobial agents was determined. The commonest microorganisms isolated was *Pseudomonas aeruginosa* (32.8%).

In this paper we studied the effect of acetic acid and salicylic acid in different concentrations on *Pseudomonas aeruginosa* which is the predominant bacteria in burn wound infections.

المستخلص

أعطت هذه الدراسة فكرة عن التهابات الجروح الناتجة عن الحروق في ردهات الحروق، حيث كانت نسبة عالية من هذه الالتهابات معرضة للإصابات البكتيرية في ردهة الحروق، وأهمية التشخيص المبكر للإصابة في تقليل الوفيات. شملت الدراسة ٧٠ حالة من حالات المرضى الراقدين في المستشفى لأوقات مختلفة من خلال أخذ مسحات وتنميتها للتشخيص المختبري. فقد عزلت نسبة عالية من البكتيريا *Pseudomonas aeruginosa* (٣٢,٨%) . في هذا البحث تمت دراسة تأثير كل من حامض الخليك، وحامض السلسليك بتركيزات مختلفة على البكتيريا المعزولة *Pseudomonas aeruginosa* السائدة في التهابات الحروق.

Introduction

Microorganisms proliferate rapidly in burn wounds and are severe enough to impair immune function and sepsis remains the major fatal complication of burns. Infections require aggressive systemic treatment. Full thickness burn wounds require skin grafting. This is performed as soon as possible after stabilization of the patient[1].

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*Assist. Prof \ Health and Medical Technology College

**Medical Technician \Health and Medical Technology College

Infection of burn wounds is essentially universal, may be associated with bacteremia, may carry a significant mortality and interferes with the acceptance of skin grafts[2]. Infection of burn wounds has been categorized into 3 divisions[3,4,5]:

1. **Non invasive infections**: Infection occurs to some extent in all burn wounds and colonization with one or mixture of microorganisms is universal. Usually cultures reveal predominant organisms with other bacteria and fungi in lesser members.
2. **Invasive infections without bacteremia**: Such infections occur more commonly with some organisms. Invasive infection is commonly seen with *Pseudomonas aeruginosa* and *Streptococcus pyogenes*.
3. **Invasive infections with bacteremia**: Both colonizing and invading bacteria may enter the lymphatics and traverse into the systemic circulation, direct invasion into blood vessels can also occur especially with *Pseudomonas aeruginosa*.

Pseudomonas aeruginosa grows well in the burn wound and is resistant to most commonly used antibiotics. It's often seen in patients with septicemia, hypothermia, a depressed white count, and ileus are characteristic in advanced cases[6].

Acetic acid ($C_2H_4O_2$), is an astringent, low toxicity and is considered antimicrobial agent[7,8]. The mechanism of action of organic acid preservatives and acidulants can not thus be explained solely by an alteration of internal pH, so acetic acid interacts with the cytoplasmic membrane to neutralize the electrochemical potential, it also lowers internal pH and may cause denaturation of protein[9]. Generally in wound infection, acetic acid acts as antiseptic by using it in concentration of 0.25 to 0.5% against *Pseudomonas aeruginosa*. So the antimicrobial action of acetic acid requires prolong contact between the acid and the bacteria and a concentration of 2% was frequently used as a wet dressing to overcome infection in infected burn wound while more than 2% was not used clinically because this concentration causes much more pain on application, and because the biochemical disturbance has not been evaluated yet. So a well established fact that acetic acid doesn't have the broad spectrum efficacy or wide margin of safety of chlorohexidin or Povidone Iodine[10,11].

Salicylic acid ($C_7H_6O_3$), a systemic name and 2-hydroxybenzene carboxylic acid and its a common names salicylic acid. Salicylic acid itself is used as a disinfectant in some first aid sprays and ointments and it is so irritating that it can be used only externally[12].

Salicylic acids are the common derivatives of straight chain monocarboxylic acid, salicylic acids are sometimes incorporated into products used for topical treatment of fungal skin infections[9,13]. Salicylic acid is quite irritating to skin and mucosa and destroys epithelial cells. The keratolytic action of the free acid is employed for the local treatment of warts, corns, fungal infections and certain types of eczematous dermatitis. The tissue cells swell, soften and desquamate. Salicylic acid is rapidly absorbed from the intact skin, especially when applied in oily liniments or ointments and systemic poisoning has occurred from its application to large areas of skin[14,15].

Aim of the Study

- The purpose of the study is to investigate the efficacy of new specific topical antimicrobial agent by its effect on burn wound infections.

