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Comparative study of EUSOL and Silverstream in healing of pressure sore in traumatic spinal cord injury patients

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Abstract

Pressure sore is among the most common long-term secondary medical complication in persons with spinal cord injury. The majority of morbidity problems and the most frequent cause of death were sepsis associated with genitourinary and pressure ulcer sequelae. Healing of bed sore is great challenge. We studied two dressing material (eusol and silverstream) in healing of bed sore. 22 bed sore patient were randomly allocated in two groups and the result of their dressing were compared in followup. There was faster rate of healing in grade 2 and grade 3 bed sore with silverstream as compared to eusol, but result was not statistically significant ($p > 0.05$). However in grade 4 bedsore patient healing was poor with both dressing materials and almost always require plastic surgery intervention for healing.

Keywords: pressure sore, bedsore, EUSOL, silverstream

Introduction

Pressure sores are areas of tissue damage that occur in people who cannot reposition themselves, the acutely ill, the older person, and the malnourished. Pressure sore negatively affect quality of life and impose a significant financial burden on healthcare systems^[1].

The most common place for pressure sore are over bony prominence (bone close to the skin) like the elbow, heels, hips, ankles, shoulders, back and the occiput of the head^[2].

Pressure sore develop when capillaries supplying the skin and subcutaneous tissues are compressed enough to impede perfusion, leading ultimately to tissue necrosis. Thus, keeping the external pressure less than 32 mm Hg should be sufficient to prevent the development of pressure sore. However, capillary blood pressure may be less than 32 mm Hg in critically ill patients due to hemodynamic instability and co morbid conditions; thus, even lower applied pressures may be sufficient to induce ulceration in this group of patients. Pressure sore can develop within 2 to 6 hours. Therefore, the key to preventing pressure sore is to accurately identify at-risk individuals quickly, so that preventive measures may be implemented^[3].

The most common system of staging pressure sore classifies them based on the depth of soft tissue damage, ranging from stage of suspected deep tissue injury to unstageable. There is purple or maroon colour area of discoloured intact skin or blood filled blister in suspected deep tissue injury, intact skin with non-blanchable redness of localized area in stage 1, a loss of partial thickness of skin appearing as an abrasion or shallow open ulcer in stage 2; a loss of full thickness of skin presented as a deep crater in stage 3; a loss of full thickness of skin exposing muscles or bone in stage 4; and full thickness tissue loss in which base of ulcer is covered by slough (yellow, tan, gray, brown) and /or eschar in unstageable^[4].

Hence the care givers knowledge regarding general measures such as positioning, exercise, skin care, nutrition and support will enhance the quality of outcome and prevent complication. Management refers as nursing intervention for managing pressure sores among bedridden patient like manipulation of environment, ongoing assessment, change of position, back care, good nutrition, wound care with dressing materials and ambulation^[5].

Material and Method

Materials

All bed sore patients with traumatic spinal cord injury reporting to emergency and indoor

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Methods

Review of patients with bed sores after spinal cord injury admitted in orthopaedic department PMCH Patna.

Variable assessed include

1. Age and sex of patients.
2. Assessment also include:
3. Grading of pressure sore,
4. Need for wound debridement or surgical treatment.
5. comparative study of dressing with EUSOL and Silverstream in healing of bed sore

Inclusion Criteria

Patient age: 15-80 years

Devoid of medical problem like diabetes, hypertension and medical neurological disease.

Exclusion Criteria

Age <15 years, >80 years

Acute or chronic wound other than pressure sore like diabetic ulcer or venous ulcer.

Initial assessment of the pressure ulcer should include:

- Stage/Depth
- Location

- Surface area (*length x width*)
- Odour
- Sinus tracts/Undermining/Tunneling
- Exudate – type and amount
- Appearance of the wound bed and
- Condition of the surrounding skin (periwound) and wound edges.

