ORIGINAL RESEARCH PAPER

General Surgery

EFFECTIVENESS OF TOPICAL APPLICATION OF SUPEROXIDISED SOLUTION TO PREVENT SSI IN POST OPERATIVE WOUND OF EMERGENCY LAPAROTOMY IN A RURAL TERTIARY CARE CENTRE: A PROSPECTIVE STUDY

KEY WORDS: Postoperative Wound of Emergency Laparotomy, Superoxidised solution, Povidone Iodine

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ABSTRACT

BACKGROUND: The management of wounds is fundamental in the practice of surgery. Wound complication in postoperative wound of Emergency laparotomy is a very common phenomenon in our daily practice & it's manage is a challenge to surgeon. Superoxidised solution is a new concept in wound management, it is an electrochemically processed aqueous solution with neutral pH, non toxic, non-irrigating, no rinse dermal wound irrigant.
AIMS: To compare the efficacy of Superoxidised aqueous solution against Povidone Iodine on postoperative wound of emergency laparotomy in terms of wound healing and disinfection.
SETTINGS & DESIGN: This prospective study was conducted at Bankura Sammilani Medical College & Hospital for a period of 18 month (from July 2017-februry 2019.) on a study population of 60 patients .
MATERIAL AND METHODS: Study group included 60 patients who undergone emergency laparotomy. Informed consent was taken, routine and specific investigations, history taken..Assessments were done on Day5,8,11,14 Days.
Summary: Superoxidised solution is safe and effective in post operative wound of emergency laparotomy in wound care management and gives better efficacy and faster response as compared to the traditional Povidone-iodine topical application.

INTRODUCTION:

Emergency Laparotomy is a most common surgical procedure done by routine surgical team. In surgical language, the word laparotomy explains exploration of the abdomen and proceed further according to the cause identified(1) Most important part in postoperative period of emergency laparotomy is management of wound. Though postoperative wound complications are very common phenomenon but the key to success is earle detection & prompt wound management. The severity of these complications embraces mild cases needing local wound care and antibiotics to serious cases with multiple reoperations and a high mortality rate. In most cases, such complications prolong hospitalization, with a substantial increase in cost of care. A proper post-surgical wound care thus becomes an extremely important factor in preventing the occurrence of infection. An effective wound care product should address the most important aspects of infection control and safety.

Although a multimodel therapy is the basis of wound healing, an ideal antiseptic is one that is rapidly lethal to all forms of bacteria and their spores, capable of bactericidal activity for a prolonged period, has no injurious effect on wound healing tissues.

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 [2]. Super oxidized solutions are elelctrochemically processed aquous solutions manufactured from pure solutions which is rich in reactive oxygen species with neutral pH and longer half life (>12 months). Oxum is a stable, non-flammable and noncorrosive bactericidal, virucidal, fungicidal and sporocidal solution that is ready to use with no further dilution or mixing.

Ingredients

Oxidized solution (H2O), sodium hypochlorite (NaOCl), Hypochlorous Acid (HOCl), Hydrogen peroxide (H2O2), Ozone (O3), Chlorine dioxide (ClO2), Sodium hydroxide (NaOH), Sodium Carbonate (Na2CO3) and Sodium chloride (NaCl).

Mechanism of Action

During the electrolysis process, solutions molecules are broken, ions and free radicals are formed. They rapidly react and denature proteins of bacterial cell wall. They also have anti-inflammatory effect and produce an environment with an unbalanced osmolarity that damages single cell organism. The damage is a direct result of the osmolarity difference between the concentrations of the ions in the solution versus the concentration of the same ions in the cell. Multicellular organisms are not prone to such osmolarity changes, therefore host tissues are spared. Once the single cell membrane is damaged, the ions in the product denature the bacterial proteins as well [3].

AIMS AND OBJECTIVES -

To compare the efficacy of Superoxide aqueous solution against Povidone Iodine on postoperative wound of emergency laparotomy in terms of wound healing and disinfection.

