

## Role of Lemon Juice Therapy in Wound Bed Preparation

Ravi Kumar Chittoria<sup>1</sup>, Konda Sireesha Reddy<sup>2</sup>, Elan Kumar S<sup>3</sup>

### How to cite this article:

Ravi Kumar Chittoria, Konda Sireesha Reddy, Elan Kumar S/Role of Lemon Juice Therapy in Wound Bed Preparation/RFP Journal of Plastic Surgery and Transplantation. 2023;4(2):71-74.

### Abstract

**Background:** Wound healing is multifactorial event with wound bed preparation (WBP) being the most important part of it. Pseudomonas aeruginosa is a significant cause of wound infections delaying the process of WBP. The growth of pseudomonas is suppressed in acidic media. Vinegar (acetic acid) has been in use to provide acidic media to suppress the growth of pseudomonas. Citrus group of fruits such as lemon, orange and grapes are rich source of Vitamin C (ascorbic acid) and citric acid.

**Materials and Methods:** This is a comparative prospective study done in two groups having 3 patients in each group. Group A patients were investigated for the effect of local application of lemon juice for providing acidic media in wounds to suppress growth of pseudomonas to enhance wound bed preparation (WBP) for reconstruction. Group B included 3 patients treated by povidone iodine.

**Results:** On an average the number of applications of Lemon juice therapy required was less than povidone iodine to control pseudomonas infection in wounds.

**Conclusion:** Lemon Juice can be used as a source of providing acidic media for suppressing the growth of pseudomonas infection in wounds. It is an easily available and natural source of acidic media.

**Keywords:** Lemon Juice Therapy (LJT); Pseudomonas; Wound Bed Preparation (WBP).

## INTRODUCTION

Wound Bed Preparation (WBP) is an important pre requisite for wound reconstruction by skin graft or flap. In the presence of infection

**Author Affiliation:** <sup>1</sup>Professor, <sup>2,3</sup>Senior Resident, Department of Plastic Surgery, Jawaharlal Institute of Postgraduate Medical Education and Research, Pondicherry 605006, India.

**Corresponding Author:** Konda Sireesha Reddy, Senior Resident, Department of Plastic Surgery, Jawaharlal Institute of Postgraduate Medical Education and Research, Pondicherry 605006, India.

**E-mail:** aesculapius.siree@gmail.com

**Received on:** 20-04-2023

**Accepted on:** 31.05.2023

especially resistant pseudomonas the process of WBP is delayed. Local antimicrobial agents are better than systemic antibiotics due to high cost and risk of resistance. Pseudomonas aeruginosa is a classic opportunistic pathogen with innate resistance to many antibiotics and disinfectants.<sup>1</sup> It is resistant to commonly available antiseptics and disinfectants such as quaternary ammonium compounds (e.g., cetrimide and benzalkonium chloride), chloroxylenol and hexachlorophanen.<sup>2,3</sup> Its isolation has been reported from povidone-iodine, chlorhexidine, dettol and savlon solutions used in hospitals.<sup>4-8</sup> Approximately, one third of burn wounds are infected by P. aeruginosa. It is an important cause of nosocomial infections and is associated with high morbidity, increased stay

in hospital and increase cost of treatment because of its resistance to commonly available antibiotics. In recent years, an increased frequency of strains resistant to several antimicrobial agents has been reported.<sup>9-11</sup> In spite of continuing introduction of potent antipseudomonal agents, it is the most difficult nosocomial pathogen to be eliminated from infection site. Growing resistance to antimicrobial agents seriously hampers the therapy of pseudomonal infections. The incidence of such multiple drug resistant isolates remains very high in burn units. Thus, *P. aeruginosa* continues to create a threat to patient care.<sup>11</sup> *Pseudomonas* growth is suppressed in acidic media. Usually topical vinegar is used to provide acidic media but toxic to normal cells in higher concentration. Acidic media may be provided by natural citrus fruits which are rich source of ascorbic acid and citric acid. Among various citrus group of fruits lemons are easily available in all the seasons and relatively cheaper compared to other citrus fruits. Few studies are available on effect of ascorbic & citric acid in control of resistant pseudomonas in wounds. This study investigated the effect of local application of lemon juice for providing acidic media in wounds to suppress growth of pseudomonas to enhance wound bed preparation (WBP) for reconstruction.

## MATERIALS AND METHODS

This comparative prospective study was conducted during June 2017 to October 2017 in 6 patients (Duration of study is only 5 months during which only 6 patients have come who fit into the inclusion criteria). Informed consent was taken from all the patients. Ethical clearance was obtained.

**Inclusion criteria:** During the study duration, all the patients with wounds having *Pseudomonas* growth according to exudate culture report were included in this study.

**Exclusion criteria:** Wounds having growth of organisms other than *Pseudomonas*.

Wounds showing growth of more than one organism were excluded from the study.

