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Cooled Boiled Tap Water versus Sterile Normal Saline for Traumatic Wound Cleansing: a Comparative Clinical Trial

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Abstract: Cleansing is a cornerstone of wound management; Studies that compared cleansing solutions as normal saline and boiled water are few. The present study aimed to evaluate the comparative incidence rate of wound infections following cleansing with normal saline and boiled tap water on patients with traumatic clean wounds. Setting the study was carried out at the Emergency Department at the Main University Hospital. Alexandria- Egypt. This is a Quasi-experimental study. Data were collected from 150 patients attending the pre-mentioned setting. A wound assessment sheet was developed for data collection. Subjects were sequentially enrolled, as convenient into either sterile saline solution or boiled tap water. Signs and symptoms of wound infections were watched on 3th, 5th days and at the day of suture removal. Results no significant differences were found between the normal saline and boiled tap water groups at any observational days. There were significance relationship between patients' age and incidence of wound infection in both groups, where χ^2 (^{MC}p) =14.075* (<0.001*) and 11.054* (0.002*), respectively. No significant relations were detected between incidence of wound infection and patient's sex, marital status, or occupation in both groups. Conclusion no significant differences were elicited in the infection rate of wounds cleansed with either saline solution or boiled water, making boiled water a safe and cost-effective alternative to saline solution for wound cleansing. Recommendations; additional randomized controlled trials are needed to determine the effectiveness of various types of water (Tap, boiled, distilled) used for wound cleansing among various populations and settings.

Key words: Wound Cleansing · Saline Solution · Boiled Water

INTRODUCTION

Wound care is considered the cornerstone of health care in hospital, community and nursing home environments [1]. Wounds can be surgical or due to trauma [2]. Traumatic wounds are the second most common reason individuals seek medical care [3].

Many studies reported that about 11 million traumatic wounds is enrolled annually in the emergency departments in USA[2,4-6]. Traumatic wounds are a wide category of injuries caused by physical force. It includes everything from burns to injuries from motor vehicle accidents, crushing injuries and cuts from knives and other sharp instruments and gunshot wounds [2, 7].

Infection is the most common and serious complication of traumatic wounds [8-11]. It is the first suggested cause of delayed wound healing and is more prevalent in traumatic wounds [3, 7, 12]. Wound etiology, patient’s age, delay in treatment and some underlined diseases especially diabetes mellitus can increase the risk of infection [13, 14].

The early signs and symptoms of wound infection include redness and swelling around the skin edges, increasing throbbing or tenderness of the wound; an unpleasant odor coming from the infected wound; pulse rate and temperature elevation; and an elevated white blood cell count. Wound infection increases hospital length of stay, costs of care and risk for further complications [15].

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Cleansing the wound and surrounding skin is a vital component of wound care [16, 17]. Wound cleansing is described by Towler [18] as 'the application of fluid to aid removal of exudates, debris, slough and contaminants. In addition, Miller and Gilchrist [19] mentioned that wound cleansing allow better view of the area for wound assessment.

Despite significant advances in wound care technology in recent years, few studiess has conducted on the use of cleansing solutions [20]. Mirshamsi *et al.* [21] indicated an important role of washing solutions on preventing wound infections. Although various solutions have been recommended for cleansing wounds, normal sterile saline is most often preferred as an appropriate cleansing solution, because it is an isotonic solution, a nontoxic to tissues, does not alter the normal flora of the skin, impede normal healing, damage tissue, cause sensitization or allergies and does not burn or sting when applied [14, 20-22].

Normal Saline solution is commonly used to clean wounds and help prevent infections, but pre-packaged solution is very expensive and large quantities are required in today's health care practices [1]. It is important to note the date of opening a saline container, as bacterial growth in saline may be present within 24 hours of opening the container [23].

Water is an effective wound cleansing solution in the absence of normal saline [16-18]. Gannon [24] mentioned that in practice, patients can cleanse wounds with water as a part of a normal hygiene routine, as long as wounds are not soaked for long periods. Tap water is advantageous because it is easily accessible, less expensive, is chlorinated and monitored for bacterial content through local governments and has been used throughout the years for minor cuts in homes around the world [25-29]. Tap water has been used for centuries as a wound cleanser without evidence of adverse effects or associated infection risk [21]. Several studies have suggested that tap water is a safe, easily accessible and efficacious alternative to sterile saline in the cleansing of lacerations in the emergency department [22, 25, 28, 29].

