

Outcome of Vinegar Versus Normal Saline Dressing in Diabetic Foot Ulcers

Vinegar VS
Normal Saline
Dressing in
Diabetic Foot
Ulcers

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ABSTRACT

Objective: To evaluate the outcome of vinegar compared to normal saline dressings in diabetic foot ulcers in terms of rate of negative cultures, change in necrotic material amount and change in wound surface area.

Study Design: Randomized clinical trial study

Place and Duration of Study: This study was conducted at the Department of Surgery, Jinnah Hospital Lahore from 1st July 2025 to 31st December 2025.

Methods: Eighty-four patients aged 20 to 65 years of both genders having Wagner grade 3 and 4 diabetic foot ulcers were randomized through lottery method for one of treatment. In Group A normal saline dressings were started in wet to dry manner and in Group B vinegar dressings were done in wet to dry manner. Data was entered in SPSS version 22.0 and analyzed. Frequency and percentages were calculated for qualitative variables like gender, rate of negative of wound cultures.

Results: The baseline characteristics of patients were comparable in both groups. The wound size was decrease lesser in normal saline group to 2.76 ± 0.83 while in vinegar group it decreased to 1.36 ± 0.84 . The necrotic wound size was decrease lesser in normal saline group to 1.09 ± 0.60 while in vinegar group it decreased to 0.25 ± 0.35 . The results were statistically significant ($p < 0.001$). Almost 95% of infections got cleared by vinegar while 76% infections were cleared by normal saline at 8 weeks ($p = 0.013$).

Conclusion: Vinegar dressing is better than normal saline dressing for diabetic foot ulcers for decreasing size of wound, necrotic material as well as infection rate.

Key Words: Vinegar dressing, Normal saline dressings, Diabetic foot ulcers

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INTRODUCTION

The physical barrier for body to protect against bacterial invasion is the skin, which may be destroyed either surgically or by trauma, sometimes leading to sepsis and even death.¹ These wounds also have physical, nutritional, vocational, financial, psychological and social toll on the patient.² One type of these wounds are diabetic foot ulcers (DFU) which are a common, highly morbid consequence of longstanding and poorly managed diabetes and one of the most difficultly treated wounds. Of the estimated 537 million people worldwide who have diabetes, 19% to 34% will develop a DFU in their lifetime.³

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DFU is associated with numerous risk factors and has complex mechanisms and insignificant clinical manifestations. Its pathogenesis is roughly categorized into peripheral neuropathy, Peripheral arterial disease and infection.⁴ Out of these, infection is treatable with adequate debridement, antibiotics and proper dressing. The different materials used in the past include honey, vinegar, wine and spider webs. Modern types of dressings made their appearance in the twentieth century which included gauze, lint and plasters.⁵

In a retrospective study comparing normal saline and vinegar therapy, the size of necrotic tissue in wound decreased by 4.1 cm by vinegar therapy while there was no change with normal saline dressings ($p < 0.02$). The vinegar therapy was 70% effective in making culture negative as compared to 40% of saline therapy at end of 3 weeks ($p < 0.001$). The mean decrease in size of wound was 2.67 ± 1.0 cm in vinegar group as compared to 1.55 ± 0.4 cm in saline group ($p = 0.001$).⁶ Another quasi-experimental study shows that there is significant reduction in stage of diabetic foot ulcer with use of vinegar.⁷ In some older studies it has been shown to be effective against pseudomonas destroying later in 14 out of 16 patients with two weeks treatment.⁸

The rationale of this study is that healthy wound healing is a very important part of treating the patients

with DFU. It helps to reduce anxiety of patient, hospital stay, healthcare burden and other patient problems. There are a number of dressings available with variable effectiveness for DFU but are also costly. The two types of dressings under consideration are cheap, easily accessible and easy to use. Also despite the effectiveness, locally there is very less utilization of this kind of dressing. But keeping the need of the hour under consideration, the study is undertaken to compare the outcome of vinegar compared to normal saline dressings in diabetic foot ulcers in terms of rate of negative cultures, change in necrotic material amount, changes in wound surface area in our setting to evaluate technique that has better outcome and reduce morbidity for patients.