MATERIAL AND METHODS

The present study was conducted to evaluate the effect of Superoxised water (Oxum) V/s Conventional dressing (Povidone Iodine) on postoperative wound of emergency laparotomy. The study was conducted at Bankura Sammilani Medical College & Hospital for a period of 18 month (from July 2017-februry 2019.) & it is a prospective study using 60 patients with 30 patients in each groups viz. Group A where dressing and topical management was done using superoxidised solution (oxum). Group B where dressing and topical management was done using betadine solution).

Inclusion criteria

All patients aged 18 to 65 years for abdominal surgery under general anesthesia. Emergency surgeries open appendicectomy, Exploratory laparotomy

Exclusion criteria Laparoscopic surgeries

Procedure: Patients were recruited for the study, after studying the inclusion and exclusion criteria. The informed consent was taken in all patients.

Preoperative preparations:
Informed and written consent will be obtained. Shaving of parts on the morning of surgery with clipper will be done. Patient will be kept nil by mouth for 6 hours. Xylocaine sensitivity test will be done.

Peri-operative preparation:
All cases will be operated under General or Spinal anaesthesia. Injection Ceftriaxone 1gm iv given during induction of anaesthesia. Cleaning and painting is done by 10% povidone iodine solution. Draping is done using sterile linen drapes.

- **Postoperatively** Patients will be kept NpM for 24 hrs. Oral liquids will be started after 24 hrs. Injection Ceftriaxone 1 gm IV 12 hourly for 2 days.inf metrogyl 100 mi tds for 2 days Injection Diclofenac Sodium 75 mg IV according to the complaints of patient. Tab. Cefuroxime 500mg BID started on 3rd postoperative day for next 3 days. Tab. Diclofenac 50 mg BID will be given according

Post-operative wound of emergency laparotomy were assessed and were managed with Oxum dressings (twice a day) in Group A and with Povidone iodine application in Group B. The efficacy evaluation was based on appearance, presence or absence of odour, discharge, necrotic tissue, periwound swelling & oedema,epithelisation & granulation tissue at the site of the wound.The patients were also assessed based on the symptoms such as pain, edema, sleeplessness, dryness and itching.The wounds were treated for 14 days.The assessments were made on the days 5,8,11, 14. Primary outcome measures included complete healing, partial healing and non-healing on the days 5,8,11,14.

The collected data was analysed and interpreted using appropriate statistical tests.

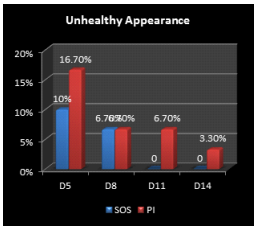
RESULT:
The study was conducted in 60 patients {30 patients in each Group viz.: Superoxide solution (Group A) and Povidone Iodine (Group B) Group}.

The demographic characteristics of the two Groups are as given in Table 1. The average age of patients in Group A was 35.4+ 4.8 whereas the corresponding age in Group B was 33.12 + 4.6 . Medical history (Table 1) of the enrolled patients signifies that 8 (26.7%) patients in Group A and 6 (20%) patients in Group B had a history of previous HTN, 3 (10%) and 4 (13.3%) patients had a history of DM in Group A & Group B respectively. Also 11 (36.7%) patients in Group A and 9 (30%) patients in Group B had a history of chronic smoking. Overall, both the Groups were matched well and there was no significant difference between the two Groups.

