Effect of Using Topical Insulin on Improving Pressure Ulcers Healing Among Neurological Patients

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Abstract
Background: Pressure ulcers are significant health issues and one of the biggest challenges that organizations face daily. Many new modalities of wound treatment have been promoted including wound care through using growth factors such as insulin. Topical application of insulin in PUs promote the ulcer healing .
The aim of this study was to evaluate the effect of using topical insulin for improving PUs healing.
Method; Quasi-experimental research design was conducted in Neurological Department at Mansoura University Hospital. The sample of this study composed of 60 patients who were divided into two equal groups; study group who received dressing with topical insulin and control group who received ordinary hospital dressing.
Results; indicate significant improvement in PUs healing for study group than control group with p value (< 0.05).
Conclusion: using topical insulin has a positive effect on improving PUs healing.
Keywords: Topical insulin , Pressure ulcers, Healing.

I. Introduction

Skin is a complex tissue, an injury to this stratified structure is considered to be the beginning of a sequence of events designed to restore skin integrity{1}. PUs are described as injuries to the skin and surrounding tissues because of an extended pressure at one or more places on it{ 2}. PUs has been described as one of the most costly and physically debilitating complications in the 20th century, it considers the third most expensive disorder after cancer and cardiovascular disease{3}. According to Agency for Healthcare Research and Quality (2013), the annual rate of PUs in persons with neurologic impairment is predicted to be 5% to 8%, PUs are listed as a primary cause of death in 7% to 8% of patients with spinal cord injury{4}. PUs are often preventable, it's prevention is easier and cheaper than therapy{5}. Wound managements entail many lines such as remove necrotic tissue, treat infection, fill dead space, and protect the wound from infection. In addition to, many new modalities of wound treatment have been promoted including negative pressure wound therapy, electric stimulation, derrma graft, and wound care through using growth factors{6}.wound healing process may be divided into 4 quickly overlapping phases that include coagulation, inflammation, proliferative phase, and scar formation phase{7}. Insulin receptors are found in all cells as fibroblasts and keratinocytes and it is able to additionally set off phophatidylinositol-3 kinase and mitogen-activated protein kinase indicators in skin fibroblasts and keratinocytes.

Therefore, insulin can stimulate cell development, proliferation, migration, and secretion through fibroblasts and keratinocytes{8}. On other hand, topical insulin application assist to regulate the traumatic inflammatory response, through the enhancement of expression of neutrophils adhesion molecules to reinforce the cell functions of migration, phagocytosis and bactericidal actions{9}.

II. Methodology

2.1 Aim;
To evaluate the effect of using topical insulin for improving pressure ulcers healing among patients in neurology department.

2.2 Research hypothesis;
There will be a significant improvement of pressure ulcers healing parameters among study group as compared with control group.

2.3Research design;
Quasi –experimental research design was utilized in this study

2.4 Setting;
This study was conducted at Neurological Department at Mansoura University Hospital.

2.5 Participants;
Sample of this study comprised of 60 patient of both sexes, had PUs grade 2 or 3with or without diabetes mellitus. They were divided into two equal groups; study group with the use of topical insulin dressing and control group who received ordinary hospital dressing.

2.6 Tools;
Two tools were used in this study as the following;
2.6.1 Tool I: Socio-demographic characteristics and medical data sheet, it divided into 2 parts.
Part I: Socio-demographic data sheet; to assess personal data such as age, sex, occupation..etc..

Part II:; Medical data sheet. This part was related to patient health status data such as date of admission, patient diagnosis, past medical history, skin hygiene, level of mobility, presence of urinary incontinence, presence of stool incontinence, moisture, site , shape and degree of bedsores, , using pressure relieving devices and types of them, hemoglobin level, white blood cells level, culture swab results, random blood sugar level, method of feeding, and Mini Nutritional Assessment.

2.6.2 Tool II: Pressure Ulcer Scale for Healing (PUSH Tool 3.0).
This tool was adapted from National Pressure Ulcer Advisory Panel version 3 ,1998, as a quick, reliable tool to monitor the change in PUs status over time. This tool described PUs with respect to three parts Part I: surface area : using ruler to measure the largest width and greatest length, multiple their measures to determine wound surface area in cm2. Part II: exudates amount: through evaluating old dressing discharges as none, light, moderate, or heavy. Part III: types of tissue in the wound as necrotic, slough, granulation, reepithalzation, or closed. Each type of this tissue has score. Record a sub-score for each of these ulcer characteristics. Add the sub-scores to obtain the total score. A comparison of total scores measured over time provides an indication of the improvement or deterioration in PUs healing.