The 6 patients included were divided into 2 groups. Group A included three patients treated by lemon juice therapy (LJT). Group B included 3 patients treated by povidone iodine. No systemic antibiotic was given in either group. Wound exudate cultures were sent before each dressing until no *Pseudomonas* growth was found. Demographic profile, number of applications of LJT or povidone iodine required to control pseudomonas infection

and method of final reconstruction were recorded.

LJT set includes lemons, knife (to cut the lemon), lemon juice extractor and a container with sprayer (fig. 1). Outer surface of Lemon was wiped with alcohol swab. Lemon juice was extracted by a



Fig 1: Lemon Juice Therapy (LJT) Set

extractor (after autoclaving) commonly available in kitchen. Extracted juice was transferred in glass container (without crack & plugged with cotton) and autoclaved (at temperature of 121 degree centigrade with pressure of 15 psi for 20 min). In group A, sterile extracted juice was transferred in a bottle with spray device to spray the lemon juice over the wound. For every 10 sq.cm of wound, 2ml of undiluted lemon juice was sprayed directly over the wound (fig. 2). In group B, povidone iodine was used to irrigate the wound to control the pseudomonas infection. In both the groups wounds were covered with conventional moist dressing. Dressing was changed every 3 to 4 days depending upon the soakage. Before every dressing tissue culture was sent. Various parameters were recorded like number of applications of LJT required to control pseudomonas, method of reconstruction for wound cover (graft or flap).



Fig. 2: Spraying of lemon juice on a left trochanter pressure ulcer

## RESULTS

In group A patients, on an average two numbers of LJT applications were required to control the

pseudomonas infection. In group B patients, four applications of povidone iodine was required to control the pseudomonas infection (Table 1 & fig. 3).

## DISCUSSION

To the clinician it is important to reduce the number of bacteria in wounds as part of wound

**Table 1:** Demographic Details & Results

Age	Gender	Diagnosis	Tissue culture report	Group allotted	No. of LJT applications	No. of povidone iodine applications	Method of reconstruction
14	Male	Post burn raw area	Pseudomonas resistant to all antibiotics	A (treated by LJT)	1	Nil	Skin Graft
24	Male	Left trochanter pressure ulcer	Pseudomonas resistant to all antibiotics	A (treated by LJT)	2	Nil	Tensor fascia lata (TFL) flap
24	Male	Post traumatic raw area right heel	Pseudomonas resistant to all antibiotics	A (treated by LJT)	2	Nil	Reverse sural artery flap
32	Male	Postburn raw area	Pseudomonas resistant to all commonly used antibiotics	B (treated by povidone iodine)	-	3	Skin Graft
35	Male	Multiple pressure ulcers	Pseudomonas resistant to all antibiotics	B (treated by povidone iodine)	-	4	Skin Graft
47	Male	Post traumatic raw area left forearm	Pseudomonas resistant to all antibiotics	B (treated by povidone iodine)	-	4	Skin Graft



**Fig 3:** Left trochanter pressure ulcer reconstructed with left tensor fascia lata (TFL) flap after control of pseudomonas infection.

bed preparation (WBP) to reconstruct with skin graft or flap. Pseudomonas is one of the most common & resistant bacteria delaying the process of wound bed preparation (WBP). The growth of pseudomonas is suppressed in an acidic media, vinegar being one of the commonly used topical agents. Few articles are available, mentioning other topical agents like citric acid and ascorbic acid.

The antiseptic management has a dichotomous history anchored in tradition and science. It is an integral part of the management of acute as well as chronic wounds.<sup>12,13</sup> The ideal topical therapy is aimed at reduction of bacterial contamination and removal of soluble debris without adversely affecting cellular activities vital to wound healing

process. Although several studies support the value of topical antimicrobial agents, many commonly used antiseptic agents are not approved for use in wound infections.

Repeated and excessive treatment of wounds with antiseptic agents, except for short-time application to attack the causative pathogens and control the infection, may have negative outcomes or promote a micro-environment similar to those found in chronic wounds.<sup>14,15</sup>

Dilute acetic acid though successfully used by many researchers for the treatment of wound infections caused by *P. aeruginosa* but has side effects. Line a weaver *et al.* showed that a 0.25% acetic acid solution killed 100% of exposed fibroblasts in an in vitro model impairing wound healing. Acetic acid has also been shown to slow down the wound epithelization and limit polymorphonuclear neutrophil function.<sup>16</sup> Many others also have reported that these agents are cytotoxic, retard healing and can do more harm than good when they are not used in a proper concentration. They can interfere with the normal healing process, are toxic to fibroblasts and may permit more virulent microbes to dominate.<sup>17</sup>

Mujumdar in 1993, reported use of ascorbic acid in 35 cases with second degree burn injury involving 20-40% of body surface area infected with *P. aeruginosa*. He used 2% ascorbic acid to

wash wound thoroughly and to create an acidic medium in a tropical climate where warm weather and alkalinity of the medium renders 0.1% silver sulfadiazine less effective. This treatment modality showed a dramatic reduction (88%) in pseudomonas infection.<sup>18</sup> Various studies have mentioned that 2-3% citric acid is successful in treatment of infections caused by resistant *P. aeruginosa*. Citric acid has been found to be simple, reliable, non toxic, effective and economical approach in the management of infections caused by resistant strains of *P. Aeruginosa*.<sup>19,20</sup> Knowing these disadvantages of acetic acid, in our study, we used naturally available citric & ascorbic acid present in lemon juice. In our study, it was found to be effective in wound bed preparation (WBP) by controlling the resistant pseudomonas infection and helping in wound reconstruction. Our study has various limitations like single center, small sample size, non-randomized, prospective study, with no controls, and dose & concentration of lemon juice not standardized.