Management of Pressure sore

Management of pressure sore aims at removing dead or devitalized tissue by debridement and use of various dressing material. In our study, 22 patients had bed sore. Bed sore patients were randomly allocated in 2 groups each containing 11 patients with similar grade, we used two dressing material, in one group dressing was done with eusol with gauze and another group dressing was done with silver containing dressing material (silverstream), and there results were compared in follow up studies.

Use of a pressure injury healing scale is recommended. PUSH Scale⁶ is used to monitor healing of pressure sore. Categorize the ulcer with respect to surface area, exudates, and type of wound tissue. Record a subscore for each of these ulcer characteristic. Add these subscore to obtain the total score. A comparison of total score measured over time provides an indication of improvement or deterioration in pressure ulcer healing.

Table 1: Bed Sore Presentation

Length*width (cm*cm)	0	1	2	3	4	5	Subscore
	0	<0.3	0.3-0.6	0.7-1.0	1.1-2.0	2.1-3.0	
exudate	0	1	2	3	4	5	Subscore
	none	light	moderate	heavy			
Tissue type	0	1	2	3	4	5	Subscore
	closed	Epithelial tissue	Granulation tissue	slough	Necrotic tissue		
							Total score

Length* width: Measure the greatest length and greatest width. Multiply these two measurement to obtain an estimate of surface area in square centimetres.

Exudate amount: Estimate the amount of exudates present after removal of dressing and before applying topical agent to ulcer. Estimate the exudates as none, light, moderate, or heavy.

Tissue type: This refers to the type of tissue that are present in wound bed. Score as 4 if there is any necrotic tissue present. Score as 3 if there is any amount of slough present and necrotic tissue absent. Score as 2 if the wound is clean and contains granulation tissue. A superficial wound that is reepithelializing is scored as 1. When wound is closed score as 0.

4- Necrotic Tissue (Eschar): black, brown, or tan tissue that adheres firmly to the wound bed or ulcer edges and may be either firmer or softer than surrounding skin.

3- slough: yellow or white tissue that adheres to ulcer bed in string or thick clumps or is mucinous.

2-Granulation tissue: Pink or beefy red tissue with a shiny, moist, granular appearance.

1-Epithelial tissue: for superficial ulcer, new pink or shiny tissue that grows in from the edges or as islands on the ulcer surface.

0-Closed/resurfaced: the wound is completely covered with epithelium (new skin)

Aims and Objectives

- Comparative study of dressing with EUSOL and Silverstream in healing of bed sore.

Observation and Result

In our study of 22 bed sore patients 16 patient had bed sore at the time of admission in hospital, in which 5 had paraparesis and 11 had quadriparesis. 6 patients developed bed sore during their stay in our hospital.

Table 2: Grading of Bed Sore

	Bed sore at admission		Develop later	
Paraparesis	5	23%	4	18%
Quadriparesis	11	50%	2	9%

In our study of 22 bed sore patients, 4 had grade 1, 9 had grade 2, 7 had grade 3, 2 patient had grade 4 bed sore. So maximum number of cases (41%) are of grade 2 bed sore followed by grade 3 (31%).

Table 3: Age Distribution of Bed Sore Patients

	Grade 1	Grade 2	Grade 3	Grade 4
Bed Sore	4	9	7	2

In our study, 22 bed sore patients, maximum no of cases (9) are between age group of 30-45 years. Mean age for occurrence of bed sore is 39.04 years with SD of 15.78 years.

Table 4: Bed Sore Distribution According To Their Site

Age group	No of cases
15-30 years	8
30-45 years	9
45-60 years	4
>60 years	1

In our study of bed sore patients, most common site of occurrence of bed sore was sacrum (20), next was trochanter of femur and dorso – lumbar region.

