



HYPOCHLOROUS ION BASED DRESSING: THROWBACK TO THE SURGEONS' CHOICE

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ABSTRACT

1.1 BACKGROUND : As per Robbin's pathology (*Robbins & Cotran Pathologic Basis of Disease - 10th Edition, n.d.*) "an ulcer is the breach of the continuity of skin, epithelium or mucous membrane caused by sloughing out of inflamed necrotic tissue." In an era of modern-day fast track surgery and premier practices of medicine, management of wound remains an archaic, almost omnipresent challenge to a health care provider mediating the need for solutions. The hunt for an optimum dressing agent has been everlasting, one of which is our point of discussion in this study. The addition of Chlorine(Cl₂) to Water(H₂O) gives rise to Hypochlorous ion, a weak acid that has been used traditionally as disinfectant, sterilizer and beaches. These properties can be utilised for wound disinfection and swifter wound healing.

1.2 AIMS AND OBJECTIVES:

- To study the efficacy of Hypochlorous ion-based dressing over traditional normal saline based dressing .
- To study the effects factoring in various associated comorbidities in patients such as Diabetes Mellitus, Peripheral Vascular Disease, Trauma and Pressure Ulcer.

1.3 METHODOLOGY: A comparative study was conducted in a tertiary care facility in India that included 101 patients who were distributed randomly utilizing computerised algorithms into study and control group. The control group received daily normal saline dressing whereas the study group underwent daily hypochlorous ion-based dressing. The subjects were analysed after 4 weeks and evaluated for decrease in wound surface area and improvement of wound quality and tabulated for analysis.

1.4 CONCLUSION: Hypochlorous ion based daily dressing shows significant reduction in wound surface area as well as significantly better and faster improvement in the quality of wound in patients of Traumatic, Diabetic and Pressure Ulcer whereas the results in patients suffering from Peripheral Vascular Disease were equivocal.

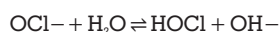
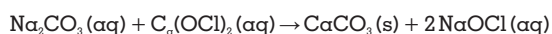
KEYWORDS : Hypochlorous ion based dressing, Wound surface area, Wound Quality, Comorbidities.

2. INTRODUCTION:

As surgeons, we have all been confronted with the pestering challenge of wound management. The grinds of daily dressing are a time-consuming chore for both the surgeon and the patient. In modern day practice of medicine, a search for an ideal wound dressing agent is essential to curtail this necessary evil and optimise the hospital stay of the patient.

Since ancient ages, various aspects of wound and wound healing, together with inventions and innovation into wound care has increased exponentially. In today's day and age, vacuum assisted closure and the usage of hydrocolloids has further advanced the knowledge of wound healing. (*Five Millennia of Wound Care Products--What Is New? A Literature Review - PubMed, n.d.*)

Of the multitude of dressing materials available, one such is hypochlorous ion based dressing.



HOCl, the active ingredient. (*A HANDBOOK OF ANTISEPTICS BY HENRY DRYSDALE DAKIN, D.Sc., F.I.C., F.R.S. AND EDWARD KELLOGG DUNHAM, M.D. EMERITUS PROFESSOR*

OF PATHOLOGY, UNIVERSITY AND BELLEVUE HOSPITAL MEDICAL COLLEGE MAJOR, MEDICAL OFFICERS RESERVE CORPS, U. S. ARMY - Yahoo Search Results, n.d.) has rapid and broad-spectrum antimicrobial activity against clinically relevant microorganisms in vitro and in vivo including vegetative bacteria and to a lesser extent endospore-forming bacteria and fungi. It is fully capable of inactivating all groups of gram-negative and gram-positive bacteria, yeast, and fungi, including *S. aureus*, methicillin-resistant *S. aureus*, vancomycin-resistant *E. faecium* and *Bacillus anthracis* spores (*Hypochlorous Acid: An Ideal Wound Care Agent With Powerful Microbicidal, Antibiofilm, and Wound Healing Potency. Serhan Sakarya, Necati Gunay, Meltem Karakulak, Barcin Ozturk, Bulent Ertugrul - Yahoo Search Results, n.d.*) This action is mediated by the ability to prevent the development of cell wall while destroying the cell walls of existing cell wall and hence the sterilising action. (Heggers et al., 1991)

The presence of co-morbidities such as Diabetes Mellitus, Peripheral vascular Disease, Pressure and Traumatic Ulcer are integral factor in early wound healing. (*11 Comorbidities That Inhibit Wound Healing, by Bruce E. Ruben MD - Yahoo Search Results, n.d.*), they delay the process of healing and worsen the effects of existing ulcer while letting the traditional forms of wound healing redundant.