## CONCLUSION

Lemon Juice as a naturally & easily available source of providing an acidic media for suppressing the growth of pseudomonas infection in wounds for wound bed preparation (WBP) may be considered in the armamentarium of wound management. But large, controlled, prospective, multi center trials needs to be done to substantiate this study.

## REFERENCES

- Greenwod D, Slack RCB, Peutherer JF. Medical microbiology. 16th ed. *Edinburgh: Elsevier*; 2012. Pp 298-304.
- Parakar MT, Collier EH. Topley and Wilsons principles of bacteriology, virology and immunity, vol. II, 8th ed. *London: Edward Arnold*; 1990. Pp 708.
- Kumar S. Textbook of microbiology. *New Delhi: Jaypee*; 2012. Pp 405-412
- Kurihara T, Sugita M, Motai S, Kurashige S. In vitro induction of chlorhexidine and benzalkonium resistance in clinically isolated *Pseudomonas aeruginosa*. *Kansenshogaku Zasshi* 1993;67:202-6.
- Nagoba BS, Deshmukh SR, Husain RA, Gomashe AV, Wadher BJ. Bacteriological analysis of various environmental sources in a rural hospital. *Indian Journal of Medical Sciences* 1997;51:465-9.
- Arjunwadkar VP, Bal AM, Joshi SA, Kagal AS, Bharadwaj RS. Contaminated antiseptics – an unnecessary hospital hazard. *Practitioner Section* 2001;7:393-8.
- Ananthnarayan R, JayaramPanikar CK. Textbook of microbiology. 8th ed. *Madras: Universities Press*; 2009. p. 315-9.
- Collee JG, Fraser AG, Marmion BP, Simmons A. Mackie and McCartney practical medical microbiology. 14th ed. *New Delhi: Churchill-Livingstone*; 2006.
- Beheshti S, Zia M. Bacteriology of burns and antibiogram in an Iranian burn care centre. *African Journal of Pharmacy and Pharmacology* 2011;5:538-41.
- Tam VH, Chang KT, Abdelraouf K, Brioso CG, Ameka M, Mc Caskey LA, et al. Prevalence, resistance mechanisms, and susceptibility of multidrug-resistant blood stream isolates of *Pseudomonas aeruginosa*. *Antimicrobial Agents and Chemotherapy* 2010;45:1160-4.
- Bennet JV. Nosocomial infections due to *Pseudomonas*. *Journal of Infectious Diseases* 1974;130:54-5.
- Smith RG. A critical discussion of the use of antiseptics in acute traumatic wounds. *Journal of the American Podiatric Medical Association* 2005;95:148-53.
- Khan MN, Naqui AH. Antiseptics, iodine, povidone iodine and traumatic wound cleansing. *Journal of Tissue Viability* 2006;16:6-10.
- Hunt TK, Hopf HW. Wound healing and wound infection – what surgeons and anaesthesiologists can do? *Surgical Clinics of North America* 1997;77:587-606.
- Thomas GW, Rael TL, Bar-Or R, Shimonkevitz R, Mains CW, Slone DS, et al. Mechanisms of delayed wound healing by commonly used antiseptics. *Journal of Trauma* 2009;66:82-91.
- Linea weaver W, Howard R, Soucy D, Mcmorris S, Freeman J, Crain C, et al. Topical Antimicrobial Toxicity. *Archives Of Surgery* 1985;120:267-70.
- Pathare NA. Infections and diabetes mellitus. *Journal of Diabetes Association of India* 1998;38:4-6.
- Mujumdar RK. Treatment of resistant *Pseudomonas* infection in burn patients in tropical climate using acidic medium, oxidising agent and metronidazole. *Indian Journal of Surgery* 1993;55:501-7.
- Nagoba BS, Gandhi RC, Wadher BJ, Gandhi SP, Deshmukh SR. Citric acid treatment of severe electric burns complicated by multiple antibiotic resistant *Pseudomonas aeruginosa*. *Burns* 1998;24:481-3.
- Nagoba BS, Wadher BJ, Deshmukh SR, Mahabaleshwar L, Gandhi RC, Kulkarni PB, et al. Treatment of superficial pseudomonal infections with citric acid - an effective and economical approach. *Journal of Hospital Infection* 1998;40:155-7.

