

A study to assess the effectiveness of citric acid in healing foot ulcer among diabetic patients at Sree Balaji Medical College and Hospital, Chennai.

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Abstract:

Background of the study: Diabetes mellitus is a metabolic disorder which is characterized by multiple long-term complications that affect almost every system in the body. Foot ulcers are one of the main complications of diabetes mellitus. Various recommendations and practices are experimented to reduce the diabetes foot ulcer.

Aims: to assess the effectiveness of citric acid in healing foot ulcer among diabetic patients with the selected demographic and clinical variables among the patients with diabetic foot ulcer.

Methodology The study was conducted in surgical wards at Sree Balaji Medical College Hospital, Chennai Diabetic patients who are admitted with foot ulcer during the period of data collection. The investigator followed a Qualitative research design was used for this study is pre test and post test design. Convenient sampling of 40 patients, age group between 35 to 70 years was selected for sampling based inclusion and exclusion criteria. The investigator adopted 'Hall's - core, care, and cure model' (1960) for helping the diabetic foot ulcer patients in healing and granulation and The tool used for the study was Modified Bates Jensen's Wound assessment tool and data was collected by observation method. The wound dressing was carried by using 3% citric acid solution upto 7 days daily once. The wound was assessed before and after citric acid dressing on 6. **Results:** The mean post-test foot ulcer level is 16.0 was lower in the pre test group. The obtained paired 't' test value is 29.3 *** was statistically significance at $P < 0.001$. It is inferred that citric acid dressing was effective in healing foot ulcer among diabetic patients.

Conclusion: There was good response to citric acid dressing on wound healing of diabetic foot ulcer. Citric acid solution dressing is more effective on wound healing of diabetic foot ulcer. It is simple and the better than other dressing solution used for diabetic wound dressing

Key words: Diabetes foot ulcer, citric acid dressing, healing, Lydia hall, bates Jansen scale

I. Background of Study:

Diabetic foot ulcers are one of the most common and devastating complications of diabetes mellitus. The macrovascular and microvascular changes and the neuropathy all contribute to changes in the lower extremity called the diabetic foot. One major factor is sensory neuropathy, which may lead to painless trauma, ulceration and infection. Macrovascular and microvascular changes produce tissue ischemia and skin changes that can cause ulcerations and infections and prevent healing. The interrelationship of all these factors, as they contribute to lesion that results in gangrene and ultimately amputation.

India is set to become the diabetes capital of the world with a projected 109 million individuals with diabetes by 2035. India ranks second (after China) with more than 66.8 million diabetics in the age group of 20-70. The prevalence of Diabetes in India is 8.6% and, as of 2013, more than 1 million Indians die each year due to diabetes related causes.

Diabetic Foot (DF) is one of the most common complications for admissions imposing tremendous medical and financial burden on our healthcare system. The lifetime risk of a person with diabetes having a foot ulcer could be as high as 25% and is the commonest reason for hospitalization of diabetic patients (about 30%) and absorbs about 20% of the total health-care costs, more than all other diabetic complications.^{9, 10} The prevalence of foot ulcers in diabetics attending a centre managing diabetic foot (both indoor and outdoor setup) in India is 3%. Foot ulcers among outpatient and inpatient diabetics attending hospitals in rural India was found to be 10.4%.

Peripheral vascular disease (PVD) occurs in about 3.2% diabetics below 50 years of age and rises to 55% in those above 80 years of age. 14-15% of those with diabetes for a decade suffer from diabetic foot, where as it increases to almost 50% by another decade.

Diabetes is the third leading cause of death by disease mostly because of the high rate of coronary artery disease among people with diabetes mellitus. The estimated incidence of diabetes in the US exceeds 1.5

million new cases annually, with an overall prevalence of 20.8 million people or 7% of the nation's populations. An estimated 14.6 million persons are currently diagnosed with foot ulcers. More than 120 million people in the world have diabetes mellitus and too many of these subjects suffer from diabetic foot ulcers which may eventually lead to an amputation. In 1995 India had 19 million diabetes compared to 16 million in China which comes second.