In consideration of these above-mentioned aspects, we propose to study the efficacy of hypochlorous ion-based dressing in comparison with traditional normal saline based dressing.

3. MATERIAL AND METHODOLOGY:

3.1 Data source:

101 patients admitted in the surgical ward of a tertiary care facility in Western India between 2nd May 2018 to 2nd January 2019.

3.2 Type of study:

Randomised Control Trial, Hospital Based, Time Bound Study

3.3 Sample Size:

101 patients

3.4 INCLUSION CRITERIA:

- Patients aged between 12 to 90 years
- Patients giving consent for Hypochlorous ion-based dressing
- Existence of 1 or more of the 4 co-morbid condition responsible for the ulcer: Diabetes Mellitus, Pressure Ulcer, Peripheral Vascular Disease, Traumatic Ulcer

3.5 EXCLUSION CRITERIA:

- Patients less than 12 and more than 90 years of age
- Patients not giving consent for Hypochlorous ion based dressing
- Associated septicaemia and/or osteomyelitis
- Immunocompromised status
- Any other co existing co-morbid conditions other than mentioned in the inclusion criteria

3.6 Method of data collection:

a. Selected patients underwent measurement of the size of ulcer in largest dimension and subsequently surface area of the ulcer was calculated in mm square at the time of admission and after 4 weeks.

b. Selected patients were analysed for the condition of the ulcer at the time of admission and categorised as:

- Slough (S): Poorest, identified as the presence dead tissue (creamy yellow in colour)
- Granulation (G): Middle condition, identified as the presence light red to pink tissue and moist in nature
- Epithelised (E): Final condition, identified as the reappearance of healthy natural skin cover of the patient, closely matching regular surrounding skin in terms of consistency and colour.

c. The collected data was tabulated and analysed using univariate analysis with chi square and unpaired t test applied to the study model. A p value of less than 0.05 was considered as significant.

d. The participants were divided by randomised computer programs into a study and a control group and analysed over a period of 4 weeks.

4. RESULTS AND TABULATION OF DATA:

The study was conducted in a tertiary care hospital in India and included 101 participants divided into a study and control group randomly. The study participants were divided into a study group containing 51 and a control group containing 50 patients.

4.1 Age Distribution:

Table 1. Mean Age of the participants according to the group

Group	Mean Age	Standard Deviation
Control	54.1 years	15.24
Eusol	53.9 years	18.94

Table 2: Sex Distribution

Condition of the ulcer at the end of 4 weeks	Frequency	Percentage
Deteriorated	3	3.00%
Improved	50	49.50%
No Change	48	47.50%
Total	101	100%

Table 3: Changes in the condition of the ulcer over a period of 4 weeks:

Groups	Sex	Frequency	Percent
Control	F	24	48.00%
	M	26	52.00%
	Total	50	10.00%
Eusol	F	20	39.20%
	M	31	60.80%
	Total	51	10.00%

Table 4: Reduction in the size of the ulcer (in %) over a period of 4 weeks:

Percentage reduction in the size of the ulcer	Frequency	Percentage
<25%	54	53.50%
25 to 50%	36	35.60%
More than 50%	11	10.90%
Total	101	100%

Table 5: Association between reduction in the size of the ulcer after 4 weeks and control and intervention group:

Percentage in size reduction	Control group	Eusol group	Total
<25%	33 (61.1%)	21 (38.9%)	54 (100%)
25 to 50%	13 (36.1%)	23 (63.9%)	36 (100%)
More than 50%	4 (36.4%)	7 (63.6%)	11 (100%)
Chi Square	P Value	Association	
6.253	0.044	Significant	

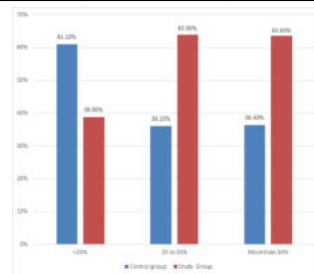


Figure 1: Association between the groups and percentage reduction in size of ulcer