Cooper and Seupaul [30] reported that little attention is given to wound cleansing; it has become common practice to cleanse wounds with sterile saline, but is this the best practice? There is no agreement amongst wound care authorities on the advantages of using normal saline solutions over cooled boiled water. As the debate over which solution to use for wound cleansing continues, it remains unclear which solutions are appropriate to use. Hence, the purpose of this study was to examine if there is a decrease in infection rates when wounds are cleansed with boiled tap water compared to sterile normal saline.

Operational Definition

Boiled Tap Water: Tap water was boiled & then allowed to cool to room temperature before use; and stored in a sterile bottle for use.

Aim: To evaluate the comparative incidence rate of wound infections following their cleansing with sterile normal saline and cooled boiled tap water on patients with traumatic clean wounds.

Research Hypothesis: Traumatic wound patients who have received boiled tap water for wound cleansing would have less wound infection rates than those on normal saline cleansing solution.

MATERIALS AND METHODS

Design: Quasi-experimental, research design was used for the purpose of study.

Settings: The study was carried out at the Emergency Department at Alexandria Main University Hospital.

Subjects:

- A convenient sample of 150 adult male/female patients, afflicted with traumatic acute clean wounds was included.
- Subjects were involved, provided that they met the following criteria:
- Able to give consent & willing to participate
- Having acute clean traumatic wounds less than 6 hours and could be treated by primary suture.
- Wound length ranging between 5 - 10 cm
- Free from uncontrollable disease (Diabetes Mellitus, Hypertension, or renal disease, etc…).

Exclusion criteria included the following:

- Puncture wounds; bite wounds
- Wounds involving tendon, joint, or bone
- Patients with Diabetic mellitus; significant peripheral disease; immunocompromised conditions (Cancer, AIDS) or patients on corticosteroids or chemotherapy or taking antibiotics.

- Contaminated wounds requiring surgical debridement
- Pregnant patients.

Study subjects were equally and sequentially recruited into two groups (75 patients each) according to the used cleansing solution as following:

- Normal saline (Control) group
- Boiled Tap Water (Study group)

Sample size calculation: Epi info -7 programs was used to estimate the sample size using the following parameters:

- Population size = 250/ 3months
- Expected frequency = 50 %
- Acceptable error = 5%
- Confidence co efficient =95 %
- Minimum sample size =150 patients

Tools of the study: One tool was used in this study for data collection.

Wound Assessment Sheet: This tool was developed by the researchers after a thorough review of related literatures to assess signs of infection, for wounds cleansed with sterile normal saline versus boiled tap water till primary wound closure [2, 3, 7& 21]. It included three main parts:

Part I: This part consisted of socio-demographic characteristics of the studied patients; age, sex, marital status, level of education, occupation….. etc.

Part II: Wound characteristics sheet: it includes wound mechanism (Blunt/sharp), site, length (cm), No. of stitches, post wound dressing treatment, area surrounding and types of solutions used in wound cleansing.

Part III: Signs and symptoms of wound infections. A wound was classified as infected if it exhibited any signs and symptoms of infection; as erythema $\geq$ 1cm, stitch abscesses, purulent drainage, fever $\geq$ 38°C and an elevated white blood cell count.

- Appearance of signs and symptoms of infection was specified and recorded on the observational days (3^{rd}day, 5^{th} day and day of suture removal).

Methods:

- Permission to carry out the study was obtained from the directors and the responsible authorities of the identified setting after explanation of the aim of the study.
- The study tool was developed, based on recent review of literature. Content and construct validity of the developed instruments were ascertained by a jury of 5 experts in the fields of medical surgical nursing and Plastic surgery. The necessary modifications were introduced accordingly.
- Study participants were given a covering letter preceding data collection which included a description of the purpose and nature of the study and a written consent to participate in the study. For illiterate patients, verbal explanation of the covering letter and patients' oral consent were secured. The studied patients were reassured that their participation in the study is voluntary and they could withdraw from the study at any time.
- After obtaining consents, subjects were sequentially recruited into either the control group or the study group
- A Pilot study was conducted on 10% of patients for testing feasibility and applicability of the developed tool and modifications were introduced accordingly. Pilot study patients were excluded from the study sample.
- Upon patients enrollment in the study, initial wound assessment was done, data were recorded for each subject using the study tool part I and II.
- All wounds in both groups were managed according to the following protocol:
- Wounds were anaesthetized using 1% lidocaine
- A 60 ml syringe equipped with an 18 gauge IV catheter was used to deliver the cleansing solution (Normal saline for group I and boiled tap water for group II). Every time, 500 ml of solution was used to clean the wound. Surgical wound assessment and dressing lasted for around 30 minutes each.
- Simple interrupted wound closure and sutures was carried out by the surgeons in charge as needed.
- Wound dressing and reassessment for signs and symptoms of wound infections were carried out for the study subjects as they show up at the study setting and as predetermined on the 3^{rd}, 5^{th} and day of suture removal.