METHODS

This randomized clinical research was conducted at the Department of Surgery, Jinnah Hospital, Lahore, Pakistan, from 1st July 2025 to 31st December 2025. The study was approved by College of Physicians and Surgeons vide letter number CPSP/REU/SGR-2022-055-14063 dated 1st January 2025 and also registered with clinical trials numbered NCT07373327. Eighty-four patients were selected by non-probability consecutive sampling. The sample size was calculated keeping confidence level at 95%, power of study at 80% and assuming the treatment efficacy by culture at end of 3rd week of saline and vinegar were 40% and 70% respectively.⁶ The patients aged 20 to 65 years of both genders having Wagner grade 3 and 4 diabetic foot ulcers were included. The patients having Wagner grade 1, 2, 5 and 6 diabetic foot, received radiotherapy, chemotherapy, steroids, immunosuppressive drugs or any allergies to vinegar were excluded. Diabetic foot ulcers are ulcers which occur on feet of diabetic patients. They may occur on the sole or any of the toes of foot. They were classified according to Wagner classification in this study. Grade 3 and 4 included severe ulcer without and with bone involvement respectively. The outcome of the study was measured in terms of negative culture rate, change in amount of necrotic material as well as change in size of wound. The bacteriological cultures were assessed in coordination with pathology department. The swabs were taken weekly and reports recorded up till the wound was culture free. The change in amount of necrotic material, measured in centimeters was the non-viable tissue in wound; assessed using manual planimetry weekly up till complete healing. The change

in wound size in centimeters was measured by planimetry from start day of dressings. The wound outcomes were recorded on baseline, 1st to 8 weeks on weekly bases and then fortnightly till complete healing. Complete epithelialization of wound was considered as healing.

Informed consent was taken from each subject. Subjects were randomized through lottery method for one of treatment. In Group A normal saline dressings were started in wet to dry manner and in Group B vinegar dressings were done in wet to dry manner. The vinegar solution was prepared by adding a tablespoon of plain white vinegar to a cup of normal saline. Then, soak clean gauze with vinegar solution just so much that it's wet and not drips. The soaked gauze was applied to wound, and this was covered by dry gauzes. This process was done at least twice daily. The normal saline dressing was done by simply washing wound with normal saline and doing wet to dry saline-soaked dressing twice daily. The diabetic control was strictly observed. Data was entered in SPSS-22.0 and analyzed. The Chi-square test was applied for qualitative variables while student t-test was applied for quantitative variables. A p<0.05 was taken as statistical significance.

RESULTS

The baseline characteristics of patients were comparable in both groups. These characteristics included age (years), gender and duration of disease, grades of diabetic ulcers, co-morbidities and presenting complaints (Table 1). The wound size was similar in both groups at baseline, 6.14±0.83 in vinegar and 6.27±0.62 (p=0.420). The necrotic wound size was, however, 3.60±0.64 in vinegar and 3.76±0.58 in normal saline group (p=0.250). The size of both these started to decrease from the first week onwards. The wound sizes were decrease lesser in normal saline group to 2.76±0.83 while in vinegar group it decreased to 1.36±0.84 (p<0.001). The necrotic wound sizes were decrease lesser in normal saline group to 1.09±0.60 while in vinegar group it decreased to 0.25±0.35 (p<0.001). The results were statistically significant (Table 2). Almost 95% of infections got cleared by vinegar while 76% infections were cleared by normal saline at 8 weeks (p=0.013) (Table 3). The decrease in wound size was more significant in 46 to 60 and more than 60 years of age (p<0.001) (Table 4). Figures 1 and 2 showed graphical representation of decrease in size of wound as well as infected wound size.

Table No.1: Baseline characteristics of patients (n=84)

Variable	Vinegar	Normal Saline	P value
Age (years)	53.31±7.25	53.88±6.93	0.713 ^(f)
Gender			
Male	23 (54.8%)	20 (47.6%)	0.513 ^(c)
Female	19 (45.2%)	22 (52.4%)	

Duration (weeks)	12.10±6.03	11.45±5.17	0.602 ^(t)
Wagner Grade			
Grade-3	30 (71.4%)	30 (71.4%)	-
Grade-4	12 (28.6%)	12 (28.6%)	
Hypertension	20 (47.6%)	19 (45.2%)	0.827 ^(c)
IHD	11 (26.2%)	6 (14.3%)	0.277 ^(c)
Debridment done	42 (100%)	42 (100%)	-
HbA1C	8.95±1.09	8.95±1.12	0.992 ^(t)
Presenting Complaint			
Discharge with fever	4(9.5%)	6(14.3%)	0.617 ^(c)
Foul smell and discharge	9(21.4%)	4(9.5%)	
Foul smell with necrotic tissue	11(26.2%)	10(23.8%)	
Pain and discharge	5(11.9%)	9(21.4%)	
Pain with difficulty walking	7(16.7%)	6(14.3%)	
Swelling & pain	6(14.3%)	7(16.7%)	