Table 6: Association between condition of the ulcer after 4 weeks and control and intervention group:

Condition of the ulcer at the end of 4 weeks	Control	Eusol group	Total
Deteriorated	1 (33.3%)	2 (66.7%)	3 (100%)
Improved	11 (22%)	39 (78%)	50 (100%)
No Change	38 (79.2%)	10 (20.8%)	48 (100%)
Chi Square	P Value	Association	
32.3	<0.001	Significant	

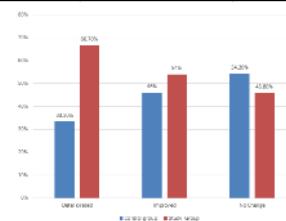


Figure 2: Association between the groups and condition of the ulcer at the end of 4 weeks

Table 8: Comparison of reduction in the size of the wound using unpaired t test:

Group	Mean	Standard Deviation	95% Confidence Interval		P Value
			Lower	Upper	
Control	18.96	13.6476	24.34	13.588	<0.001
Eusol	37.3418	13.79709			

5. DISCUSSION

5.1 Age distribution:

Age of a patient on admission can give valuable insights to us in the epidemiology of a disease. The mean age of the participants was 53.9 years in the study and 54.1 years for the control group thereby signifying the prevalence of ulcers in chiefly late adult age groups. There is no significant variation between the control or the study group and hence age is not a significant factor.

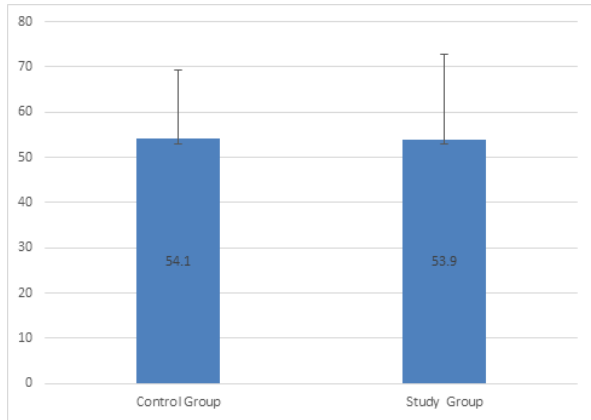


Figure 3: Mean Age of participants

It can be concluded that wound healing is slightly delayed in elderly individuals i.e >60 years of age which is evident on further discussion.

Common problems in the elderly population include diabetes, peripheral arterial disease and chronic venous insufficiency. Impaired wound healing leading to chronic wounds is primarily associated with comorbidities, which are more prevalent in old age. Nevertheless, age (>60 years) is an independent risk factor for less frequent closure of chronic wounds. (Age-Related Aspects of Cutaneous Wound Healing: A Mini-Review. Sgonc R. · Gruber J. - Yahoo Search Results, n.d.)

5.2 Sex Distribution:

The prevalence of wound/ulcer in males was marginally higher than in women and hence demonstrating a clear conclusion that the incidence was higher in men.

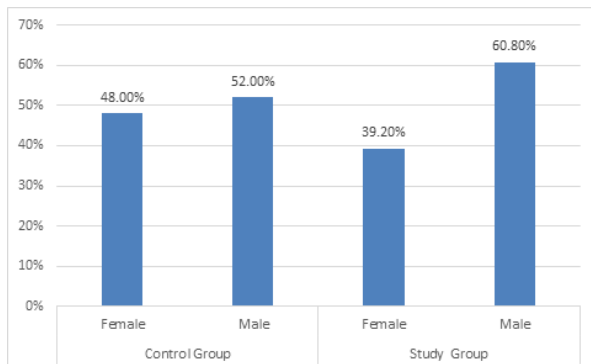


Figure 4: Distribution of participants according to Sex

Leg ulcers are a common chronic wound, with an incidence of

0.3% among the adult male population, rising to 8.3% of males over 85. (Moffatt C. J., Franks P. J., Doherty D. C., Martin R., Blewett R., Ross F. (2004). Prevalence of Leg Ulceration in a London Population. QJM 97, 431-437 - Yahoo Search Results, n.d.)

5.3 Reduction in Size Of Ulcer:

Of the total 51 patients in the study group, 23 of them showed reduction in surface area of the wound in a range of 25% to 50% while 7 patients showed marked reduction of over 50% decrease in surface area. This was in stark comparison with the control group where only 13 and 4 patients of the total 50 evaluated were falling in the aforementioned criteria respectively.