2.7 Validity and reliability of the instruments
The developed tool was tested for content- related validity by 5 experts, from the faculty of nursing and from the faculty of medicine, Mansoura University, who reviewed the tool for clarity, relevance, understanding, and applicability for implementation. According to their critiques, minor modifications were done.

2.8 Pilot study
▪ A pilot study was carried out on 10% of subjects for testing the feasibility and applicability of the tools. The needed modification, omission and addition were made.

2.9 Ethical considerations:
Ethical approval was obtained from the research ethics committee of the Faculty of Nursing at Mansoura University. A permission to conduct this study was obtained from the administrator of Neurological Department at Mansoura University Hospital after explaining the aim of study.

2.10Field of work: The field of working included pre procedure, procedure, and post procedure.

Pre-procedure ;
● The researcher started by introducing herself to patients of both groups or their relatives, and giving them brief idea about the aim of the study.
▪ Each patient was interviewed before dressing intervention in both groups to collect the necessary data.
▪ Culture swab was taken before the researcher start her intervention for both groups.
▪ In first day of dressing for study group random blood sugar was measured 10 minutes before dressing and one hour after dressing in the first morning dressing. And the same measurements had taken in morning dressing of second day.
▪ The wound was evaluated in both groups for first time immediately on the first day before intervention.

Procedure ;
- **Dressing for study group:** started with cleaning the wound with saline, then applying gauze soaked with insulin, the gauze was left to dry and then covered with sterile dressing. The researcher used two types of insulin, act rapid and mixtard 30/70.In the study group, first fifteen patient were used act rapid insulin for dressing, while second fifteen patient were used mixtard 30/70 for dressing. Comparison between 2 types of insulin was done to determine if there were differences in the effect of them on PUs healing.
- **Dressing the wound among control group:** the patient received the usually routine hospital dressing; cleaning the wound with saline or bedatine then applying topical antibiotic, finally covered the wound with sterile dressing.
- Dressing was applied twice per day for one week for both groups. One in the morning and other in evening.

Post procedure;
- The wound was evaluated in both groups for second time one week after intervention. A comparison was done between dressing of study and control groups.

2.11. Statistical analysis;
After collection of the data, it was analyzed using the statistical package of social science "SPSS" software. Descriptive statistics in the form of frequencies and percentages for qualitative data, and means and standard deviations and medians and inter quartile ranges for quantitative variables. Quantitative continuous data were compared using the non- parametric Mann-Whitney test. Qualitative categorical variables were compared using chi-square test. Statistical significance was considered at p-value <0.05.

III. Results
Table 1:Socio-demographic characteristics of study and control groups (n= 60).

Table (1): Showed the general socio-demographic characteristic of the studied sample. Concerning to gender, (70% and 56.7%) of study and control groups respectively were females. The majority of participants in the study and control groups (73.3% and 70%) respectively were married. Above half of participants (56.7%) were illiterate in each group. In relation to occupation, (63.3% and 60%) were housewives in study and control groups respectively. Concerning age, the median for study and control groups was (54 year and 53year) respectively. As regard to hospital stay, the median for study and control group was (15.5 and 14 days respectively).

Table 1: Socio-demographic characteristics of study and control groups (n= 60).