- Two nurses were employed as research assistants to carry out the specific surgical dressing, each for either group. Wound assessment was followed up by the researchers, in conjunction with surgeons in charge.
- Data was collected over a period of 3 months starting from January to end of March 2015.

Statistical Analysis: After data collection, it was coded and transferred into a specially designed format to be suitable for computer feeding. Following data entry, checking and verification process were carried out to avoid errors during data entry.

Statistical analysis was performed using Statistical package for Social Sciences (SPSS version 20). The level of significance selected for this study was p equal to or less than 0.05.

The following statistical measures were used:

- Descriptive measures included: frequency and percentages for describing and summarizing variables. Arithmetic means, standard deviation and range (Maximum and minimum) were used as measures of control tendency and dispersion, respectively, for normally distributed quantitative data.
- Statistical tests included:

- Chi-square test: For categorical variables, to compare between different groups
- Fisher's Exact or Monte Carlo correction: Correction for chi-square when more than 20% of the cells have expected count less than 5

RESULTS

Table (1) shows Distribution of the studied patients according to their sociodemographic characteristics. It demonstrated that the number of males 54% exceeded females 46%. The mean age was 45.61±10.63. The majority of the studied patients (65%) were married, while only 5.3% of them had bachelor degree. More than half of the studied patients (54%) had professional work, while only 5.3% of them were clerical work.

Table (2) Displays distribution of the studied patients according to wound characteristics. More than half of the respondents (50.7%) had blunt wounds and 53.3% of the wounds were in the forearm. All patients had superficial wounds, with median of 7- 8 cm length. Forty two percent of the study subjects had 5 sutures, while only 11.3% of them had 8 sutures.

Table (3), Fig. (1) Illustrate incidence rate of wound infection in both groups according to wound cleansing solution. The results showed that in the Normal Saline group, 6 patients developed wound infections, with incidence rate of 8%, while 10 patients in the boiled tap water group developed wound infections, with incidence rate of 13.3%. No significant differences in wound infection rates were detected between the two groups, since (p=0.290)

Table (4) presents distribution of the infected wounds by type of cleansing solutions according to infection criteria. The table illustrates that each group showed one or more clinical signs of infection. Erythema was the most frequent wound infection criterion in both groups. Half of the infected wounds showed more than one sign of infection in the normal saline group, compared to 60% of the boiled tap water group. No significant differences in all wound infection criteria were noted between the two groups.

Table (5), Fig. (2) Show wound infection incidence rates on different observational days according to wound cleansing solution. The table/figure displays that the highest incidence of wound infection (4&, 6.7% respectively) appeared in both groups by the day of suture removal. No significant differences were found between both normal saline and boiled tap water groups on any of the observational days.

Table (6) displays relationships between incidence of infection and socio-demographic characteristics of the studied patients in the normal saline and boiled tap water groups. Significance relationships were detected between patients' age and incidence of wound infection in both normal saline and boiled water groups, where χ^2?(^{MC}p) =14.075* (<0.001*) and 11.054* (0.002*), respectively. All of the infected wounds in the saline group were in the 50-60 years old, while 80% of them in the boiled tap water group were in the 50-60 years old. Also, there were significant relationships between incidence of wound infection and patients' level of education in both groups. All infected patients in the saline group were illiterate, while 50% were illiterate/read and write in the boiled water group

No significant differences were elicited between incidence of wound infection and patient's sex, marital status, or occupation in both groups.

