

Original Research

Comparative Analysis of the Therapeutic Efficacy of Superoxide Solution (Oxum) Versus Eusol in Surgical Wound Dressing: A Prospective Study

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ABSTRACT

Introduction: All operative wounds are contaminated by micro-organisms but only a minority actually presents clinical infections. Superoxidized Solutions have shown to be both safe and efficient as a wound care product that moistens, lubricates, debrides and reduces the microbial load of various types of lesions. The present study was done to compare the effect of superoxide solution (oxum) v/s eusol in surgical wounds dressing.

Material and methods: All patients admitted to the surgery wards at Guru Nanak Dev Hospital, attached to Govt. Medical College, Amritsar, who underwent any sort of surgical intervention were included. Twenty five patients were included in GROUP A where dressing and management was done using superoxide solution (OXUM) and twenty five patients in GROUP B where dressing and management was done using EUSOL. In both the groups attempt was made to include similar type of wounds. Antibiotics were used in both the groups after taking a swab for culture and sensitivity prior to dressing.

Results: Swab culture was found to be more positive in GROUP B compared to GROUP A. Most common organism found positive were pseudomonas, staphylococcus and E.coli. There were many host factors contributing to delayed wound healing like old age, diabetes mellitus, obesity etc. Superoxide solution and EUSOL both are safe and effective antiseptic solutions and capable of reducing microbial numbers or bacteria present on the wound. Our study observed that there was remarkable reduction in signs of inflammation like oedema and erythema and remarkable increase in signs of healing of the ulcer i.e. granulation and fibrin formation. Healing time was faster in GROUP A compared to GROUP B so as less hospital stay in various categories of wound observed in group A compared to group B. Less morbidity, more improvement and higher cure rate was seen in group A compared to group B. Treatment with superoxide solution reduces the microbial flora and less painful during cleaning and debridement of wound. Example diabetic foot ulcers, venous stasis ulcer, burns, cellulitis etc where superoxide solution can be used safely. Wounds treated with OXUM heals with better cosmetic results. Easily applied and less expensive due to reduced hospital stay.

Conclusion: it was concluded that OXUM shows more favourable results than EUSOL.

Key words: Eusol, Oxum, Wound infection

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INTRODUCTION

Surgical site infections are the most common serious perioperative complications. ¹ The field of hospital infection prevention gained momentum by the end of 1960's. The main focus was on the number and the nature of the micro-organisms contaminating wounds and the nature of human microbial flora in disease states. This led to major advancement in the use of

prophylaxis and therapeutic antibiotics in surgical patients.²

There has always been a search for an ideal antiseptic that is rapidly lethal to all forms of bacteria and their spores, capable of bactericidal property for a prolonged period with no ill effect on host tissues. Superoxidized solutions may represent an alternative to the currently available antiseptics for the disinfection of skin and wounds. Superoxidized

Solutions have shown to be both safe and efficient as a wound care product that moistens, lubricates, debrides and reduces the microbial load of various types of lesions.^{3,4}

Oxum is a stable, non-flammable and non-corrosive bactericidal, virucidal, fungicidal and sporocidal solution that is ready to use with no further dilution or mixing. Super oxide solution (OXUM) is an antiseptic solution consisting of hypochlorous acid (HOCL) 0.003%, sodium hypochlorite (naocl) 0.004% and electrolyzed water 99.97%; it has bactericidal ability against a large array of pathogens. This superoxide solution is a ph neutral, non-irritating, aqueous solution that possesses a good antiseptic, antimicrobial activity and wound healing properties.

EUSOL (an acronym for Edinburgh University solution of lime) is one of several hypochlorite solutions that have been widely used in the management of open wounds left to heal by secondary intention. Eusol consists of a chlorinated lime and boric acid solution containing 0-25% weight/volume of available chlorine with a ph between 7.5 and 8.5. EUSOL solution consists of 12.5 gm BORIC ACID, 12.5 gm Bleaching Powder and Sterile Water upto 1 litre. It releases Nascent chlorine and become useless after 24 hrs. Dakin's solution (introduced during the first world war) and Milton are similar but have a higher ph, whereas chloramine is an organic derivative with greater stability and a longer shelf life.^{5,6,7}