Diabetic complications may be disabling or even life-threatening. According to the International Working Group on the Diabetic Foot (IWGDF), a diabetic foot ulcer (DFU) is a full-thickness wound penetrating through the dermis (the deep vascular and collagenous inner layer of the skin) located below the ankle in a diabetic patient. Eight out of 10 non-traumatic limb amputations are attributable to diabetes, of which 85% are due to DFU. People with foot problems and diabetes mellitus have 15 times the increased risk of undergoing a lower extremity amputation compared to those without diabetes. The mortality after unilateral lower limb amputation has been projected to be as high as 39%–80% at 5 years, which is similar or worse than many common types of cancer. Diabetic foot disease (DFD) is one of the diabetic complications associated with major morbidity, mortality, and reduced quality of life and is the most serious complication of diabetes mellitus. The incidence of DFD is still rising. According to the international consensus on diabetic foot, a foot ulcer is defined as a full-thickness wound below the ankle in a diabetic patient, irrespective of duration.

The International Diabetes Federation estimate that at least one limb is lost due to DFU somewhere in the world every 30 seconds. DFU is the most common cause of hospitalization in diabetic patients and also has significant socioeconomic impact. It is estimated that a person with diabetes has a 25% lifetime risk of developing DFU. Patients with DFU have a greater than twofold increase in mortality compared with nonulcerated diabetic patients. Five-year mortality rates after ulceration were around 40%. Furthermore, the DFD and its long-term sequelae account for direct medical expenditures and lengthy periods of disability.

The global diabetic foot ulcer treatment market size was valued at USD 3.6 billion in 2017. It is anticipated to expand at a CAGR of 8.2% over the forecast period. Rising prevalence of diabetes and rapidly growing geriatric population worldwide are among the primary growth stimulants for DFU treatment market. Diabetic foot ulcer is one of the major complications of diabetes mellitus, which forms a major characteristic of diabetic foot.

Healing of wounds is typically an innate mechanism. However, certain metabolic disorders such as diabetes mellitus delays typical pace of wound healing process. Diabetic foot ulcers are most commonly caused by irritated or wounded feet, nerve damage, poor circulation, and high blood sugar (hyperglycemia). Unusual swelling, redness, irritation, and stench on one or both feet are common initial symptoms of foot ulcer.

Infection is a common reason for poor wound healing, especially, in chronic wounds. Significant reduction in the number of bacteria is essential for healing. Citric acid was more effective against almost all bacterial pathogens causing wound infections *in vitro*. Local application of citric acid to a variety of chronic infected wounds such as diabetic foot infections, chronic traumatic wound/non-healing ulcers, lepromatous ulcers, necrotizing fasciitis, burns infections, etc. resulted in complete healing in more than 95% of chronic infected wounds indicating that the citric acid is most effective in the treatment of various wounds, including wounds for which there are no alternative options available (Nagoba, 2012). Citric acid dressing will improve wound healing, minimize the incidence of amputation and reduce the health care utilization, the stay and the cost of hospitalization, which would improve the quality of life among the patients with diabetic foot ulcer. So, the present study was conducted to assess the effect of Citric Acid Dressing on Wound Healing of Diabetic Foot Ulcer in and to identify the effectiveness of wound healing with the selected demographic variables among the patients with diabetic foot ulcer.

Citric acid treatment of chronic infected wounds offers excellent results. It has been found to be effective against a variety of bacteria causing wound infections. Clinical results with this treatment showed early formation of healthy granulation tissue and enhancement of the healing process.