(t): Independent sample t-test, (c): Chi Square test

Table No. 2: Infected wound necrotic size and wound size in groups (n=84)

Week	Infected Wound Necrotic size (cm)			Wound Size		
	Vinegar	Normal Saline	p-value	Vinegar	Normal Saline	p-value
Baseline	3.60±0.64	3.76±0.58	0.250	6.14±0.83	6.27±0.62	0.420
1 st	2.89±0.52	3.48±0.61	<0.001*	5.38±0.72	5.86±0.71	0.003*
2 nd	1.89±0.56	3.03±0.58	<0.001*	4.29±0.77	5.18±0.68	<0.001*
3 rd	1.04±0.53	2.45±0.61	<0.001*	3.22±0.74	4.43±0.74	<0.001*
4 th	0.47±0.40	1.89±0.56	<0.001*	2.32±0.84	3.88±0.68	<0.001*
8 th	0.25±0.35	1.09±0.60	<0.001*	1.36±0.84	2.76±0.83	<0.001*

*p-value <0.05

Table No.3: Infection clearance in study groups

Variable		Vinegar	Normal Saline	p-value
Infection Clearance	Baseline	-	-	-
	Week-1	4 (9.5%)	4 (9.5%)	-
	Week-2	21 (50%)	15 (35.7%)	0.186 ^(c)
	Week-3	32 (76.2%)	21 (50%)	0.013 ^(c)
	Week-4	34 (81%)	25 (59.5%)	0.032 ^(c)
	Week-8	40 (95.2%)	32 (76.2%)	0.013 ^(c)

(c): Chi Square test

Table No.4: Comparison of Wound Size and Infected wound necrotic size at 8th week post treatment stratified for patient’s characteristics

Variables	Group	Wound Size		p-value	Infected Wound Necrotic size		p-value
		N	Mean±SD		N	Mean±SD	
29-45 Years	Vinegar	7	1.68±1.15	0.499	7	0.51±0.44	0.026*
	Normal Saline	4	2.17±1.00		4	1.21±0.36	
46-60 Years	Vinegar	29	1.30±0.84	<0.001	29	0.19±0.31	<0.001*
	Normal Saline	33	2.72±0.75		33	1.04±0.60	
>60 Years	Vinegar	6	1.25±0.38	0.001	6	0.25±0.33	0.028*
	Normal Saline	5	3.42±0.96		5	1.33±0.74	
Gender							
Male	Vinegar	23	1.46±0.82	<0.001*	23	0.27±0.30	<0.001*
	Normal Saline	20	2.89±0.75		20	1.14±0.67	
Female	Vinegar	19	1.23±0.88	<0.001*	19	0.23±0.39	<0.001*
	Normal Saline	22	2.63±0.89		22	1.05±0.52	
	Normal Saline	24	2.79±0.99		24	1.21±0.67	