Table 5: Relation Between Dressing Material And Bed Sore Patients

Site	Sacrum	Trochanter (Femur)	Dorso-Lumbar	Occiput
	20	3	2	1

In our study of 75 spinal cord injury patients, 22 patient developed bed sore. Out of 22 bed sore patients 11 patient dressing was done with eusol solution and gauze; rest 11 patient dressing was done with silver containing dressing (Silverstream) with gauze.

no	Dressing material	
	Eusol	Silver
Number of bed sore patients	11	11

Result of Dressing With Eusol in Bed Sore Patients

No	Name,age and sex	Grade and site	Initial wound characteristic (push score)	After 2week (push score)	After4week/at discharge/follow up(push)	outcome
1	Rajendra mandal 40/M	1, sacrum	Size-1cm ² exudate-none tissue in bed-epithelial PUSH-4	Healed		healed
2	Manish kr pandit 35/M	1,sacrum and dorsum(back)	Size(at sacrum) -16 cm ² Exudates-none Tissue-closed (push-9) push of dorsum sore-4	healed		healed
3	Gopal Sharma 40/M	2,sacrum	Wound size-6cm ² exudate-light tissue-epithelial (push-9)	Size- 4cm ² Exudates-none, tissue-epithelial (push-7)	Size-1 cm ² Exudates-none, tissue-epithelial (push-4)	Push 9 to 4,wound size-decreased (80%) in 4 week
4	Saraj kr gupta 18/M	2,sacrum	Wound size-6 cm ² exudate-light, tissue-granulation (push-10)	Size-4.5cm ² exudate-light, tissue-epithelial (push-9)	Size-4cm ² exudates-none, tissue- epithelial (push-7)	Push 10 to 7, size decreased (35%) in 4 week
5	Guddu kr 30/M	2,sacrum	Wound size-1.5 cm ² , exudates-light, tissue-slough. (push-8)	Size-1.5 cm ² , exudates-none, tissue-slough (push-7)	Size-1 cm ² exudates-none, tissue-epithelial (push-4)	Push changed from 8 to 4, size decreased (40%) healed in 2 month.

N0	Name, age and sex	Grade and site	Initial wound characteristic (push score)	After 2 week (push score)	At 4 week /at discharge/ follow up(push)	Outcome
6	Madan das 35/M	2, dorsal	Wound size-4.5 cm ² ,exudates-none,tissue- epithelial (push- 8)	Size- 2 cm ² , exudates-none, tissue- epithelial (push-5)	Size-2cm ² exudate-none, tissue- epithelial (push-5)	Push change from 8 to 5, size decreased(50%) in 4 week. healed in 2 month.
7	Sudama rai 80/M	2,sacrum	Wound size-21cm ² , exudates-light, tissue-necrotic,(push-14)	Size-18 cm ² ,exudates-light, tissue-granulation, (push- 12)	Size-15 cm ² ,exudates-light, tissue-granulation, (push-12)	Push change from 14 to 12, size decreased (30%) in 4 weeks.
8	Suresh kr 60 /M	3, sacrum	Wound size-55cm ² , exudates-moderate, tissue-Necrotic(push 16)	Size-55cm ² , exudates-moderate, tissue-granulation (push-14)	Size-50 cm ² , exudate-light, tissue-granulation, (push-13)	Push change 16 to 13, size decreased(10%) in 4 weeks.
9	Tribhuvan pandey 45/M	3, sacrum	Wound size-35cm ² ,exudates-moderate, tissue-slough (push-15)	Size-35 cm ² ,exudates-light, tissue-slough(push-14)	Size-28 cm ² , exudates-light,tissue-granulation (push-13)	Push change 15 to 13, size decreased (20%) in 4 week.
10	Tejo das 40/M	3,sacrum	Wound size-18 cm ² ,exudate-moderate, tissue-necrotic,(push-15)	Size-18 cm ² , exudate-light, tissue-necrotic,(push-14)	Size-15 cm ² , exudate-light, tissue- slough (push-13)	Push change 15 to 13, size decreased (20%) in 4 week. Dead in 2 month
11	Jawahar Prasad 50/M	4, sacrum	Wound size-108 cm ² , exudates-moderate, tissue- slough, (push-15)	Size-77cm ² , exudates-moderate, tissue-granulation (push-14)	Size-77cm ² , exudates-moderate, tissue-granulation(push-14)	Push change 15 to 14, size decreased(20%) need plastic surgery intervention.

