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Original Research Paper

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COOLED BOILED WATER VERSUS STERILE NORMAL SALINE IN WOUND CLEANSING, A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Introduction: Wound cleansing plays a vital role in wound management. Although various solutions have been recommended for cleansing wounds, normal saline is favoured as it is an isotonic solution and is not thought to interfere with the normal healing process. Cooled boiled water is commonly used in community settings for cleansing wounds because it is easily accessible, efficient and cost-effective; however, there is an unresolved debate about its use. **Aims And Objectives:** The aim of the study was to test whether there are differences in wound infection and wound healing rates when wounds are irrigated with cooled boiled water compared to sterile normal saline. Can this approach be used in a community environment without risk? **Method:** Subjects were randomly assigned to wound cleansing with cooled boiled water (experimental group) or sterile normal saline (control group). Wound assessment was conducted at each hospital visit, and an assessment of wound size was conducted once a week. The main outcome measures, occurrence of a wound infection and wound healing, were assessed over a period of 6 weeks. **Conclusion:** Study findings indicate that cooled boiled water is a safe alternative to sterile normal saline for wound cleansing and this method can be safely applied to community setting.

KEYWORDS : Cooled boiled water, sterile normal saline, wound cleansing.

INTRODUCTION:

Healthcare professionals are indoctrinated during their training to believe that sterile is best and anything less does not have a place in wound care. Wound cleansing has been described as often ritualistic, not evidence-based and inconsistent with significant variability in the irrigation techniques and fluids employed. Wound cleansing plays a vital role in wound management, and a variety of solutions and techniques are used to cleanse the wound, prevent infection, promote healing, reduce discomfort and reduce the cost of care. In most situations, sterile normal saline is used in both western and eastern countries because of its isotonic properties, its osmotic pressures, which are similar to intracellular fluid, as well as its sterile and noncytotoxic properties.

Tap water as an irrigation fluid is certainly cost-effective, can be patient-delivered and a feeling of wellbeing has been reported by patients who were allowed to shower their own surgical wounds. The demand for wound care management in the community setting is increasing, as acute care facilities attempt to reduce length of hospital stays and rely more on community services. In addition, cooled boiled tap water costs less than sterile normal saline, and it is both readily available in the community setting and relatively affordable to most.

The cost of sterile saline, combined with manufacturer recommendations that the contents of the bottle be discarded 24 hours after opening, results in higher costs than those associated with cooled boiled tap water. Community nursing aims at maximizing existing resources to achieve optimal health outcomes for individuals. Use of cooled boiled tap water for wound cleansing in the community setting is anticipated to augment self-management of wounds at home. Hence, more evidence is needed to support its safe use in the community setting.

Cleansing involves the application of fluid to aid removal of loosely attached cellular debris and surface pathogens contained in wound exudate or residue from topically applied wound care products from the wound bed. If the rationale for wound cleansing is to remove loose slough, debris and the components of chronic wound fluid (e.g. senescent cells, proteases, bacteria), then the choice of a solution with which the irrigation will be carried out should be one that will do no harm and prevent infection while achieving this objective.

METHODS:

In order to test this hypothesis, we conducted a randomized controlled trial. Data were collected over a time period: from January 29 to March 5, 2023 (6 weeks). 96 Subjects were recruited from the general surgery department, K R Hospital, MMCRI, Mysuru. Inclusion criteria for the study were: age 18 years or more and receiving either chronic or acute wound care treatment from our hospital. Exclusion criteria were immunosuppressed persons, long-term corticosteroid therapy.

Subjects were randomly assigned to cleansing with cooled boiled tap water (experimental group) or sterile normal saline (control group) by computer-generated random numbers.

OUTCOME MEASURES:

The main outcome measures were wound infection and wound healing. Wound infection was defined as an invasion of bacteria into healthy tissues, followed by continued proliferation and a host reaction including erythema, pain, swelling, persistent high-volume exudate, odour, and delayed healing. We operationally defined a wound infection as clinical signs and symptoms like erythema, presence of high volume of exudates and odour, and sensation of increased pain by subjects. Wound healing was measured by the change in wound size and the presence of epithelial tissues on the wound bed. Wounds were measured using a flexible wound measuring scale, which is considered a standardized measurement for wound size. Two-dimensional measurements in the form of surface area were done by measuring its linear dimension, for example, a rectangle (length × width), a circle (diameter × diameter), or an oval (maximum diameter × maximum diameter perpendicular to the first measurement).