Table 1: Distribution of the studied patients according to their socio-demographic characteristics

	Normal saline Group (n =75)		Boiled Tap water Group (n =75)		Total (n =150)	
Socio-demographic characteristics	No.	%	No.	%	No.	%
Sex						
Male	20	26.7	61	81.3	81	54.0
Female	55	73.3	14	18.7	69	46.0
Age (years)						
20 >35	28	37.3	21	28.0	49	32.7
35 >50	28	37.3	30	40.0	58	38.7
50 – 60	19	25.4	24	32.0	43	28.6
Mean ± SD	44.51±10.60		46.71±10.62		45.61±10.63	
Marital status						
Single	23	30.7	11	14.7	34	22.7
Married	43	57.3	55	73.3	98	65.3
Divorced	0	0.0	9	12.0	9	6.0
Widow	9	12.0	0	0.0	9	6.0
Educational level						
Illiterate	6	8.0	5	6.7	11	7.3
Read and write	34	45.3	26	34.7	60	40.0
Diploma	35	46.7	36	48.0	71	47.4
Bachelor degree	0	0.0	8	10.6	8	5.3
Occupation						
Clerical work	0	0.0	8	10.7	8	5.3
Professional work	20	26.7	61	81.3	81	54.0
House wife/ not working	55	73.3	6	8.0	61	40.7

Table 2: Distribution of the studied patients according to wound characteristics

	Normal saline Group (n =75)		Boiled Tap water Group (n =75)		Total (n =150)	
Wound characteristics	No.	%	No.	%	No.	%
1-Wound mechanism						
Sharp	39	52.0	35	46.7	74	49.3
Blunt	36	48.0	40	53.3	76	50.7
2-Site of wound						
Upper arm	36	48.0	34	45.3	70	46.7
forearm	39	52.0	41	54.7	80	53.3
3-Depth of wound						
Superficial	75	100.	75	100.	150	100.0
4. Median Wound Length	7-8 cm					
5. Number of sutures / wound						
5	28	37.3	35	46.7	63	42.0
6	27	36.0	19	25.3	46	30.7
7	11	14.7	13	17.3	24	16.0
8	9	12.0	8	10.7	17	11.3

Table 3: Incidence rate of wound infection in both groups according to wound cleansing solution (N=150)

	Normal saline Group (n =75)		Boiled Tap water Group (n =75)		Total (n =150)		
Wound infection	No.	%	No.	%	No.	%	P
No	69	92.0	65	86.7	134	89.3	0.290
Yes	6	8	10	13.3	16	10.7	

Table 4: Distribution of the infected wounds by type of cleansing solutions according to infection criteria.

	Normal saline Group (n =6)		Boiled Tap water Group (n =10)		
Wound infection criteria	No	%	No	%	P
Erythema ≥ 1cm	4	66.7	5	50.0	0.633
Stitches abscesses	1	16.7	2	20.0	1.000
Purulent drainage	0	0.0	1	10.0	1.000
Fever ≥ 38°C	1	16.7	1	10.0	1.000
Elevated WBC_S count	0	0.0	1	10.0	1.000
More than one sign of infection	3	50.0	6	60.0	1.000

Table 5: Wound infection incidence rates on different observational days according to wound cleansing solution

	Normal saline Group (n =6)		Boiled Tap water Group (n =10)		
Days of observation	No	%	No	%	Chi square Test P - value
3rd day	1	1.3	2	2.7	1.000
5th day	2	2.7	3	4.0	1.000
At the day of suture removal	3	4.0	5	6.7	0.719

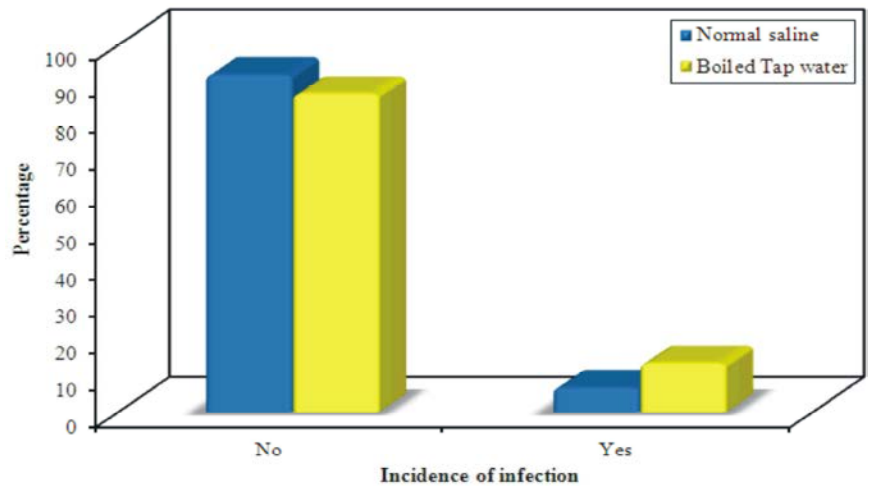

Fig. 1: Incidence rate of wound infection in both groups according to wound cleansing solution (N=150)