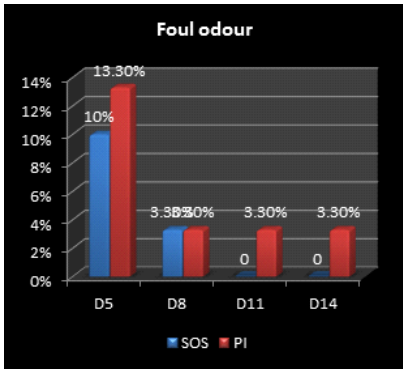
Demographic variations among patients			
Characteristics	**S.O.S.**	**P.I.**	**p-value**
Mean age (Years)	35.4+4.8	33.12+4.6	.161
Hypertension	8 (26.7%)	6 (20%)	.313
Diabetes	3 (10%)	4 (13.3%)	.162
Poor nutritional status	2 (6.7%)	2 (6.7%)	.000
Obesity	3 (10%)	4 (13.3%)	.162
Immunocompromised	0	0	-
Smoking	11 (36.7%)	9 (30%)	.300

Table 2 shows the details of laparotomy wound assessments according to gross appearance in both the Groups. Three (10%) patients in Group A and 5 (16.7%) patients in Group B had an unhealthy wound appearance on day 5, whereas on day 14, none of the patients in Group A but 1 (3.3%) patient in Group B showed unhealthy wound appearance (Graph 1). Three (10%) in Group A and four (13.3%) in Group B had foul odour on day 5. On day 14 none of the patients in Group A had foul odour; however, one patient in Group B had foul odour (Graph 2). Similarly, 1 (3.3%) patients in each Group had bleeding wounds on day 5 but none of the patients had a bleeding wound on day 10 . 3 patient(10%) group A & 4 pt (13.3%) in Group B had pus discharge on day 5, whereas none of the patients in Group A had pus discharge on day 14 (Graph 4). 4 patients in Group A (13.3%) and 5 (16.7%) patients in Group B had wound edge color changes on day 5 whereas none of the pt in grp A on day 14 .3 pt in grpA(10%) & 4 pt in group B(13.3%)had periwound swelling & oedemawhereas on day 14 no pt in grp A had periwound swelling & oedema(Graph3). 3pt in grp A(10%) & 5 pt in grp B (16.7%) had a necrotic or fibrotic tissue on day 5 and none in grp A on day 14(Graph6). On day 5, 27 (90%) patients in Group A and 25 (83.33%) patients showed granulation tissue on day 5, whereas all the patients in Group A had granulation tissue on day 11. (Graph 5).

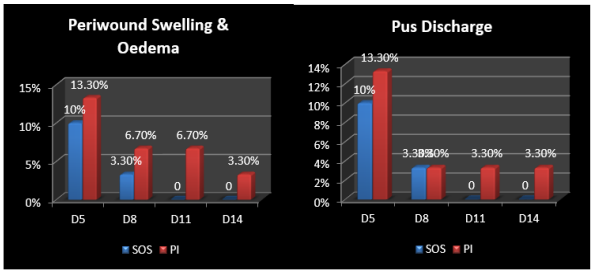
Laparotomy wound assessment according to gross appearance			
Characteristics	**S.O.S.**	**P.I.**	p-value
Unhealthy appearance			
• D5	3 (10%)	5 (16.7%)	P = 0.448
• D8	2 (6.7%)	2 (6.7%)	P = 1.000
• D11	0	2 (6.7%)	P = 0.150
• D14	0	1 (3.3%)	P = 0.313
Bleeding			
• D5	1 (3.3%)	1 (3.3%)	P = 1.000
• D8	0	0	P = 0.448
• D11	0	0	P = 0.448
• D14	0	0	P = 0.448
Foul odour			
• D5	3(10%)	4(13.3%)	P = 0.688
• D8	1(3.3%)	1(3,3%)	P = 1.000
• D11	0	1(3.3%)	P = 0.313
• D14	0	1(3.3%)	P = 0.313
Wound edge colour changes			
• D5	4(13.3%)	5(16.7%)	P = 0.718
• D8	1(3.3%)	2(6.7%)	P = 0.554
• D11	1(3.3%)	2(6.7%)	P = 0.448
• D14	0	2(6.7%)	P = 0.448
Peri-wound swelling & erythema			
• D5	3 (10%)	4 (13.3%)	.162
• D8	1 (3.3%)	2 (6.7%)	.351
• D11	0	2 (6.7%)	.150
• D14	0	1 (3.3%)	.313
Pus discharge			
• D5	3 (10%)	4 (13.3%)	.162
• D8	1 (3.3%)	1 (3.3%)	.000
• D11	0	1 (3.3%)	.313
• D14	0	1 (3.3%)	.313
Necrotic & Fibrotic tissue			
• D5	3 (10%)	5 (16.7%)	.577
• D8	1 (3.3%)	2 (6.7%)	.351
• D11	0	2 (6.7%)	.150
• D14	0	1 (3.3%)	.313
Granulation tissue & epithelisation			
• D5	27(90%)	25(83.33%)	.577
• D8	29(96.67%)	28(93.33%)	.351
• D11	30(100%)	29(96.67%)	.313
• D14	30(100%)	29(96.67%)	.313
Increased wound edge gap			
• D5	4(13.3%)	5(16.7%)	.131
• D8	1(3.3%)	2(6.7%)	.351
• D11	0	1(3.3&)	.150
• D14	0	1(3.3%)	.000