As disinfectants all these hypochlorites are effective for cleaning working surfaces and laboratories and for purifying water, but evidence is accumulating of their toxic effect on healing tissues when used topically, which is causing controversy between traditionalists and experimentalists.^{8,9,10}

AIMS AND OBJECTIVES

To study and comparative effect of two different antiseptics superoxide solution (Oxum) and EUSOL solution to prevent surgical wound infections and evaluation of wound healing under the following wound characteristics

1. Incidence of hyperemia and induration of wound site.
2. Presence/absence of any adverse eruption at the wound site.
3. **The incidence of wound sepsis:**
 - A) Serous discharge present/absent.
 - B) Purulent discharge present/absent
 - 4) Presence/absence of odour from wound.
 - 5) Stitch removal and final healing time.

MATERIALS AND METHOD

All patients admitted to the surgery wards at Guru Nanak Dev Hospital, attached to Govt. Medical College, Amritsar, who underwent any sort of surgical intervention were included. The study was conducted after approval from Institutional Ethics Committee, Government Medical College, Amritsar and written

informed consent from patients to be enrolled in study. This is a study of 50 cases that meet the inclusion and exclusion criteria comparative study of effect of superoxide solution (oxum) v/s eusol in surgical wounds dressing. The following inclusion and exclusion criteria are used-

INCLUSION CRITERIA

- Any inflammatory organ pathology because of any etiological factor like, fourniers gangrene.
- All cases of Surgical Site Infection in exploratory laprotomy wound operated perforation peritonitis.
- All cases of diabetic foot ulcer, burn, carbuncles, venous stasis ulcer
- All cases of cellulitis.
- All cases of gluteal abscess.

METHOD OF DATA COLLECTION

This study comprised of 50 cases in which two groups were taken:

Study group (A) comprise of 25 cases where dressing and topical management done with superoxide solution oxum.

Study group (B) comprise of 25 cases where dressing and topical management done with eusol solution.

PREPARATION OF EUSOL

Eusol is prepared by dissolving 12.5 gm of bleaching powder in about 100ml of distilled water to form a paste and the add 12.5 gm of boric acid powder to form amalgamated paste and then add distilled water to make 1 litre solution, allow solution to stand and then filter it, solution to be used in 24 hours).

Patients were subjected to detailed history and thorough physical examination.

Various investigations such as haemogram, blood Sugar, renal function tests (blood urea, serum creatinine), serum proteins (TSP, DSP) serum electrolytes (Na⁺ K⁺,Ca⁺⁺), liver function tests (serum bilirubin, SGOT, SGPT, serum alkaline phosphatase), pus swab for culture and sensitivity, radiological investigations wherever indicated were carried out. The antibiotics was be given in both the cases after culture and sensitivity wherever indicated. Observations was be made during dressings and examination of the patients/wounds was done on day 1, 3, 5, 7, 9, 12, 14, 18, 21 and was noted in the written proforma.

The efficacy evaluation was based on appearance, presence or absence of odour, discharge, necrotic tissue, granulation tissue and epithelization at the site of wound. The patients were also assessed based on symptoms such as pain, oedema, redness, dryness and itching. In all cases, operative findings and postoperative course was followed up for six months for any complication or any need of re-surgery. Final outcome was evaluated on the basis of clinical, operative, radiological findings and recorded in proforma.

STATISTICAL ANALYSIS

The data was systematically collected, tabulated and subjected to quantitative statistical analysis and relevant conclusions was drawn. SPSS version 23.0 was used. Chi- square test and Mann Whitney tests were applied. Results were expressed as frequency, percentages, mean \pm SD. P value less than 0.05 was considered significant.

RESULTS

In group A, maximum patients (7) were in age group 41-50 years and in group B, maximum patients (8) were in age group 41-50 years. The mean age of group A patients was 48.5 \pm 12.6years. The difference between the two groups was found to be statistically non-significant ($p>0.05$)

Group A comprised of 13 (52%) males and 12 (48%) females and group B, 15 (60%) males and 10 (40%) females. The difference between the two groups was found to be statistically non-significant ($p>0.05$).