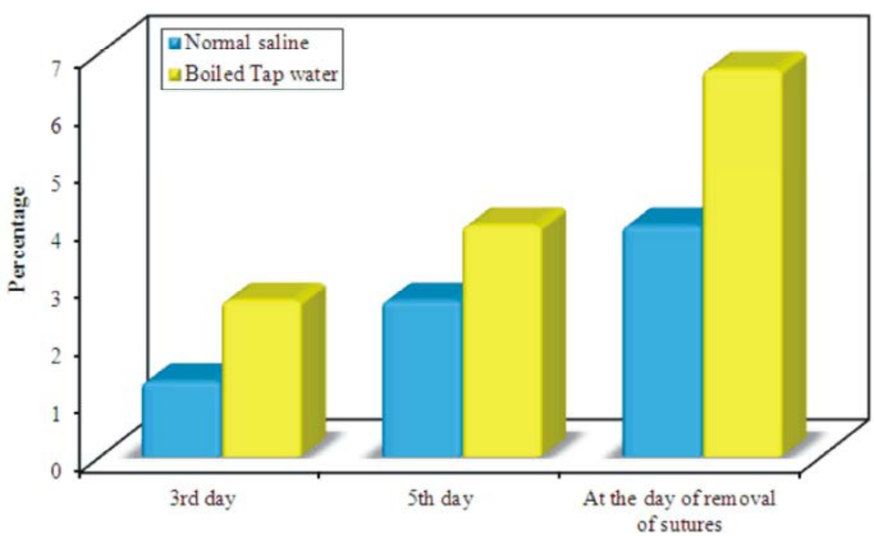

Fig. 2: Wound infection incidence rates on different observational days according to wound cleansing solution

Table 6: Relationships between incidence of infection and socio-demographic characteristics of the studied patients in the normal saline and boiled tap water groups

	Normal saline Group (n =75)				Boiled Tap water Group (n =75)			
	No infection (n = 69)		Infection (n = 6)		No infection (n = 65)		Infection (n = 10)	
Socio-demographic characteristics	No.	%	No.	%	No.	%	No.	%
Sex								
Male	20	29.0	0	0.0	51	78.5	10	100.0
Female	49	71.0	6	100.0	14	21.5	0	0.0
χ^2 (^{FE}p)	2.372 (0.184)				2.648(0.192)			
Age (years)								
20 >35	28	40.6	0	0.0	21	32.3	0	0.0
35 >50	28	40.6	0	0.0	28	43.1	2	20.0
50 – 60	13	18.8	6	100.0	16	24.6	8	80.0
χ^2 (^{MC}p)	14.075* (<0.001*)				11.054* (0.002*)			
Marital status								
Single	19	27.5	4	66.7	11	16.9	0	0.0
Married	41	59.5	2	33.3	45	69.2	10	100
Widow	9	13.0	0	0.0	0	0.0	0	0.0
Divorced	0	0.0	0	0.0	9	13.8	0	0.0
χ^2 (^{MC}p)	3.218(0.151)				3.044 (0.189)			
Educational level								
Illiterate	0	0.0	6	100.0	0	0.0	5	50.0
Read and write	34	49.3	0	0.0	21	32.3	5	50.0
Diploma	35	50.7	0	0.0	36	55.4	0	0.0
Bachelor degree	0	0.0	0	0.0	8	12.3	0	0.0
χ^2 (^{MC}p)	35.228* (<0.001*)				27.446* (<0.001*)			
Occupation								
Clerical work	0	0.0	0	0.0	8	12.3	0	0.0
Professional	20	29.0	0	0.0	51	78.5	10	100.0
House wife/ not working	49	71.0	6	100.0	6	9.2	0	0.0
χ^2 (^{MC}p)	2.372 (0.184)				1.412 (0.542)			

χ^2, p: χ^2 and p values for Chi square test
^{MC}p: p value for Monte Carlo for Chi square test
^{FE}p: p value for Fisher Exact for Chi square test
*: Statistically significant at p = 0.05

Table 7: Relationships between incidence of infection and wound characteristics of the studied patients in the normal saline and boiled tap water groups.