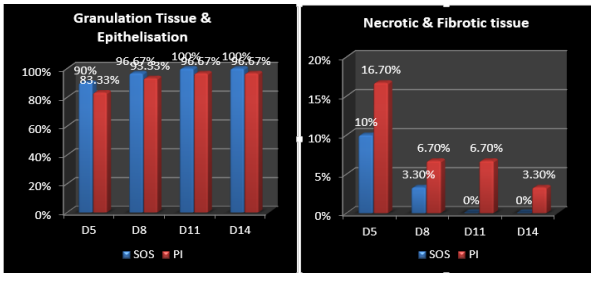
Graph1.



Graph 2.



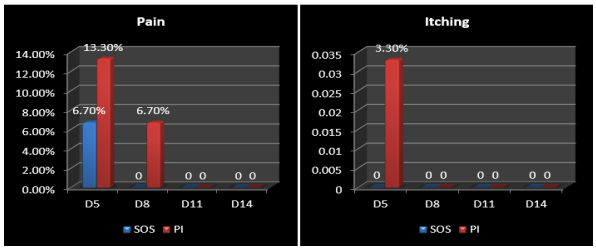
Graph 3. **Graph 4.**



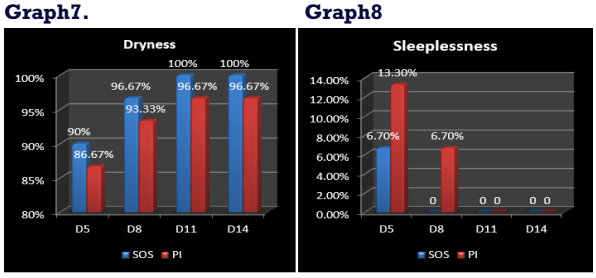
Graph 5. **Graph6.**

Surgical wound symptom assessment is as shown in Table 3. Only 2 patient (6.7%) in Group A and 4 (13.3%) patients in Group B had pain at surgical site on day 5, whereas none of the patients had pain at surgical site wounds on day 14 (Graph 7). 2 patients in GroupA & 4 pt in grpB had sleeplessness on day 5 which subsided on day 14 (Graph 10). Dryness in the area of wound was observed in 100% patients in both the Groups on day 5 (Graph 9).None of the patients had itching sensation near the area of wound on day14(graph8)

Laparotomy wound assessment according to symptoms			
Characteristics	**S.O.S.**	**P.I.**	p-value
Pain			
• D5	2(6.7%)	4(13.3%)	.131
• D8	0	2(6.7%)	.150
• D11	0	0	-
• D14	0	0	-
Itching			
• D5	0	1(3.3%)	.131
• D8	0	0	-
• D11	0	0	-
• D14	0	0	-
Dryness			
• D5	27(90%)	26(86.67%)	.162
• D8	29(96.67%)	28(93.33%)	.351
• D11	30(100%)	29(96'67%)	.313
• D14	30(100%)	29(96.67%)	.313
Sleeplessness			
• D5	2(6.7%)	4(13.3%)	.389
• D8	0	2(6.7%)	.131
• D11	0	0	-
• D14	0	0	-