So, all the patient with grade 1 bed sore healed within 2 week with eusol containing dressing material; While in grade 2 bed sore patients wound size decreased by 47% (mean) in 4 week period with maximum number of patient (3) wound healed in

8 weeks. Patient with grade 3 and grade 4 bed sore healing was very slow; with only 17% (mean) decreased in wound area in 3 -4 week in grade 3 and 15-20% decrease in grade 4 bed sore.

Result of dressing with topical silver preparation in bed sore patients

no	Name, age and sex	Grade and site	Initial wound characteristic (push score)	At 2 week (push score)	At 4 week /at discharge/follow up	Outcome
1	Hareram rai 40/M	1, sacrum	Wound size-0.5 cm ² ,exudates-none,tissue-closed (push-2)	healed		healed
2	Teju kr 18/M	1,sacrum	Wound size-0.25 cm ² ,exudates-none,tissue-closed, push 1	healed		healed
3	Chandan kr 20/M	2,sacrum	Wound size-40 cm ² ,exudate-light,tissue-slough, push-14	Size-24 cm ² , exudates-light,tissue-granulation (push-12)	Size-4.5 cm ² , exudates-none, tissue- epithelial, (push-8), at 7 week push-6,	Push change-14 to 6, size decreased(90%) in 6 week.Almost healed in 7 week.
4	Pappu ram 40/M	2, sacrum	Wound size-0.5 cm ² , exudates-light,tissue-epithelial (push-4)	Size-0.3 cm ² exudate-light,tissue-epithelial, (push-3)	Healed in 4 week	50% decrease in size in 2 week. Healed in 1 month
5	Suresh ram 60/M	2, sacrum	Wound size-6 cm ² , exudates-light,tissue-slough,(push-11)	Size-2cm ² , exudate-light,tissue-granulation push-7	Size-3 cm ² ,exudates-none,tissue- epithelial, (push-4)	Push change 11 to 4, size decreased (50%) in4 week, almost healed in 6 week.
6	Tannu chaudhary 35/M	2, sacrum	Wound size-5 cm ² , exudates-light, tissue-granulation (push-10)	Size-2.5 cm ² , exudates-light,tissue-granulation,(push-8)	Size-2 cm ² (3 weeks), exudates-light,tissue-epithelial, (push-6)	Push changed 10 to 6, size decreased (50%) in 2 week. Healed in 4 weeks
7	Raja ram 40/M	3,sacrum and GT	Wound size(sacrum)- 80 cm ² , exudates-heavy, tissue-slough (push-16), push of gt-16	Size-64 cm ² , exudates-moderate,tissue -granulation, push-14, push of gt-15	Size -52 cm ² ,(3week) exudates-light,tissue-granulation, (push-13), push of gt-14	Push change 16 to 13, size decreased (35%) in 3 week, need plastic consultation.
8	Mukesh kr pandey 21/M	3, sacrum	Wound size-56 cm ² , exudates-moderate, tissue-slough, (push-15)	Size-48 cm ² , exudates-light, tissue-granulation, (push-13)	Size-40 cm ² ,(3 wk) exudates- light, tissue-granulation, (push-13)	Push change 15 to 13, size decreased (20%) in 3 weeks,
9	Lalit yadav 40/M	3,sacrum	Wound size-48 cm ² ,exudates-heavy, tissue-granulation, (push-15)	Size-48 cm ² , exudates-moderate, tissue-granulation, push-13	Size- 21 cm ² , exudates-moderate, tissue-epithelial, push-11	Push change 15 to 11, size decreased (40%) in 4 week, healing in 3 month.
10	Manoj sahni 30/M	3, sacrum	Wound size-150 cm ² , exudates-moderate, tissue-granulating, (push-14)	Size- 140 cm ² , exudates-light, tissue- granulating, (push-13)	Slight decrease in size in 3 week, need plastic surgery consultation	Push change 14 to 13, size decreased (10%) in 3 week,
11	Vinod ram 22/ M	4, sacrum	Wound size-90 cm ² , exudates-moderate, tissue-slough, (push- 15)	Size-75 cm ² , exudates-moderate, tissue-granulating, (push-14)	Size -49 cm ² (6 week), Exudates-light, tissue-granulating, (push-13)	Push change 15 to 13 and Wound size decreased (45%) in 6weeks, need plastic surgery intervention