OBJECTIVES

1. To assess the level of diabetic foot ulcer patients among pre test group
2. To assess the effectiveness of citric acid dressing among post test group
3. To compare the pre test and post test result in effectiveness of healing foot ulcer among diabetic patient

II. Material and Methods:

The study was conducted in surgical wards at Sree Balaji Medical College Hospital, Chennai. Totally, 40 diabetic foot ulcer patients who are admitted in general surgical ward during the period of data collection in this study. Qualitative research design was used for this study. Convenient sampling method was used for sampling based inclusion and exclusion criteria. The patients who were received other type of dressing and other complication and then the patients who were sensitive to citric acid and critically ill were excluded from the study. Socio-demographic variables of the patients and the clinical data were gathered by using the

interview method in regional language. The investigator adopted ‘Hall’s - core, care, and cure model’ (1960) for helping the diabetic foot ulcer patients in healing and granulation and The Modified Bates Jensen’s Wound Assessment tool was used to assessing the diabetic foot ulcer. It is a comprehensive tool which gives adequate information of diabetic foot wound like size, depth, edges, undermining, necrotic tissue types, necrotic tissue amount, exudate type, exudate amount, skin colour surrounding the wound, peripheral tissue edema, peripheral tissue induration, granulation tissue, and epithelization. The tool evaluates fourteen wound characteristics on a five point rating scale, with lower scores indicating greater desirability of wound healing process. The continuum had two extreme ends of wound condition spectrum. They were wound regeneration and wound degeneration. Each parameter was marked with scores based on the severity of the wound. Total scores ranged from fourteen (skin intact but at risk for further damage) to 70 (profound tissue degeneration). The Scores Were divided into the following categories; score 13 –healthy tissue, score 14-55 wound regeneration score 60 wound degeneration. Ethical approval was obtained and permission for data collection was sought from the dean, Sree Balaji Medical College Hospital. Descriptive and inferential statistics were used for analyzing the data. The mean, standard deviation, percentages, paired‘t’ test were used to express the data.

Citric acid solution preparation: Commercially available citric acid (Monohydrate) was used for pharmaceutical purpose. It easily dissolves in water. Citric acid is added to distilled water in the ratio of 3gm/100ml. Planning for preparation of citric acid solution, 3mg citric acid mixed with 100 ml distilled water stored in a large container bottle, closed with air tight cap and wrap the container with sterile towel and then autoclave at 121 degree C for 15 minute. The wound status was assessed before starting citric acid dressing (pre assessment) on the first day. The wound was cleaned with 3% citric acid soaked gaze pieces, and then the spread the citric acid soaked gazes over wound and applied dressing not used any other solutions. For each dressing, approximately 50 to 100 ml of citric acid solution was needed. Initially wound size was large, so more solution was required and gradually wound size became small after healing which required less solution. The citric acid dressing was carried out upto 7 days daily once. The data analysis was done with descriptive and inferential statistics and paired‘t’ test.

III. Data Analysis And Report

The analysis and interpretation of data of this study was based on the data collection and objectives of the study. The obtained data were sorted and descriptive analysis (frequency and percentage) was performed to condense the demographic variables. The variables were analyzed by using descriptive and inferential statistics.

Table 1: Frequency and percentage distribution of demographic variables. (n=40)

S.NO	Demographic Variables	Frequency	Percentage %
(i)	Age (years)		
	15-25 years	- 10	0%
	25-40 years	19	25%
	40-60	11	47.5%
	Above 60 years		27.5%
(ii)	Sex		
	Male Female	29 11	72.5 27.5
(iii)	Religion Hindu Christian Muslim		
	Others	28 5 7 -	70 12.5 17.5 -
(v)	Educational status Middle school Higher education Degree course		
	None	16 9 4 11	40 22.5 10.0 27.5
(vi)	Occupation Cooley Agriculture Business		
	Employee	17 8 8 7	42.5 20 20 17.5
(vii)	Income		
	< 3000	10	25
	3001-5000	20	50
	>5000	10	25
(viii)	Sources of health information		
	Family members	11	27.5
	Friends Media	5	12.5
	Health personnel	6 18	15 45