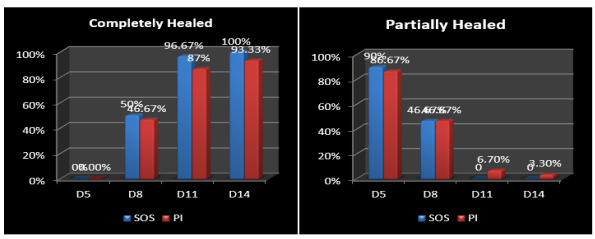
Graph7. **Graph8**



Graph9. **Graph10**

As shown in Table 4, 27 pt in grp A(90%) & 26 pt (86.67%)in grp B had partially healed surgical wounds on day 5 whereas on day 14(Graph11), 30(100%) patients in Group A and 28(93.33%) patients in Group B were completely healed (Graph 12).

Healing of laparotomy wound			
Characteristics	**S.O.S.**	**P.I.**	p-value
Partially healed			
• D5	27(90%)	26(86.67%)	.162
• D8	14(46.67%)	14(46.67%)	.015
• D11	0	2(6.7%)	.053
• D14	0	1(3.3%)	.000
Completely healed			
• D5	0	0	.000
• D8	15(50%)	14(46.67%)	.061
• D11	29(96.67%)	26(86.67%)	.161
• D14	30(100%)	28(93.33%)	.000
Non-healed (Infected)			
• D5	3(10%)	4(13.3%)	.015
• D8	1(3.3%)	2(6.7%)	.162
• D11	1(3.3%)	2(6.7%)	.061
• D14	0	1(3.3%)	.000



Graph11. **Graph12.**

Other different outcomes of laparotomy wound			
Characteristics	**S.O.S.**	**P.I.**	**p-value**
Mean healing time (Days)	9.07	9.21	.000
Wound dehiscence (Person @D14)	0	2	.150
Burst abdomen (Person @D14)	0	0	-

Table 5 reveals the global efficacy and safety evaluation of patients in both the Groups. As shown in the table,

Global efficacy & Safety evaluation			
Characteristics	**S.O.S.**	**P.I.**	p-value
Efficacy by Surgeon			
• Excellent	13	11	<0.05
• Good	10	7	
• Moderate	5	8	
• Poor	2	4	

Safety by patients			
• Excellent	11	8	<0.05
• Good	7	9	
• Moderate	9	9	
• Poor	3	4	

surgeons reported excellent efficacy of the treatment in 13 (43%) patients in Group A. The corresponding value in Group B was 11 (36.66%) patients. 10 (33.33%) patients in Group A and 7(23.33%) patients in Group B were reported to experience good efficacy of the treatment. A moderate efficacy was reported by the surgeon for 5(16.66%) patients in Group A and 8 (26.66%) patients in Group B. Only 2 (6%) patient in Group A and 4 (13.33%) patients in Group B were reported by surgeons to have poor response to the treatment . Global safety evaluation indicates that excellent safety was reported by 11 (36.66%) patients in Group A and 8 (26.66%) patients in Group B. 7 (23.33%) patients in Group A and 9(30%) patients in Group B reported good safety profile of the treatment. 9 patients (30%) in both the Groups reported moderate safety profile of the treatment. Only 3 patients in Group A (10%) and 4 patients in Group B (13.33%) reported poor safety profile of the drug .