So, all the patient with grade 1 bed sore healed within 2 week of dressing with silver containing material. Maximum of grade 2 bedsore patient healed within 6 week; average reduction in size of wound in grade 3 bed sore patients was 26% in 3-4 week, while grade 4 bed sore healing was very slowly with 15- 20% decrease in wound size in 2 week.

Photographs

1. Jawahar prasad



Grade 4: bedsore at sacrum, after dressing with eusol solution (not healing)



Grade 4: bedsore after debridement



Grade 4: bedsore undergoing flap coverage



Grade 4: bed sore after flap cover

2. Tunnu Chaudhary



Grade 2: bed sore at sacrum, dressing started with silver stream solution with gauze



After 2 week of dressing, wound size further decreased



Grade 2: bed sore completely healed after 4 week of dressing

Discussion

The occurrence of pressure ulcer is among the most common long-term secondary medical complication in persons with SCI^[7]. Pressure ulcers are likely to require a number of weeks or months to heal depending on their severity and the individual's co-morbidity. Moist wound management can result in improved healing^[8]. Wounds are cleansed with warm tap water or warm saline to remove visible debris and to aid assessment. Irrigation of the wound or showering is recommended^[9]. Where local infection is suspected, the use of topical antimicrobial dressings and wound management products are considered. The presence of devitalised tissue delays the healing process by keeping the wound in the inflammatory phase of wound healing; removal of devitalised tissue helps to prevent the spread of infection^[10].

Age Distribution

In our study, mean age for occurrence of spinal cord injury patients with bed sore is 39.04 years (SD of 15.78) with maximum number of cases in age group 30-45 years. The NSCISC fact sheet states that from 1973 to 1979, the average age at injury was 28.7 years and that it has risen to 37.6 years in 2000^[11]. A study by Tricot^[12] shows mean age of spinal cord injury was 38.2 years. So our study is in accordance with above studies.

Grade of bed sore and site of bed sore

In our study, most common grade of pressure sore is grade 2 (41%) followed by grade 3 grade 1 and grade 4. A study by Kalpana A. Kamble^[13] on incidence of pressure shows that maximum sore was in grade 2 (60%) followed by grade 3. Same finding seen in study conducted by Bergstrom N^[14]. Gardner *et al.*^[15] researched the validity and reliability of the PUSH tool 3.0 in a prospective study of PU patients. Out of the 23 participants wounds, 69% were Stage II, 19% were Stage III, 6% were Stage IV, and 6% were unstageable; the majority of wounds (55%) were present for 2 weeks or less. Study conducted in Mexico revealed that from total number of 249 patients 17% developed pressure ulcer. The most frequent stage was II (32%). The ulcer were most commonly found in sacrum (74%) (Galván-Martínez *et al.*, 2012)^[16]. A study by JHM Verschuere, MWM Post, S de Groot, LHV van der Woude, FWA van Asbeck and M Rol shows that most pressure ulcers were located at the sacrum, with a much lower percentage in the heel and ischium^[17]. The most frequent stages were stages 1 and 2, stage 4 ulcers were rare. There was no clear association between stage of the ulcer and its location. So our study is in accordance of above studies.