	Normal saline Group (n =75)				Boiled Tap water Group (n =75)			
	No infection (n = 69)		Infection (n = 6)		No infection (n = 65)		Infection (n = 10)	
Wound Characteristics	No.	%	No.	%	No.	%	No.	%
Wound mechanism								
Sharp	35	50.7	4	66.7	31	47.7	4	40.0
Blunt	34	49.3	2	33.3	34	52.3	6	60.0
χ^2 (^{FE}p)	0.562(0.453)				0.206 (0.742)			
Site of wound								
Upper arm	33	47.8	3	50.0	32	49.2	2	20.0
forearm	36	52.2	3	50.0	33	50.8	8	80.0
χ^2 (^{FE}p)	0.010 (1.00)				2.988 (0.101)			
Number of sutures per wound								
5	26	37.7	2	33.3	32	49.2	3	30.0
6	26	37.7	1	16.7	16	24.6	3	30.0
7	9	13.0	2	33.3	12	18.5	1	10.0
8	8	11.6	1	16.7	5	7.7	3	30.0
χ^2 (^{MC}p)	2.779(0.409)				4.514(0.184)			

χ^2, p: χ^2 and p values for Chi square test
^{MC}p: p value for Monte Carlo for Chi square test
^{FE}p: p value for Fisher Exact for Chi square test
*: Statistically significant at p = 0.05

Table (7) presents relationships between incidence of infection and wound characteristics of the studied patients in the normal saline and boiled tap water groups. The table reveals that no significant differences were detected between incidence of wound infection with neither wound mechanism nor wound site in both groups. In addition, there were no significant relationships were noted between incidence of wound infection and number of sutures in both groups.

DISCUSSION

This study entailed an inquiry and a comparison of wound infection incidence following their cleansing with normal saline or boiled water. The most striking finding of this study indicated that there were no significant differences in wound infection rates between wounds cleansed with either normal saline, or boiled tap water. Similar results were reported by Mirshamsi *et al*. [21] as they revealed no significant differences in wound infection rates among wounds cleansed with either normal saline or boiled water. Similarly, Beam [17] and Sasson *et al.* [31] reported no significant difference in wound infection rates between wounds cleansed with either cooled, boiled water or isotonic saline. Weiss *et al.* [3] found that cooled boiled water demonstrated a significant reduction in infection rates for acute adult wounds as saline solution. Interestingly, the finding of Angeras [32] contradicts with the present study findings, as a significantly higher infection rate in the saline group was detected.

Several studies, reported that there has been considerable debate regarding the potential advantages and disadvantages of cleansing wounds with normal saline, as compared with boiled water. Saline solution is the most available solution for wound cleansing; and is an isotonic solution that does not interfere with the healing process or further tissue damage [14, 16, 21]. Sterile Water is non pyrogenic and contains no antimicrobial or bacteriostatic agents or added buffers. It is often used in cleansing, particularly in developing countries, as a less expensive alternative to isotonic saline [23].

Portable tap water in developed countries contains an insufficient number of bacteria to cause wound infections and the few bacteria isolated from tap water are not generally skin pathogens [3]. Also, Flanagan [33] postulated that tap water has been used for centuries as a wound cleanser without evidence of adverse effects or associated infection risk. The history of its use might suggest the safety of tap water as a wound cleanser. Lawrence [34] disputed such study; he claimed that as tap water is not isotonic it could cause tissue damage and pain through osmosis at a cellular level. In addition, Schremmer and Robert [25] stated that tap water is advantageous because it is highly accessible, inexpensive, chlorinated and monitored for bacterial content through local governments and has been used throughout the years for minor cuts in homes around the world.

Although, there were no significant differences in wound infection rates between isotonic saline and boiled water, the present study showed an increased rate of infection in wounds washed with boiled water than those washed with normal saline [13.3 and 8%] respectively. This could be related to the fact that sterile water is hypotonic and may cause hemolysis and will be readily absorbed by the tissues. Normal sterile saline is also regarded as the most appropriate and preferred cleansing solution because it is a nontoxic, isotonic solution that does not damage healing tissues [14, 15]. In this regard, Weiss *et al*. [3] found that the incidence of wound infection was 6.4% in the saline solution group as compared to 3.5% in the tap water. This decrease in infection rate with tap water approached but was not statistically or clinically significant. Also, Fernandez and Griffiths [14] concluded that tap water is a safe and effective wound irrigant as compared with saline solution.