Diabetic foot ulcer was present in 5 in group A and 7 in group B, perforation peritonitis in 2 in group A and B each, burn in 4 in group A and 5 in group B, carbuncles in 4 in group A and 5 in group B, venous stasis ulcer in 3 in group A and 8 in group B, Fourniers gangrene in 2 in group A and B each, cellulitis in 2 in group A and 1 in group B and gluteal abscess in 3 in group A and 1 in group B. The

difference between both the groups was statistically non-significant ($p>0.05$).

In our study, the most common site in group A and group B was foot seen in 5 (20%) and 7 (28%) respectively followed by nape of neck in 4 (16%) patients each in group A and B respectively. The difference between both the groups was statistically non-significant ($p>0.05$).

The most common shape was oval seen in both groups seen in 11 (44%) in group A and 10 (40%) in group B. The difference between two groups was statistically non-significant ($p>0.05$).

The most common edge in group A and B was regular seen in 15 (60%) in group A and 13 (42%) in group B. The difference between two groups was statistically non-significant ($p>0.05$).

Oedema was present in 15 (60%) in group A and 13 (52%) in group B patients. The difference between both groups was statistically non-significant ($p>0.05$). Oedema is considered as marker of inflammation so it was studied further on subsequent days to evaluate difference in both antiseptic solutions.

The discharge was purulent seen in 15 (60%) in group A and 14 (56%) in group B. It was serosanguinous seen in 10 (40%) in group A and 11 (44%) in group B. The difference between two groups was statistically non-significant ($p>0.05$).

Table: 1 Associated morbidity

Associated morbidity	Group A (Superoxide)		Group B (Eusol)		Total	
	Number	%	Number	%	Number	%
No	18	72	19	76	37	74
Anaemia	1	4	1	4	2	4
Diabetes	2	8	3	12	5	10
Hypertension	2	8	2	8	4	8
Malignancy	1	4	0	0	1	2
Old age	1	4	0	0	1	2
Total	25	100	25	100	50	100

$X^2:12.4$; $df:11$; $P:0.28$

Graph: 1 Wound morbidity

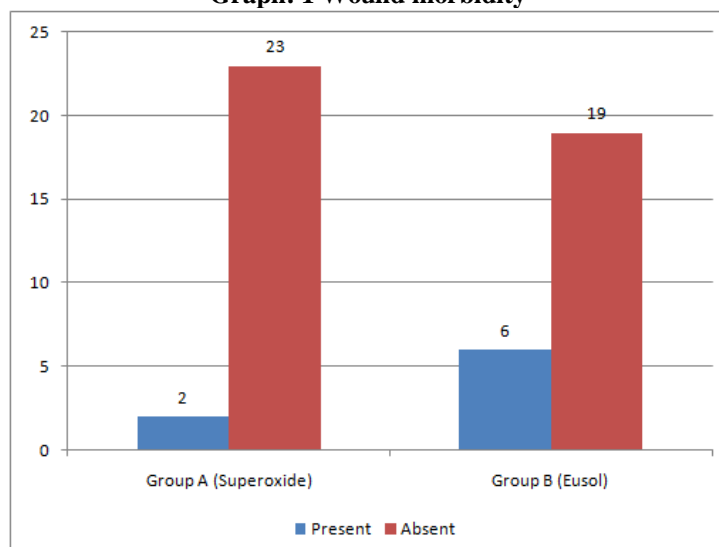


Table: 2 Improvement

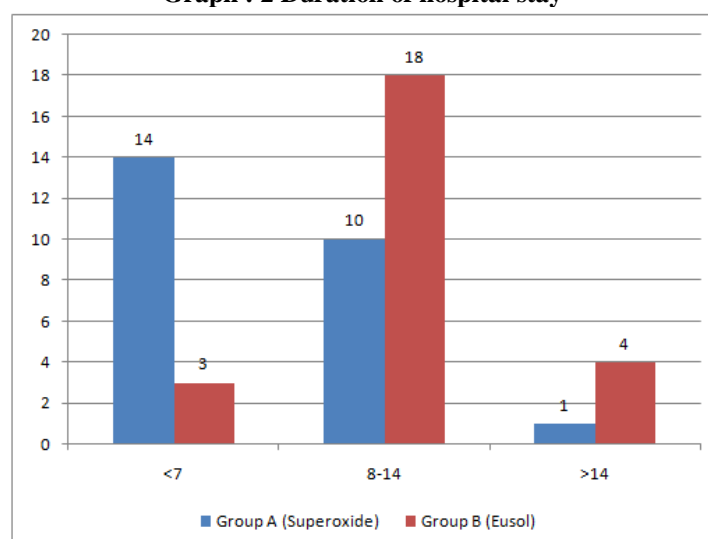
Improvement	Group A (Superoxide)		Group B (Eusol)		Total	
	Number	%	Number	%	Number	%
Present	8	32	4	16	12	24
Absent	17	68	21	84	38	76
Total	25	100	25	100	50	100