On application of statistical analysis p value for the study group was 0.044 and the association was deemed significant.

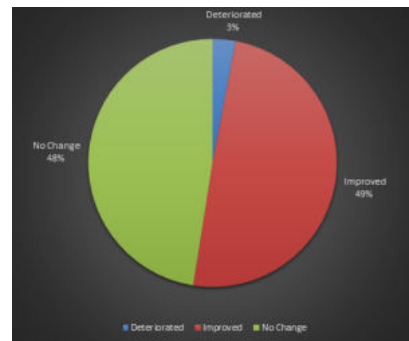


Figure 5: Condition of the ulcer at the end of 4 weeks



Figure 6: Pre and Post Hypochlorous ion based dressing

Majority of ulcers and wounds seen in surgical wards tend to heal by secondary intention especially the ones covered in our study, and hence the burden of reducing the inpatient stay of a patient rests on optimal dressing dictated by the surgeon.



Figure 7: Pre and Post Hypochlorous ion based dressing

Wound healing by secondary intention follows the general principle of granulation. The time frame for wound healing follows the timeline of Inflammatory phase lasting 0-3 days, Proliferative phase of 3-25 days and Epithelial/matrix remodelling phase 15 days to one year. (Secondary Intention

Wound Healing - Pathophysiology and Management. Jan Rice, Manager, Educational and Clinical Services, Wound Foundation Of Australia - Yahoo Search Results, n.d.)The chief principle of dressing is to shorten the time period for achieving the remodelling phase.

The presence of localised infection triggers the body's immunity which reacts with inflammation and delays wound healing.(*Collier M. Recognition and Management of Wound Infections. World Wide Wounds. - Yahoo Search Results, n.d.*), hence the need for a dressing agent that hastens wound healing while simultaneously controlling the localised infection.

Healing by secondary intention is associated with contraction of wound which is associated with the action of fibroblasts on granulation tissue collagen. Hypochlorous ion based dressing is responsible for accelerating the procedure by reducing slough and devitalised tissue while simultaneously acting as a local disinfectant.(*A Randomised Controlled Trial Comparing Eusol and Sugar as Dressing Agents in the Treatment of Traumatic Wounds in Tropical Doctor 39(1):1-3 • February 2009 with 409 Reads. DOI: 10.1258/Td.2008.080322 • Source: PubMed. - Yahoo Search Results, n.d.*)

Diluted hypochlorous ion based solutions by studies shows to affect fibroblasts and hydroxyproline formation. In our setup, the above effect can be negated principally due to the accumulated result of wound contraction as well as cost efficacy it provides.

5.4 Improvement in wound quality:

Of the total 51 patients in the study group, a vast majority showed vast improvement i.e 39 patients and hence better and faster wound healing over 4 weeks while 10 showed no change. In the control group of 50 patients only 11 showed improvement in wound quality and 38 showed no change thereby signifying the superiority of hypochlorous ion based dressing over traditional normal saline dressing in faster and more significant improvement of wound.

On application of statistical analysis p value for the study group was <0.001 and the association was deemed significant.

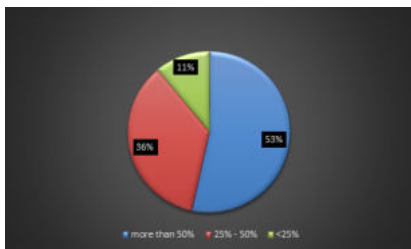


Figure 8: Percentage reduction in the size of the ulcer



Figure 9 :Pre and Post hypochlorous ion based dressing

CONCLUSION:

The selection of a wound dressing is of utmost importance. Various experimental study designs have been formulated for

the dressing and management of multiple types of wounds. (*How to Select a Wound Dressing. The Pharmaceutical Journal 1 NOV 2010. Michael Bennett-Marsden, DipClinPharm, MRPharmS - Yahoo Search Results, n.d.*)In our study the usage of hypochlorous ion based dressing is compared to that of traditional normal saline based dressing. Now, we must note that there is a rationale to usage of various dressing materials is different but the scope of the study is limited to our resources at hand Moist dressing tend to create optimal milieu for fast wound healing. Hypochlorous ion based dressing is a moist dressing technique which provides optimal moisture along with the optimum antiseptics and desloughing action to improve wound quality and bring back healthy granulation and epithelial recovery.(*Wound Dressings. Vanessa Jones, l Joseph E Grey, and Keith G Harding. BMJ. 2006 Apr 1; 332(7544): 777-780. - Yahoo Search Results, n.d.*)