Some investigators argued that tap water should be used for wound cleansing but there are occasions when sterile saline would be preferable. Lindholm *et al.* [35] emphasized that tap water should not be used in the presence of exposed bone or tendons, while Murphy [36] excluded its use with infected wounds. Morison [37] argued that while it is suitable for chronic wounds, surgically closed wounds need sterile solutions [37]. Watret and Armitage [38] claimed that tap water has been shown as an acceptable cleanser for wounds but should not be routinely used as so many wounds do not need cleaning at all.

The present study results showed no statistical significant differences between incidence of wound infections and sex, according to the type of washing solution. Contradicting the results of the current study, Mirshamsim *et al*. [21] found a significant increased incidence rate of wound infection in male wounds washed with water than females.

In addition, the results of the current study displayed that there was a relatively age related incidence rate of infection in both groups as its incidence increased with increase in patient's age. This finding is in line with

Mirshamsi *et al.* [21] who found an increased rate of infection in wounds cleansed with water than those cleansed with normal saline which increased in association with patients' age.

Significant relationships between incidence of wound infection and patient's level of education in both groups were found, as illiterate and read & write patients had the highest incidence of wound infection rates. Level of education probably has an effect on the hygienic care of the patient.

The findings also showed that infection rates progressively increased the days increased, after wound management in both groups and reached its highest rate by the suture removal day. Similar results were reported by Mirshamsi *et al*. [21] who revealed that wound infection progressively increased, by the days after wound management in both groups and finally 8.3% of wounds washed with tap water and 8.6% of wounds washed with normal saline showed one or more clinical signs of infection

As cost management is an increasingly important issue in all aspects of health care, boiled water is much less expensive than saline solution and is more readily available. From an environmental perspective, boiled water could be used in the absence of saline solution is suggested.

CONCLUSIONS

There is no significant difference in the infection rate of wounds cleansed with either saline solution or boiled tap water, making it a safe and cost-effective alternative to saline solution for wound cleansing.

Recommendations:

- Further education is required for staff so as to highlight the rationale for choosing either saline or water in practice.
- Additional randomized controlled trials are needed to determine the effectiveness of various types of water (Tap, boiled, distilled) used for wound cleansing among various populations and settings.
- Because of its availability, low cost, efficiency and effectiveness, boiled water should be strongly considered for wound cleansing.
- Further studies to assess effectiveness of boiled tap water on chronic wound are needed.
- The tap water quality in practice settings should be assessed to see if the water supply is adequate for wound care or if it has known contaminants.

REFERENCES

1. Griffiths, R.D., 2009. Comparing the effects of tap water vs normal saline on the infection and healing rates of wounds. http://www.uws.edu.au/nursing. December, 2009
2. http:/patient. Info/health/wound-infection
3. Weiss, E.A., G. Oldham, M. Lin and T. Foster, 2013. Water is a safe and effective alternative to sterile normal saline for wound irrigation prior to suturing: a prospective, double-blind, randomised and controlled clinical trial. BMJ Open, 3: e 001504. doi:10.1136/ bmjopen-2012-001504.
4. Edlich, R.F., 1984. Current concepts of emergency wound management. Emerg. Med. Reports, 5: 165-180.
5. Hollander, J.E. and A.J. Ginger, 1999. Laceration management. Ann. Emerg. Med, 34: 356-367.
6. Robson, M.C., W.F. Duke and T.J. Krizek, 1973. Rapid bacterial screening in the civilian wound. J. Surg Res., 14: 426-430.
7. http://coastalurgentcareelouisiana.com/Infected Wounds: Signs and Symptoms. APRIL, 8, 2015.
8. Rodeheaver, G.T., D. Pettry and J.G. Thacker, 1975. Wound cleansing by high pressure irrigation. Surg. Gynecol Obstet, 141: 357-362.
9. Chisholm, C.D., 1992. Wound evaluation and cleaning. Emerg. Med. Clin of North Am, 10: 665-672.
10. Day, T.K., 1975. Controlled trial of prophylactic antibiotics in minor wounds requiring suture. Lancet, 2: 1174-1176.
11. Rutherford, W.H. and R. Spence, 1980. Infection in wounds sutured in the accident and emergency department. Ann. Emerg. Med., 9: 350-352.
12. Cohn, S.M., G. Giannotti, A.W. Ong, J.E. Varela, D.V. Shatz, M.G. McKenney, D. Sleeman, E. Ginzburg, J.S. Augenstein, P.M. Byers, L.R. Sands, M.D. Hellinger and N. Namias, 2001. Prospective Randomized Trial of Two Wound Management Strategies for Dirty Abdominal Wounds. Ann. Surg., 233: 409-413.
13. Bennettm, J.E., G.L. Mandell and R. Dolin, 2004. Mandell, Douglas and Bennett's Principles and Practice of Infectious Diseases. Churchill Livingstone Publication.