$\chi^2:4.2$; df;1; P-0.05

Table: 3 Cure rates in both groups

Cure rates	Group A (Superoxide)		Group B (Eusol)		Total	
	Number	%	Number	%	Number	%
Present	24	94	18	72	42	84
Absent	1	4	7	28	8	16
Total	25	100	25	100	50	100

$\chi^2:10.4$; df;1; P-0.001

Graph : 2 Duration of hospital stay

DISCUSSION

Diabetes and hypertension were most common associated morbidity seen in 2 (8%) patients in group A and diabetes seen in 3 (12%) patients in group B. Anand A^[11] found that 2 (8%) patients in group A and 3 (12%) in group B had a history of diabetes. Similarly, 6 (24%) patients in group A and 7 (28%) in group B had a history of hypertension. Bajaj et al^[12] found that diabetes was seen in 15% cases. Okeneyi et al^[13] found that hypertension was seen in 18% and diabetes in 22% cases. The difference between two groups was statistically non-significant ($p>0.05$). The mean decrease in swelling/ oedema was 11%, 20.8%, 47.8%, 71.2%, 87.4%, 95.0%, 100.0% and 100.0% in group A and 11.5%, 20.6%, 47.6%, 71.8%, 87.8%, 95.5%, 100.0% and 100.0% in group B on day 3, 5, 7, 9, 12, 14, 18 and 21 respectively. Though the difference was non-significant, the reduction in swelling was less compared to group B. Anand A^[11] et al revealed that two (8%) patients in Group A and 3 (12%) patients in Group B had an unhealthy wound appearance on day 5, whereas on day 10, none of the patients in Group A but 1 (4%) patient in Group B showed unhealthy wound appearance. Bajaj et al^[12]

found that swelling decreased significantly till 12 days. Okeniyi et al^[13] found that oedema decreased upto 14 days in 82% cases. The difference between two groups was statistically non-significant ($p>0.05$). The mean decrease in discharge was 11.2%, 21%, 47.6%, 71.3%, 86.2%, 95.0%, 100.0% and 100.0% in group A and 11.8%, 20.6%, 46.8%, 71.8%, 87.4%, 98%, 100.0% and 100.0% in group B on day 3, 5, 7, 9, 12, 14, 18 and 21 respectively. Anand A^[11] et al two patients in each group had purulent discharge on day 5, whereas none of the patients in each group had a discharge on day 10. Bajaj et al^[12] found that presence of discharge at week 4 was seen in 15 in EUSOL and 24 patients in sugar group. Okeneyi et al^[13] found that discharge decreased upto 90% at the end of 14 days. The difference between both groups was statistically non-significant ($p>0.05$). On day 5 discharge sent for culture and Pseudomonas was seen in 24%, Staphylococcus in 24% and E. Coli in 24% in group A and Pseudomonas was seen in 32%, Staphylococcus in 20% and E. Coli in 20% in group in group B. On day 9 discharge sent for culture and Pseudomonas was seen in 4% and E. Coli in 12% in group A and Pseudomonas was seen in 20%,

Staphylococcus in 16% and E. Coli in 8% in group B. On day 12 discharge sent for culture and Pseudomonas was seen in 4% and E. Coli in 8% in group A and Pseudomonas was seen in 4% and E. Coli in 8% and staphylococcus in 12% in group B. On day 18 discharge sent for culture and E. Coli was seen in 4% in group A and Pseudomonas was seen in 8%, Staphylococcus in 4% and E. Coli in 8% in group B. On day 21 discharge sent for culture and E. Coli was seen in 4% in group A and Pseudomonas was seen in 8%, Staphylococcus in 4% and E. Coli in 4% in group B. Giacometti et al^[14], in their study of 676 surgery patients with signs and symptoms indicative of wound infection, reported 614 patients (90.8%) to be culture positive for bacteria. Bajaj et al^[12] found that a commonly encountered bacterium was Pseudomonas and E. Coli. Okeniyi et al^[13] found that a commonly isolated bacterium was Staphylococcus and E. Coli. Akula et al^[15] found that the most common organism isolated on culture and sensitivity took on day 1 from all the patients was Staphylococcus aureus, which was present in 27 patients, Pseudomonas in 15 patients, and there was no growth of any organism in 8 patients. Some of the patients had growth of one or more organisms on culture and sensitivity.