- To compare the effect of acetic acid and salicylic acid in different concentrations on *Pseudomonas aeruginosa* isolated from the burn patients.
- To find the means to improve and accelerate wound healing, lower the cost and the time of hospital stay.

Patient and Method

During the period of September, October, and December 2002, burn swabs were obtained from 70 patients. They were chosen randomly as hospitalized patients of Al-Kindy Teaching Hospital and Al-Karkh Hospital and routine bacteriological cultures were performed (all mixed cultures were excluded from the study).

Disposable sterile swabs were used; the specimens were obtained by rolling the swabs over the wounds. Swabs were immediately carried to the laboratory and cultured on.

- Blood agar plates.
- MacConkey agar plates.

All plates were incubated at 37°C for 24 hours under aerobic conditions.

Identification was made by :

1 . Morphological.

- a) Direct smear.
- b) Culture characteristics[16]

2 . Biochemical tests

By:

- 1) Oxidase test[17].
- 2) Catalase test[17].
- 3) Coagulase test[17].
- 4) IMVIC test[16,17].
- 5) Urease test[16,17].
- 6) Motility test[17].
- 7) Triple sugar iron (TSI) test or Kliglar test[17,18].
- 8) API 20E system[19].

3 . Antibiotic Susceptibility Testing[20]

In this study freshly prepared solutions of different concentrations (0.5, 1, 1.25, 1.5, 1.75, 2 grams), of acetic acid is dissolved in 100ml of distilled water, while the same concentration of salicylic acid is dissolved in 100ml of Ethanol (99%), in both of these solutions, a large number of filter paper disks have been flooded for a long time, to use them as high antimicrobial content disks.

The Results

The results of the cultures performed are shown in Table (1), 32.8% of cultures are positive for *Pseudomonas aeruginosa* (23 out of 70 cultures), so the *Pseudomonas aeruginosa* is considered the commonest microorganism in burn wound infection.

The antibacterial sensitivity test is demonstrated in the zones of inhibition around certain chemical agents in cultures of *Pseudomonas aeruginosa* and the inhibition zone in each plate was recorded .

Details of the results are shown in Tables (2 & 3).

Table 1: Types of bacteria isolated from burn wounds

Organism	No. of swabs	%
Ps. Aeruginosa	23	32.8
Staphylococcus aureus	15	21.4
E. coli	8	11.4
Mixed growth of Klebsiella and Others	14	20
No growth	10	14.3
Total	70	100%

Table 2 : Susceptibility of *Pseudomonas aeruginosa* to Acetic Acid.

Concentration of acetic acid (g/100ml)	Diameter of inhibition zone on Muller Hinton (mm) of <i>Pseudomonas aeruginosa</i>
0.5	9 – 13
1	11 – 14
1.25	12 – 15
1.5	10 – 17
1.75	14 – 18
2	18 <

Table 3: Susceptibility of *Pseudomonas aeruginosa* to Salicylic Acid.

Concentration of salicylic acid (g/100ml)	Diameter of inhibition zone on Muller Hinton (mm) of <i>Pseudomonas aeruginosa</i>
0.5	6 – 7
1	6 – 7
1.25	7
1.5	8
1.75	6
2	8 <

Discussion

The problems of burns and their treatment continue to be underestimated in our country which are the primary goal in the treatment of burn wounds is the facilitation of healing and prevention of infection. Table (1) shows that the most common infecting organism in our burn unit is *Pseudomonas aeruginosa* (32.8%) and it is evident from that gram negative organisms which represent the most likely organisms involved in wound sepsis and septicemia that all recent studies agreed on that septicemia remain the most leading cause of death in burned patients [20,21].

Tables (2 and 3) show that 2% solution of acetic acid gives a good and larger inhibition zone if compared with 2% solution of salicylic acid.

Clinically and practically acetic acid can be used safely in concentration of 1% which has an inhibition zone of (11-14mm) in vitro while the maximum concentration of salicylic acid used clinically should not exceed 0.5% because it has a bad keratolytic effect on the skin in concentration more than 0.5%[14,15]. In vitro the effect of 0.5% concentration of salicylic acid has an inhibition zone of (6-7 mm) which is much less if compared with acetic acid at 1% concentration. Therefore acetic acid is preferable therapeutically as a bactericidal agent when used in 1% concentration[7,8,10,11,22] compared to salicylic acid in 0.5% concentration. In general salicylic acid is considered as a safe, in expensive topical agent suitable for thermal burns which are not heavily contaminated, although it has no significant effect on the rate of wound healing, [13].

It's worth mentioning that many studies should be made to select appropriate antimicrobial agent that can control the resistant strain of *Pseudomonas aeruginosa* are still needed.

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