Study procedures:

Study procedures were reviewed and approved by the Ethical Committee of MMCRI, Mysuru. Informed consent was obtained from subjects if they were cognitively alert, or proxy

consent was obtained from the subject's guardian if the subject was unable to sign the consent form. Wound infection and healing were assessed each time when the wound was cleansed. Wound size was measured weekly.

Baseline data were extracted which included sex, age, medication use, medical history, personal hygiene, mental status, attitude of caregivers toward patients, wound type (acute or chronic), size, location, and frequency of wound dressing. Baseline data were collected as a part of an initial assessment on newly admitted patients. This baseline information was extracted to see whether there were any baseline differences between the experimental and control groups.

Preparation of cleansing agent:

No guidelines were given as to how the wounds should be irrigated, volume of solution to use, or time length of irrigation, therefore, it is difficult to determine if the solution or technique was responsible for any results reported.

A boiler was used to collect tap water, which was then heated to boiling point (100 °C), allowed to cool to room temperature, and then collected in sterile containers for usage.. Sterile normal saline used in the study was supplied by the hospital. Both solutions had to be used within 24 hrs after collection as chlorine in tap water dissipates after that time. Irrigation methods were identical with both solutions, increasing validity and reliability of the trial.

Data Analysis:

Statistical analysis was performed using the Statistical Package for the Social Science Program latest version (SPSS Chicago, IL). Descriptive statistics were used to examine all the variables under study. Since all the study variables had *P* values larger than .05 in the normality tests (indicating study variables were not normally distributed), nonparametric inferential tests were used to detect differences between groups.

The Mann-Whitney *U* test was used to test differences between the experimental and control groups based on age, initial wound size, frequency of dressing changes. The Fisher exact test was used to test for differences in nominal variables such as sex, medication use, comorbid conditions, personal hygiene, mental status, attitude of the caregiver toward patients, wound type, location, wound infection, presence of epithelialization and granulation, presence of inflamed peri-wound skin, exudate volume (dichotomized as high vs low), and presence of severe wound pain.

RESULTS:

Hundred persons were identified as potential subjects, and 04 were excluded based on a prior exclusion criteria. Consequently, 96 subjects (26 female and 70 male) were included in the study. Random allocation resulted in 48 subjects (14 female and 34 male) in the cooled boiled tap water (experimental) group, and 48 subjects (12 female and 36 male) in the sterile normal saline (control) group.

The average age of the 96 subjects was 57.15 ± 11.22 years (mean ± standard deviation). 81.25% (n = 78) were judged to have good personal hygiene, and 78.12% (n = 75) received good support from caregivers. Each subject had nearly one (median = 0.82) comorbid condition likely to influence wound healing such as recent acquired infections, anemia, cardiovascular diseases, diabetes mellitus, or peripheral vascular disease.

However, none received chemotherapy agents during data collection. No significant differences between the experimental and control groups were found when analyzed based on demographic characteristics.(Table 1).

Table 1. Demographic And Living Environment Of Study Sample

	GROUPS				
	EXPERIMENTAL (n = 48)	CONTROL (n = 48)	TOTAL (n = 96)		
VARIABLES	n(%)	n(%)	n(%)	Mann Whitney U	P value
Sex					
Male	34(70.83)	36(75)	70(72.91)		0.82[a]
Female	14(29.16)	12(25)	26(27.08)		
Comorbid condition[b]					
No	7(14.41)	6(12.5)	11(11.45)		1.00[a]
Yes	41(85.41)	42(87.5)	85(88.54)		
Personal hygiene					
Good	38(79.16)	40(83.33)	78(81.25)		0.79[a]
Moderate	10(20.83)	8(16.66)	18(18.75)		
Attitude of the caregiver towards patients					
Good	37(77.08)	38(79.16)	75(78.12)		1.00[a]
Fair	11(22.91)	10(20.83)	21(21.87)		
	Mean ± SD	Mean ± SD	Mean ± SD		
Age, (years)	58.12 ± 10.67	56.18 ± 12.77	57.15 ± 11.22	991	0.24[b]

Abbreviation: SD, standard deviation.
a Fisher exact test.
b Comorbid condition likely to influence wound healing.