(ix)	Working pattern		
	Heavy	10	25
	Sedentary Moderate	12 18	30 45
(x)	Family history of diabetes		
	yes no	16	40
	unknown	13 11	32.5 27.5
(xi)	Community		
	Urban	10	25
	Rural	8	20
	Semi urban	15	37.5
	Sub rural	7	17.5
(xii)	Duration		
	0-1 year	9	22.5
	2-3 year	13	32.5
	3-4 year	8	20
	Above 5 year	10	25

Table 1 – reveals the distribution of subjects according to the demographic variables. Considering the age group, 0% belonged to the age group of 15-25yrs, 25% to 25-40yrs, 47.5% to 40-60yrs, above 60yrs to 27.5% in pre test groups. Regarding sex, 72.5% were males and 27.5% were female in pre test groups. Regarding the religion, majority 70% to Hindu, 12.5% to Muslim, 17.5% to Christian. Regarding the educational status, 40% to middle school, 22.5% to higher education, 10% to degree course, and 11% to uneducated. In relation to occupational status in the experimental group, 42% were coolies, 20% were agriculture, 20% were business, and 17.5% were employee. With regard to family income in the experimental group, 25% belonged to the income group of less than Rs.3, 000/- per month. 50% to Rs. 3,001-5,000/- per month, 25% to more than Rs 5,000/- .Regarding the sources of health information in the pre test group, 27.5% to family members, 12.5% to friends, 15% to media, and 45% to health Personnel. In relation to working pattern in the pre test group, 25% to heavy working, 30% to sedentary working, 45% to moderate working pattern. Regarding family history of diabetes, 40% to yes, 32.5% to no, and 27.5% to unknown cases in pre test group. Regarding community, 25% to urban, 20% to rural, 37.5% to semi urban, 17.5% to sub rural population. Regarding in duration of disease, 22.5% to 0-1yrs, 32.5% to 2-3yrs, 20% to 3-4yrs, and 25% to above 5yrs in the pre test group.

Table 2: level of diabetic foot ulcer among pre test group

n= 40

S. No	Degree of diabetic foot ulcer among pre-test group	Pre test (1 ST Day)	
		No	%
1.	Healthy tissue Wound regeneration Wound degeneration	- - 40	0%
2.			0%
3.			100%

Table 2 reveals that 40(100%) of clients have wound degeneration, and there is no case of healthy tissue and wound regeneration in the pre test.

Table 3: Effectiveness of citric acid dressing on post test group

n= 40

S. No	Effectiveness of citric acid dressing on post test group.	Post test (7 th Day)	
		No	%
1.	Healthy tissue Wound regeneration Wound degeneration	5	12.5
2.		35	87.5
3.		-	-

Table 3 shows that 35(87.5%) of study participants attained wound regeneration, 5 (12.5%) had healthy tissue and there is no case of wound degeneration in the post test group.

Table 4:-Data On Comparing The Mean And Standard Deviation Of Pre Test And Post Test Group.
n=40

Variables	Pre test score(1Day)		Post test score(2 nd Day)		Paired 't' test
	Mean	S.D	Mean	S.D	
Bates Jansen wound scale	36.6	6.1	16.0	3.0	29.3 * * * P< 0.001

Table 4 shows that in the pre test bates Jansen wound scale; the mean was 36.6 with a standard deviation of 6.1. In the post test the mean value of the overall bates Jansen wound scale was 16.0 with a standard deviation of 3.0, clearly indicate bates Jansen wound scale between pre test and post test "t" value of 29.3* * *which is highly significant at p<0.001 level. It showed that healing foot ulcer among diabetic patients after using citric acid in the post test group.