Socio-demographic data	Groups				X^2	P
	Study group (n= 30)		Control group (n=30)			
	No	%	No	%		
Gender						
▪ Male	9	30	13	43.3	(1.148)	0.284
▪ Female	21	70	17	56.7		
Marital status						
▪ Single	1	3.3	0	0		
▪ Married	22	73.3	21	70	(1.273)	0.529
▪ Widow	7	23.3	9	30		
Education level						
▪ Illiterate	17	56.7	17	56.7		
▪ Read and write	6	20	6	20	(0.0)	1.0
▪ Secondary school	3	10	3	10		
▪ University	4	13.3	4	13.3		
Occupation						
▪ Manual work	7	23.3	4	13.3		
▪ Employee	1	3.3	6	20	(4.750)	0.314
▪ House wife	19	63.3	18	60		
▪ Retired	2	6.7	1	3.3		
▪ Others	1	3.3	1	3.3		
Age group	54		53		P	0.812

	Z	(-0.238)		
Hospital stay in days	15.5	14	**P**	0.614
	Z	(-0.504)		

Table (2) This table clarified that, there was a significant improvement in PUSH for study group than control group. where, there is no significant difference in PUSH score between the study and control groups at day one, while the score was statistically significant decreased in study group at day 7 but in control group it was increased.

Table 2:Comparison of Pressure Ulcer Scale of Healing (PUSH) between study and control group at day one and day seven (n=60):

Timing	Study group (n=30)	Control group (n=30)	p*
	Mean ± SD, Median		
Day 1	11 ± 2.2, 11	10.3 ± 2.4, 11	0.354
Day 7	8.7 ± 3.9, 9.5	10.7 ± 2.8, 11	0.030
P**	<0.0001	0.090	

Table(3):This table showed that, mixtard subgroup dressing had higher significant improvement in PUSH score than actrapid subgroup dressing where p value was (p= 0.001 and 0.002) respectively.

Table (3): Comparison of PUSH score between actrapid subgroup dressing and mixtard subgroup dressing of study group at day one and day seven (n=30):

Timing	Act rapid subgroup dressing (n=15)	Mixtard subgroup dressing (n=15)	p*
	Mean ± SD, Median		
Day 1	10.3 ± 2.3, 11	11.7± 2, 12	0.121
Day 7	7.5±4.2, 9	9.8±3.3, 11	0.087
P**	0.002	0.001	

Table (4): As shown from this table, the RBG values in first day before dressing was (190±78.7) whereas after dressing was (177.2±67.7) which was statistically significant (p=0.050), but in second day no significant difference occurred in RBG level before and after dressing.

Table (4): Difference between RBG level before and after dressing among study group at the 1st and 2nd day(n=30):

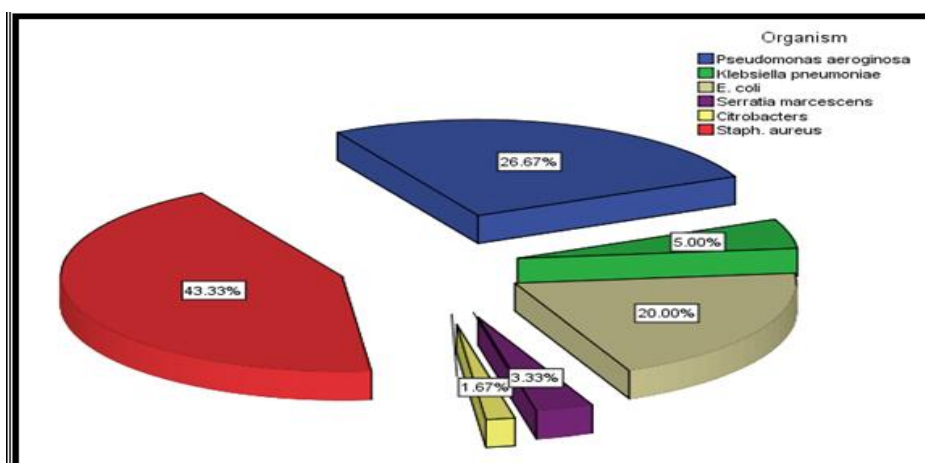| Timing of measurement	Mean ± SD of RBG (mg/dl)	p*
Day 1		
Ten minutes before dressing	190.7 ± 78.7	0.050
One hour after dressing	177.2 ± 67.7	
Day 2		
Ten minutes before dressing	180.7 ± 68.2	0.588
One hour after dressing	178.3 ± 60.5	

Figure (1):this figure illustrated that the most common microorganism was staph aurous organism (43.33%), followed by pseudomonas aeroginosa organism (26.67%) and E.Coli (20%). The lowest proportion involved klebsiella pneumonia, serratia marcescens and citrobacters (5%, 3.33%, and 1.67%) respectively.