All patients in both groups were given intravenous antibiotics on day 1. Active and passive Prophylaxis against tetanus was given to all patients of road side accident. Therefore, depending upon condition of the patient, if he is taking oral diet, oral antibiotics and analgesics were given. Though insignificant but less number of cases needed intravenous antibiotics in group A compared to group B. Piagessi et al^[16] in their study group A was locally treated with DWC, whereas group B received povidone iodine. The time taken for cultures to become negative and duration of antibiotic therapy were also significantly ($P < 0.05$) shorter in group A than in group B, whereas the number of reinterventions was significantly higher in group B ($P < 0.05$). Bajaj et al^[12] found that maximum patients iv antibiotics continued till 3 days. Okeniyi et al^[13] found that for 5 days iv antibiotics was needed.

Group A patients had less morbidity (8%) compared to group B (24%). Singhal et al^[17] found that oxum group had less morbidity and mortality. Bajaj et al^[12] found that EUSOL group had less morbidity as compared to sugar group. Okeniyi et al^[13] found that honey group had less morbidity as compared to EUSOL group. The difference between two groups was statistically significant ($p < 0.05$).

Improvement in surgical wounds was observed as appearance of healthy granulation tissue, less slough, free from infection, less discharge and good vascularity.

Anand A^[11] et al found that group A shown improvement in 32% case as compared to 16% cases in group B. Surgical wound signs assessment showed that the wound healing at the end of the study were similar in both the groups.

Bajaj et al^[12] found that improvement was more in EUSOL group as compared to sugar groups and Okeniyi et al^[13] found that EUSOL group showed better improvement.

Akula et al^[15] found that patients treated with super oxidised solution, Group A, had earlier appearance of granulation tissue, earlier resolution of peri wound erythema and oedema and earlier wound disinfection. Chaudhary PS et al^[18] compared super oxidized solution and povidone iodine solution in management of infected diabetic ulcers showed that topical super oxidized solution dressings accelerated the healing process resulting in faster recovery through reduction in ulcer area in patients infected with diabetic ulcers compared to topical povidone iodine dressing. Kapur V et al^[11] assessed the impact and examination of super oxidized arrangement and povidone iodine in various kinds of wounds revealed that super oxidized arrangement was protective and viable in a wide range of wounds. Patients treated with oxum shows early granulation and rapid epithelisation when compared to povidone iodine.

The global efficacy evaluation in various studies also confirms the superiority of oxum over povidone iodine as good to excellent efficacy response was recorded in relatively more number of patients in oxum treated group as compared to povidon-iodine treated group.^[17] The difference between two groups was statistically significant ($p < 0.05$).

Cure rate was 94% in group A as compared to 72% in group B. Remaining cases took longer time to heal. Swetha et al^[19] found that cure rate was faster in superoxidized solution Bajaj et al^[12] and Okeniyi et al^[13] found that cure rate was faster in EUSOL group. The difference between two groups was statistically significant ($p < 0.05$).

Less than 7 days hospital stay was seen in 56% in group A and 12% in group B. The mean was 9.04 days in group A as compared to 10.9 days in group B. Okeniyi et al^[13] found that length of hospital stay was significantly shorter in patients with honey-treated wounds than those treated with EUSOL ($p = 0.019$). Bajaj et al^[12] found that patients on EUSOL group had less hospital stay than sugar group ($P < 0.05$). The difference between two groups was statistically significant ($p < 0.05$).

CONCLUSION

From our study we conclude that OXUM shows more favourable results than EUSOL. Although the results are statistically significant, the strength of the study depends upon study design. The results of this study justify further research into the use of OXUM and EUSOL in treatment of various wounds. Possible sources of bias in further studies are excluded by randomization of patients to treatment and by blinded assessment of outcomes.

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