DISCUSSION:

The principle of 'Wound Dressing With Superoxide Solution was officially started in the year 2003 when it achieved a status of "Disinfectant and Antiseptic" in its homeland Mexico [4]. Dressing with super-oxide solution is not a very old topic of discussion and lately a good number of efforts have been made to evaluate the effectiveness of this approach in wound healing. There have been isolated reports of its use in healing of diabetic foot ulcers, abscess cavities, surgical wounds and various other types of ulcers [5]. The use of super oxidized aqueous solution for jet lavage debridement has been found to be as safe and effective as saline [6]. Healing rates have been reported to be significantly shorter in cases dressed with super oxide solution. Also duration for cultures to become negative and of antibiotic therapy were also reported to be shorter. Super oxide solution has been found to be safe and effective in the management of wide postsurgical lesions in the infected diabetic foot [7]. Reports have also been published indicating a better response to this solution in management of acne as compared to benzoyl peroxide. At the same time no systemic effects were observed [8]. Further, this solution has been used in management of chest wall infections and reportedly reduced the time of healing in a significant manner [9].

In this study, the results indicated that the application of superoxide solution is helpful in healing of postoperative wound of emergency laparotomy. In order to evaluate the role of super-oxide solution in dressing of various types of wounds, results were compared with conventional method with povidone iodine. Thus this study also establishes the replacement of conventional method by treatment with super-oxide solution if possible.

In respect to laparotomy wound assessment according to wound specific appearance Our study revealed less periwound oedema & swelling in wound margins when super-oxide solution is used. This finding appears to be consistent with the previously quoted fact that this solution does not damage cellular elements or restrict microcirculation of wound. Thus it ensures well being of surrounding healthy tissue. The study also revealed early reduction in discharge from wound dressed with SOS as compared to povidone iodine solution. Granulation tissue formation was also earlier in group A (cases) as compared to group B (controls) and more as per surface area as compared to controls. The findings are also comparable with earlier work of Allie et al [10] in which they have noticed that topical application of SOS enhances healing including reduction of indurations & discharge. At the same time, a significant elimination of bacterial strains in group A was found as compared to group B. The rate of secondary infection in primary sterile wounds in group A was significantly less than in group B.

If we see regarding symptoms our study reveals super-oxide solution reduces pain ,itching ,sleeplessness earlier than povidone iodine solution .In Day5 , 2 person has pain in superoxide solution group where in povidon iodine 4 person.in day 8 no person has pain in superoxide group.in day 8 no person has itching in superoxide solution group.

All the patients (100%) in both the Groups had partially healed surgical wounds on day 5, whereas on day 11, 29 patients (96%) in superoxide Group and 26 patients (86%) in Povidone-iodine Group were completely healed. On day 14, 30 patients(100%) in superoxide group & 28 patient (93%) in povidone iodine group completely healed.

These findings are supported by the findings of Dalla Paola(11) et al in a comparative study of Microcyn Superoxidized solution against Povidone iodine in the management of diabetic foot ulcer.

Our study also shows lesser mean healing time in superoxide solution group i.e mean healing time 9.07 days where as povidone iodine group 9.21 days. Burst abdomen & wound dehiscence also nil in superoxide solution group.

These findings also supported by various study & they also have proven its safety and efficacy and showed no complications were noted.[12,13,14,15]

Wolvos TA(5)used Microcyn Superoxidized solution to treat 26 patients with various wound types that included 9 patients with post-operative wound. In these patients, the wounds including those with complications healed completely with dressings of wound with Microcyn Superoxidized solution. He concluded that Microcyn Superoxidized solution could be used to treat a variety of wounds from simple to extremely complex. It can be used as the wound irrigation solution at simple dressing changes, and it can serve as the solution to moisten the gauze used to dress the wound.

Gutierrez AA16 in his study to explore various applications of Microcyn Superoxidized solution concluded that the moistening effect and the minimum toxicity found with the use of this superoxidized solution makes it a good choice for wound care management and that this nonantibiotic technology appears to offer a broad new paradigm for the prevention and treatment of acute and chronic wounds.

SUMMARY & CONCLUSION:

Superoxidized solution is safe and effective in post operative wound of emergency laparotomy in wound care management and gives better efficacy and faster response as compared to the traditional Povidone-iodine topical application.

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