IV. Discussion:

The study evaluated the effectiveness of citric acid in healing foot ulcer among diabetic patients. The study findings are discussed in this chapter with reference to the objectives, the frame work and hypothesis stated. Nowadays various methods of experimental study to promote the healing process of diabetic foot ulcer. In this study, the mean post-test foot ulcer level is 16.0 was lower in the pre test group. The obtained paired't' test value is 29.3 *** was statistically significance at P<0.001. It is inferred that citric acid dressing was effective in healing foot ulcer among diabetic patients. The interpretation of above findings clearly picture that the mean values of the diabetic foot ulcer has a positive difference with't' values, statistically significant at P<0.001. This indicates that there is a significant healing foot ulcer and improvement in granulation, epithelialisation occurred after using citric acid in the experimental group. There was good response to citric acid dressing on wound healing of diabetic foot ulcer. Citric acid solution dressing is the more effective on wound healing of diabetic foot ulcer. It is simple and better than other dressing solution used for diabetic wound dressing. For each dressing, approximately 50 to 100 ml of citric acid solution was needed. Initially wound size was large so more solution was needed and gradually wound size became small after healing which required less solution. Hence the research hypothesis H0 "there will be significance difference in the pre-test and post-test levels of healing foot ulcer among diabetic patients in the post test group result in reject a null hypothesis.

NURSING IMPLICATIONS

"Evidence based care" is more important to fulfil the comprehensive need of the patients. Citric acid is an important bactericidal action for patients with diabetic foot ulcer. The findings of the study have several implications in nursing practice, nursing education, nursing administration and nursing research.

V. Conclusion

Citric acid is an integral part of the diabetic foot care .it is a simple and relatively safer method. The use of citric acid for diabetic foot ulcer patients is beneficial in reducing foot ulcer and improving granulation actions. The hypothesis stated there is Mean Bates Jansen scale score will be significantly lower than the Mean Bates Jansen scale after the administration of citric acid among the patients with diabetic foot ulcer is accepted. The statistical data that has been analysed also supported the background literature. The investigator concluded that citric acid dressing is an effective tool in reducing foot ulcer and promoting healing and granulation functions of diabetic foot ulcer patients.

References

- [1]. Brunner and Suddarth (2004), "Textbook of Medical Surgical and Nursing", 10th Edition: Lippincott Publishers, Philadelphia. New Delhi Pp no. 1375-1435.
- [2]. Boulton .AJM et al, "Neuropathic diabetic foot ulcers" 3rd edition: Lippincott publishers, New Delhi,Pp.no- 351:48
- [3]. Basavanthappa B.T. (2003), "Medical surgical nursing", 1st edition: Jaypee brother's medical publishers, New Delhi, Pp no.687-711.
- [4]. Black M. Joyce, Hawks Hokanson Jane (2005), "Medical surgical nursing", 7th edition: Saunder's publishers. Pg no.1243-1288.
- [5]. Carol Taylor et al (1997)," Fundamentals of Nursing- the art and science ofnursing care", 3rd Edition: Lippincott publishers, New Delhi, Philadelphia. Pp no.687-711.
- [6]. Dirksen Ruff Shannon, Lewis Manlik etal (1996), and "Clinical companion to medical nursing" 1st edition: Mosby Publications, Missouri, New Delhi, Pp no. 174- 184.

- [7]. Ignatavicius. D. (2004) "Medical Surgical Nursing" 4th edition: W.B. Saunder's company, New Delhi, Pp no. 1584-1621.
- [8]. Lewis, Heitkemper and Dirksen (2004), "Medical surgical nursing", 6th Edition: Mosby Publishers, Missouri. New Delhi, Pp no. 1253 – 1288.
- [9]. Lewis L. Sharon, Heitkemper et al,(2007) "Medical Surgical Nursing", 7th edition: Mosby publishers, New Delhi, Pp no. 1253 – 1288.
- [10]. Mahajan B.K. (2004), "Methods in Bio-statistics- for Medical students and research workers", 6th Edition: Jaypee Brothers Medical Publishers Pvt., Ltd., and New Delhi. Pp no- 876-879.
- [11]. Marilyn E. Parker (2006), "Nursing theories and Nursing practice", 2nd Edition: F.A. Davis company, Philadelphia. New Delhi, Pp no- 675-678

APPENDIX-III

Before application of citric acid dressing



After application of citric acid dressing



Investigator applied citric acid over diabetic Foot ulcer patients