The above finding is in accordance with the general principle, that a granulating and clean surface is produced swiftly especially in chronic wounds with slough. (*EUSOL AND OTHER METHODS OF WOUND TREATMENT, Major C. W. Duggan, R.A.M.C Br Med J 1916 - Yahoo Search Results, n.d.*)

Despite the reducing popularity of hypochlorous ion based dressing in favour of more modern methods, it is still to note that it is one of the cheapest and efficient antiseptic mode of wound management available especially in the tropical countries where resources are scarce and difficult to mobilise with studies proving that over 82% of surveyed plastic surgeons still use it for wound management. (*Eusol: The Plastic Surgeon's Choice? Humzah MD1, Marshall J, Breach NM. J R Coll Surg Edinb. 1996 Aug;41(4):269-70. - Yahoo Search Results, n.d.*)

Hence Hypochlorous on based dressing should still be a surgeon's choice for efficient wound care

6. REFERENCES:

1. Robins and Cotran's Pathologic Basis of Disease. Textbook by Abul K. Abbas, Jon C Aster, MD PhD, Stanley L. Robbins, and Vinay Kumar
2. Five Millennia of Wound Care Products — What is New? A Literature Review. Chantal M. Moués, MD; Freerk Heule, MD, PhD; Ron Legerstee, RN, MSc; and Steven E.R. Hovius, MD, PhD
3. A HANDBOOK OF ANTISEPTICS BY HENRY DRYSDALE DAKIN, D.Sc., F.I.C., F.R.S. AND EDWARD KELLOGG DUNHAM, M.D. EMERITUS PROFESSOR OF PATHOLOGY, UNIVERSITY AND BELLEVUE HOSPITAL MEDICAL COLLEGE MAJOR, MEDICAL OFFICERS RESERVE CORPS, U. S. ARMY
4. Hypochlorous Acid: An Ideal Wound Care Agent With Powerful Microbicidal, Antibiofilm, and Wound Healing Potency. Serhan Sakarya, Necati Gunay, Meltem Karakulak, Barcin Ozturk, Bulent Ertugrul
5. Bactericidal and wound-healing properties of sodium hypochlorite solutions: the 1991 Lindberg Award. Heggers JP1, Sazy JA, Stenberg BD, Strock LL, McCauley RL, Herndon DN, Robson MC.
6. 11 Comorbidities That Inhibit Wound Healing, by Bruce E. Ruben MD
7. Age-Related Aspects of Cutaneous Wound Healing: A Mini-Review. Sgonc R. • Gruber J.
8. Moffatt C. J., Franks P. J., Doherty D. C., Martin R., Blewett R., Ross F. (2004). Prevalence of leg ulceration in a London population. QJM 97, 431-437
9. Secondary Intention Wound Healing - Pathophysiology and Management. Jan Rice, Manager, Educational and Clinical Services, Wound Foundation Of Australia
10. Collier M. Recognition and management of wound infections. World Wide Wounds.
11. A randomised controlled trial comparing eusol and sugar as dressing agents in the treatment of traumatic wounds in Tropical Doctor 39(1):1-3 • February 2009 with 409 Reads. DOI: 10.1258/td.2008.080322 • Source: PubMed.
12. Eusol. D. J. Leaper. BMJ. 1992 Apr 11; 304(6832): 930-931.
13. How to select a wound dressing. The Pharmaceutical Journal 1 NOV 2010. Michael Bennett-Marsden, DipClinPharm, MRPharmS
14. Wound dressings. Vanessa Jones, l Joseph E Grey, and Keith G Harding. BMJ. 2006 Apr 1; 332(7544): 777-780.
15. EUSOL AND OTHER METHODS OF WOUND TREATMENT, Major C. W. Duggan, R.A.M.C Br Med J 1916
16. Eusol: the plastic surgeon's choice? Humzah MD1, Marshall J, Breach NM. J R Coll Surg Edinb. 1996 Aug;41(4):269-70.