IV. Discussion

Development of PUs can interfere with the patient's functional recovery, may be complicated by pain and infection, and can contribute to longer hospital stay. Presence of PUs is a marker of poor overall prognosis and may contribute to premature mortality in some patients{10}. Recently topical insulin was used in wound dressing , because it accelerates wound healing. Insulin stimulates the growth and development of different cell types and affects proliferation, migration, and secretion by keratinocytes, endothelial cells, and fibroblasts{11}.

The socio-demographic of the present study showed that, less than three quarter of the study subjects were females, this is in harmony with **Perneger et al., 2008**{12} who mentioned that above half of his studied sample were females. In contrast **Nangole, 2003**{13} who reported that the majority of his studied sample were males. Concerning marital status the results of the current sample showed that more than two third was married, this results in the same line with **Ikechukwu et al, 2012**{14} who reported that less than three quarter of his sample was married. As regard to, level of education in the present study revealed that above half of the participants was illiterate. On other hand **Taha et al, 2015**{15} mentioned that more than one third of the study group with primary education. This may be related to the fact that the majority of the study subjects came from rural areas with low socioeconomic status and low education level A study carried out by **Boa et al, 2013**{16}, reported that the age of patients with PUs was above forty seven years. In the same line, current study found that the median of age was fifty four years old. According to **Borghardt et al, 2016**{17} who reported that patients developed PUs with a length of stay greater than ten days. The present study revealed that the median of hospital study was 15.5 day.

In the present study, there was a significant improvement into PUSH for study group as compared with control group, this mean that PUs was better healing among insulin group than control group. This goes in line with **Stephen et al, 2016**{18} who demonstrated that PUSH scores decreased for insulin group than saline group. The findings of this study proved that both actrapid and Mixtard had a significant improvement in PUSH scores, but Mixtard was more effective than act rapid. This may be attributed to fact that act rapid is a neutral solution of human insulin. It is considered fast acting insulin. Mixtard 30/70 is a pre-mixed neutral suspension of human insulin consisting of neutral insulin injection (30%) and isophane insulin injection (70%) and it consider long acting insulin **European Medicines Agency,2013**{19}.

According to **Goenka et al, 2015**{20} who using act rapid for dressing in chronic ulcers,   proved that act rapid had demonstrated positive effects of insulin on wound healing. Also, **Venkatapuram et al, 2015**{21} found that local mixtard therapy has an effective method in the treatment of chronic ulcers and is safe.

The findings of current study showed that, there was a significant difference in RBG level before and after insulin dressing in first day. In this study research not put diabetic patients under control of drugs. This is in disagreement with **Goenka   et al, 2015**{20}, who study was role of topical use of insulin in healing of chronic ulcer, all diabetic patients were brought under glycemic control with appropriate ant diabetic therapy. So that no statistically difference into RBG values before and after dressing and no significant side effects or reactions were observed and none of the participants experienced adverse systemic effects such as hypoglycemia, headache and vertigo. Concerning micro-organisms found in PUs, the results of present study revealed that less than half had staph aurous organism in PUs. This in consistence with **Dana & Bauman, 2015**{ 22} who found that the most common organism was staph aurous. Also, **Bhosle etal, 2017**{23} mentioned that most common microorganisms grown from culture taken from the lesion was staph aures followed by pseudomonas.

Limitation of the study :
▪ Financial problem related to availability of insulin and culture swab.
▪ Many patients were discharged before completing dressing for one week and the researcher had to replace them by other participants and this make data collection process more difficult and overloaded.

VI.   Conclusion

The results of the current study proved that using topical insulin dressing was effective and safe method to accelerate PUs healing than using hospital routine dressing.

VII.   Recommendation

For the nurses :
➢ Application of skin assessment and safety skin protocol especially from admission for early detection of PUs.

➢ Conferences, workshops should be applied continuously for nurses upgrade their knowledge and practice regard new dressing materials.
➢ Recommendation of using topical insulin dressing for patients with PUs.
➢ Provision of adequate nutrition for prevention of PUs and proper treatment of it.

Further studies are needed to:
➢ Application of this study on large probability sample from different geographical areas.
➢ Further studies to explore barriers to apply topical insulin dressing for patients with PUs.

Acknowledgements

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