Table 2 compares wound infection and healing outcomes of the experimental and control groups; no statistically significant differences were found for either variable. 16 wounds (33.33%) in the experimental group versus 17 wounds (34.37%) in the control group were found to be inflamed, 11 wounds (22.91%) in the experimental group and 10 wounds(20.83%) from control group exhibited severe pain, 6 wounds (12.5%) and 7 wounds(14.58%) from experimental and control group respectively showed high-volume exudate. In addition, 42 wounds (87.50%) within the experimental group and 41 wounds (85.41%) in the control group had newly developed epithelialization and granulation. During the study period, no wound from either group healed completely, but 36 wounds (75%) from experimental group and 38 (79.16%) showed decrease in their size.

TABLE 2. Comparison of Outcome Variables (Wound Infection and Wound Healing) Between Experimental and Control groups

	GROUPS			
	EXPERIMENTAL (n = 48)	CONTROL (n = 48)	TOTAL (n = 96)	
VARIABLES	n(%)	n(%)	n(%)	P value
Wound infection				
Wound infection				
Yes	16(33.33)	17(35.41)	33(34.37)	1.00[a]
No	32(66.66)	31(64.58)	63(65.62)	1.00[a]
Inflamed surrounding skin				
Yes	16(33.33)	17(35.41)	33(34.37)	1.00[a]
No	32(66.66)	31(64.58)	63(65.62)	
Presence of severe pain				
Yes	11(22.91)	10(20.83)	21(21.87)	1.00[a]
No	37(77.08)	38(79.16)	75(78.12)	
Presence of high volume exudate				
Yes	6(12.5)	7(14.58)	13(13.54)	1.00[a]
No	32(66.66)	31(64.58)	83(86.45)	
Wound healing				
Decrease in wound size				
Yes	36(75)	38(79.16)	74(77.08)	0.80[a]
No	12(25)	10(20.83)	22(22.91)	
Newly developed epithelialization and granulation				
Yes	42(87.5)	41(85.41)	83(86.45)	1.00[a]
No	6(12.5)	7(14.58)	13(13.54)	

a Fisher exact test.

Figure 1: Images showing decrease in dimension of wound and growth of granulation tissue which was regularly cleansed with cooled boiled water.

DISCUSSION:

We found no differences in wound infection and wound healing outcomes in subjects when wounds were cleansed with sterile saline versus cooled boiled tap water. Considered cumulatively, findings from these studies provide evidence that cooled boiled tap water may be used for cleansing chronic wounds in both hospital and community settings. Further studies with larger sample sizes, multicenter involvement, and longer data collection durations are recommended. To our knowledge, this is the first study to compare sterile saline with cooled boiled tap water in an Asian country, and our findings may be utilised as a basis for future study in this area.

We further acknowledge that perceptions of tap water cleanliness may influence patients' and families' willingness to use it for wound cleansing. We therefore recommend qualitative studies examining patients' perceptions toward and experience with the use of cooled boiled tap water in wound care.

Boiled and cooled water overcomes the contamination and bacterial load expected in tap water. Variation in tap water among the community level is well addressed as the water is boiled and cooled before usage. Tap water can be boiled and cooled without the assistance of medical professionals.

Limitations:

1. Small sample size
2. Boiling the water requires energy source and is time consuming as it has to cool down to room temperature before use. The process is cumbersome and we recommend further research to address these issues.

CONCLUSION:

We found no significant difference in wound infection and healing outcomes when comparing wounds cleansed with cooled boiled tap water to those cleansed with sterile saline. It can be employed in community setting safely to improve patient wound relationship. Additionally it reduces the economical burden in the patients to some extent. Finally, we recommend research establishing safety parameters for cooled boiled tap water prior to its use as a wound-cleansing agent on a local level.

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