14. Fernandez, R. and R. Griffiths, 2012. Water for wound cleansing. Cochrane Database Syst Rev;15:CD003861. http://dx.doi.org/10.1002/14651858.CD003861. pub3.
15. Hinkle, J. and K. Cheever, 2001. Brunner and Suddarth's text book of medical surgical nursing. 13th ed. Philadelphia: Lippincott Williams and Wilkins, pp: 1821-1822.
16. Fernandez, R.S., R.D. Griffiths and C. Ussia, 2001. Wound cleansing: which solution, what technique? Primary Intention, 9(2): 51-58.
17. Beam, J.W., 2006. Wound Cleansing: Water or Saline, J. Athlet. Train, 41: 196-197.
18. Towler, J., 2001. Cleansing traumatic wounds with swabs, water or saline. Journal of Wound Care, 10: 231-234.
19. Miller, M. and B. Gilchrist, 1998. Understanding Wound Cleansing and Infection. London, Emap Healthcare.
20. Gannon, R., 2007. Fact file: wound cleansing: sterile water or saline? Nursing Times, 103(9): 44-46.
21. Mirshamsi, M.H., J. Ayatollahi and M.H. Dashti, 2007. Comparison Between Traumatic Wound Infections after Irrigating Them with Tap Water and Normal Saline. World Journal of Medical Sciences, 2(1): 58-61. ISSN 1817-3055 © IDOSI Publications,
22. Griffiths, R.D., R.S. Fernandez and C.A. Ussia, 2001. Is tap water a safe alternative to normal saline for wound irrigation in the community setting? J. Wound Care, 10: 407-411.
23. http://emedicine.medscape.com/article/1895071-overview. Allen G. wound irrigation: Overview, preparation, technique. Updated: Oct 05, 2015: 1-9.
24. Gannon, R., 2007. Wound cleansing: sterile water or saline? Nursing Times, 103, 9: 44-46.
25. Schremmer, Robert, 2004. New Concepts in Wound Management. Clinical Pediatric Emergency Medicine, 5(4): 239-245.
26. Valente, J.H., R.J. Forti and L.F. Freundlich, 2003. Wound irrigation in children: saline solution or tap water?. Ann. Emerg. Med., 41: 609-616.
27. Bansal, B.C., R.A. Wiebe and S.D. Perkins, 2002. Tap water for irrigation of lacerations. Am. J. Emerg Med., 20: 469-472.
28. Godinez, F.S., T.R. Grant-Levy and T.D. McGuirk, 2002. Comparison of normal saline vs tap water for irrigation of minor lacerations in the emergency department (Abstract). Acad. Emerg. Med., 9: 397-406.
29. Moscati, R.M., J. Mayrose and R.F. Reardon, 2007. A multicenter comparison of tap water versus sterile. Acad. Emerg. Med., 14: 404-410.
30. Cooper, D. and R. Seupaul, 2012. Is Water Effective for Wound Cleansing? Annals of Emergency Medicine. Volume 60, No 5: November
31. Sasson, C., A. Kennah and B. Diner, 2005. Evidence Based Medicine: Wound Cleaning – Water or Saline?. Israeli Journal of Emergency Medicine, 5(4) Oct.
32. Angeras, M.H., 1992. Comparison between sterile saline and tap water for the cleansing of acute tissue wounds. European Journal of Surgery, 158: 347-350.
33. Flanagan, M., 1997. Wound Management. Edinburgh: Churchill Livingstone.
34. Lawrence, J.C., 1997. Wound irrigation. Journal of Wound Care, 6: 23-26.
35. Lindholm, C., 1999. Chronic wound and nursing care. Journal of Wound Care, 8(1): 5-10.
36. Murphy, A., 1995. Cleansing solutions. Nursing Times, 91(22): 78-80.
37. Morison, M., 1989. Wound cleansing: which solution? Professional Nurse, 4(5): 220-225.
38. Watret, L. and M. Armitage, 2002. Making sense of wound cleansing. Journal of Community Nursing, 16(4): 27-34.