Healing of pressure sore

In our study, we used two dressing material (Eusol and silver) and their response is assessed by weekly photograph and PUSH healing score developed by NPUAP. A comparison of total scores measured over time provides an indication of improvement or deterioration of the pressure ulcer. PUSH scoring is done at the start of intervention and at the discharge and follow up. Patient with improvement of sore and patient needing debridement and plastic surgery referral also assessed. A comparison of total scores measured over time provides an indication of the improvement or deterioration of the pressure ulcer. In our study stage 1 pressure sore healed within 2 week time period with both dressing materials. Maximum of stage 2 pressure sore healed/ improved in 6 week to 8 week with slightly faster rate of healing with silver containing material. In Stage 3 pressure sore average reduction of wound area after 4 week by silver dressing was 26 %; while with eusol dressing was 17 % and require very long time for healing; while some of grade 2 and most of grade 3 pressure sore didnot healed completely and require plastic surgery intervation. While stage 4 bed sore didnot healed and required plastic surgery interventions. According to study by Anthony Porter and Rodney Cooter; Stage I and II pressure ulcers do not requires surgical treatment^[18] as they will heal with local therapy, improvement in pressure area care and hygiene. While stage III ulcers are likely to heal spontaneously but they have a recurrence rate of between 32 and 77 per cent if managed conservatively^[19]. Surgical coverage of the ulcer aims to reduce the recurrence rate due to the unstable scar, and expedite coverage^[19]. Stage IV ulcers almost always require surgical management, due to the large size of the defect and its complications. A study by Surajit

Bhattacharya and R. K. Mishra shows that severe pressure ulcer (Grade III or IV) fails to heal, in such cases, surgery is required to fill the wound and prevent any further tissue damage^[20]. This is usually done by cleaning the wound and closing it by bringing together the edges of the wound, application of various type of skin grafts or using local and regional flaps and free tissue transfer. According to the NPUAP classification^[21], the pressure ulcers that have to be surgically treated are those in Stage 3 and Stage 4. A study by Su E. Gardner, Rita A. Frantz, Sandra Bergquist and Chingwei D. Shin shows that PUSH provides a valid measure of pressure ulcer healing over time and accurately differentiates a healing from a nonhealing ulcer^[22]. It is a clinically practical, evidence-based tool for tracking changes in pressure ulcer status when applied at weekly intervals. Thus National Pressure Ulcer Advisory Panel developed the Pressure Ulcer Scale for Healing (PUSH) tool to track healing in stage II to IV pressure ulcers^[103].

Summary and Conclusion

From our study it can be summarized that most common age group of bed sore patients with spinal cord injury is younger age group (30-45 years) men because they are more involved in outdoor activity.

Grading of bed sore is done on the basis of NPUAP System of scoring. Most of our patient fall in grade 2 followed by grade 3. Debridement of all nonviable tissue and nutritional supplementation is given to patient for better and faster healing. There is slight faster rate of healing of pressure with silver containing dressing material in grade 2 and grade 3 sore with respect to eusol dressing, but because of lesser number of subject it can not be concluded that it is very superior dressing than eusol. There is faster reduction in common signs of inflammation like odema, erythema and faster increase in signs of healing of the ulcer i.e. granulation and fibrin formation with silver containing dressing material, but there is no statistically significant difference ($p>0.05$) in healing time between two groups. In our study, grade 3 and 4 pressure sore improvement occurred very slowly and needed some form of surgical intervention either in form of debridement or referral to plastic surgery for flap reconstruction of defect. So, prevention of bed sore is better than treating it. It appears that the advanced treatment method lends itself to better wound care practice with potentially financial benefits to individuals and institutions, yet there is still a tendency for currently used traditional treatment methods to persist. Consequently a paradigm shift towards a more advanced wound care treatment method is needed. However, this will require training and education about wound care to patients, caregivers and all health care professionals.

During this study we saw an alarming lack of knowledge with regard to all aspects related to the basic principles of pressure sore prevention and treatment, not only in patients and caregivers but also health care workers which included professional nurses and physician. The development of a comprehensive best practice method for pressure sore prevention and treatment in community settings could be of an enormous value to wound care practitioners and significantly benefit patients with pressure sores in the community.

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