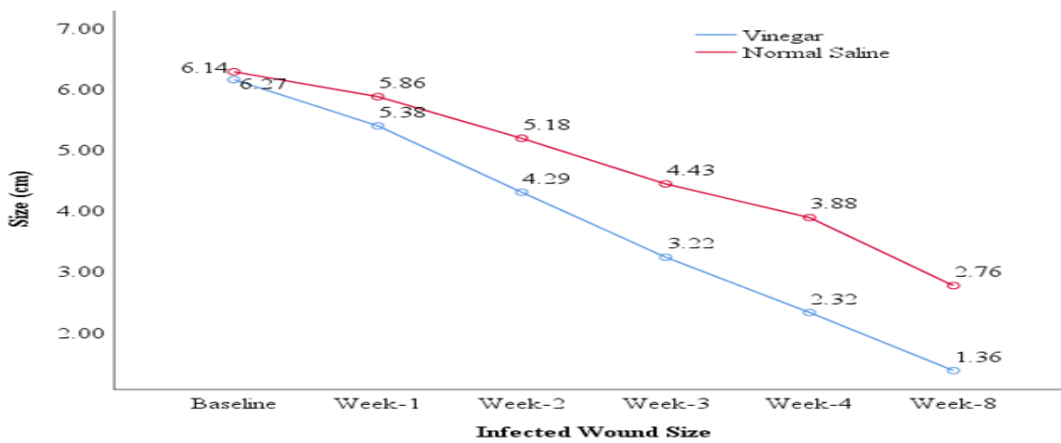


Figure No. 1: Infected wound necrotic size at different follow up interval

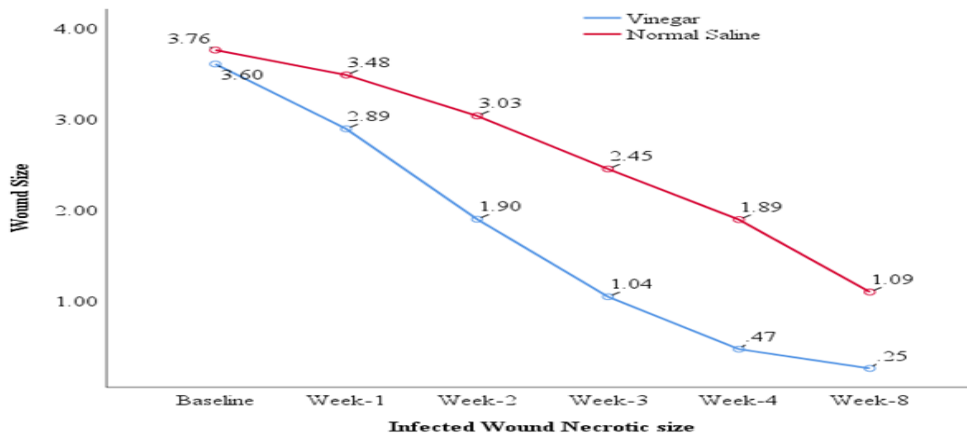


Figure No. 2: Wound size at different follow up interval

DISCUSSION

The severe complications of diabetes include foot ulcer as well as gangrene.⁹ Almost 85% of amputations in non-trauma patients result from diabetic foot ulcers (DFU). DFU are associated with extensive infections which results in gangrene.¹⁰ Diabetic foot ulcers have multifactorial etiology. Almost 45 to 60% of these are neuropathic in nature while rest 45% have mixed ischemic as well as neuropathic components.¹¹ The management of wound is very significant in these cases as chronic wounds like DFU can add to economic burden in the form of expensive treatments and medical visits along with possibility of complications including infections, hospitalizations or amputations.¹² The cleansing of wound and appropriate dressings are very essential in this regard.¹³ Hippocrates in ancient Greece used vinegar to treat wounds from 460 to 370.¹⁴ Our study is the first comparative study for comparing vinegar therapy with conventional saline soaked dressings. It is, to the best of our knowledge, the first randomized trial to compare both.

Acetic acid present in vinegar acts as antibiotic at low concentrations including killing Gram-negative and Gram-positive pathogens which are opportunistic and act as biofilms. Other compounds in vinegar enhance the effect of acetic acid to accelerate its effect on

bacteria.¹⁵ Using vinegar soaks for 15 minutes a day effectively decrease the wound pH and reduce bacterial load. This has been also shown to be effective for *Staphylococcus aureus* and other gram-negative rods in previous case series.¹⁶

The wound and necrotic wound size started to decrease from first week onwards in our study, however, decrease was lesser in normal saline group to 2.76 ± 0.83 while in vinegar group it decreased to 1.36 ± 0.84 ($p < 0.001$). The necrotic wound sizes decrease lesser in normal saline group to 1.09 ± 0.60 while in vinegar group it decreased to 0.25 ± 0.35 ($p < 0.001$). The results were statistically significant (Table 2). Almost 95% of infections got cleared by vinegar while 76% infections were cleared by normal saline at 8 weeks ($p = 0.013$) [Table 3]. The decrease in wound size was more significant in 46 to 60 and more than 60 years of age ($p < 0.001$) [Table 4]. Fana et al¹⁷ also showed that vinegar use effectively debrided the non-healing diabetic foot ulcers. They showed that there was rapid decrease in the size of wound, growth of bacteria and improvement in the granulation tissue. They showed that wound healing was complete within three weeks' time with vinegar in comparison to 0% with conventional therapy. Other dressing materials like honey, olive oil and papaya have been more under consideration in the past. AlSaleh et al¹⁸ concluded that

85% of patients treated with honey had complete ulcer healing in the same time period as 55% had complete healing with conventional dressings. The acetic acid soaks have also shown improvements in literature. Nayak et al¹⁹ showed that the wound decreased from 41.05 ± 4.77 to 24.6 ± 12.87 ($P < 0.001$) with acetic acid soaks while no significant change was observed in the control group ($P=0.94$).

CONCLUSION

Vinegar dressings are more effective than conventional normal saline dressings in treatment of diabetic foot ulcers for decreasing wound size and reducing infection of wound.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Mian Muhammad Bilal, Khushbakht Ali Khan, Masooma Bukhari
Drafting or Revising Critically:	Masooma Bukhari, Ghufuran Akbar, Farhan Javed
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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