

Effect of Transcutaneous Electrical Nerve Stimulation (TENS) On the Wound Healing Process in Patients with Diabetes Mellitus Carried Diabetic Foot Ulcer Treatment at Roemani Muhammadiyah Hospital, Semarang

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Abstract :

Background: The increasing number of the patients with DM significantly every year and the data revealed that 15% of the total patients with DM experience ulcer. The purpose of this research is to know the effect of TENS towards wound healing process of the patients with DM under foot ulcer care.

Research Design: Quasy Experiment Pretest-Posttest Control Group Design.

Method: There are 16 respondents consist of 8 interventions and 8 control group. The wound examination was conducted before and after TENS intervention for 15 minutes with the frequency of 100Hz which was done twice and examined and measured by using BWAT measurement.

Results: There is difference in wound healing between intervention group and control group with $P=0.000$. The giving of TENS intervention effectively accelerates the wound healing process towards the patients with diabetic foot ulcer with p value of <0.005 .

Conclusion: The giving of TENS contributes to the wound healing process towards the patients with DM under the diabetic foot ulcer care.

Keywords – TENS, Wound Healing Process, Diabetes Mellitus

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I. Introduction

Diabetes mellitus is an imbalance sugar level in blood due to the disruption of the insulin hormone in which the body is unable to produce enough insulin to their needs, or the inability of patient to produce insulin at all, or the patient is able to produce enough insulin, but the cells can not receive the insulin because the receptor that functions as catcher of the insulin decreased in function (1).

In 2015, there were 415 million adults with diabetes, it was four folds rising from 108 million in the 1980s. In terms of epidemiology, it is estimated that by 2030 the prevalence of DM in Indonesia will be 21.3 million people (2).

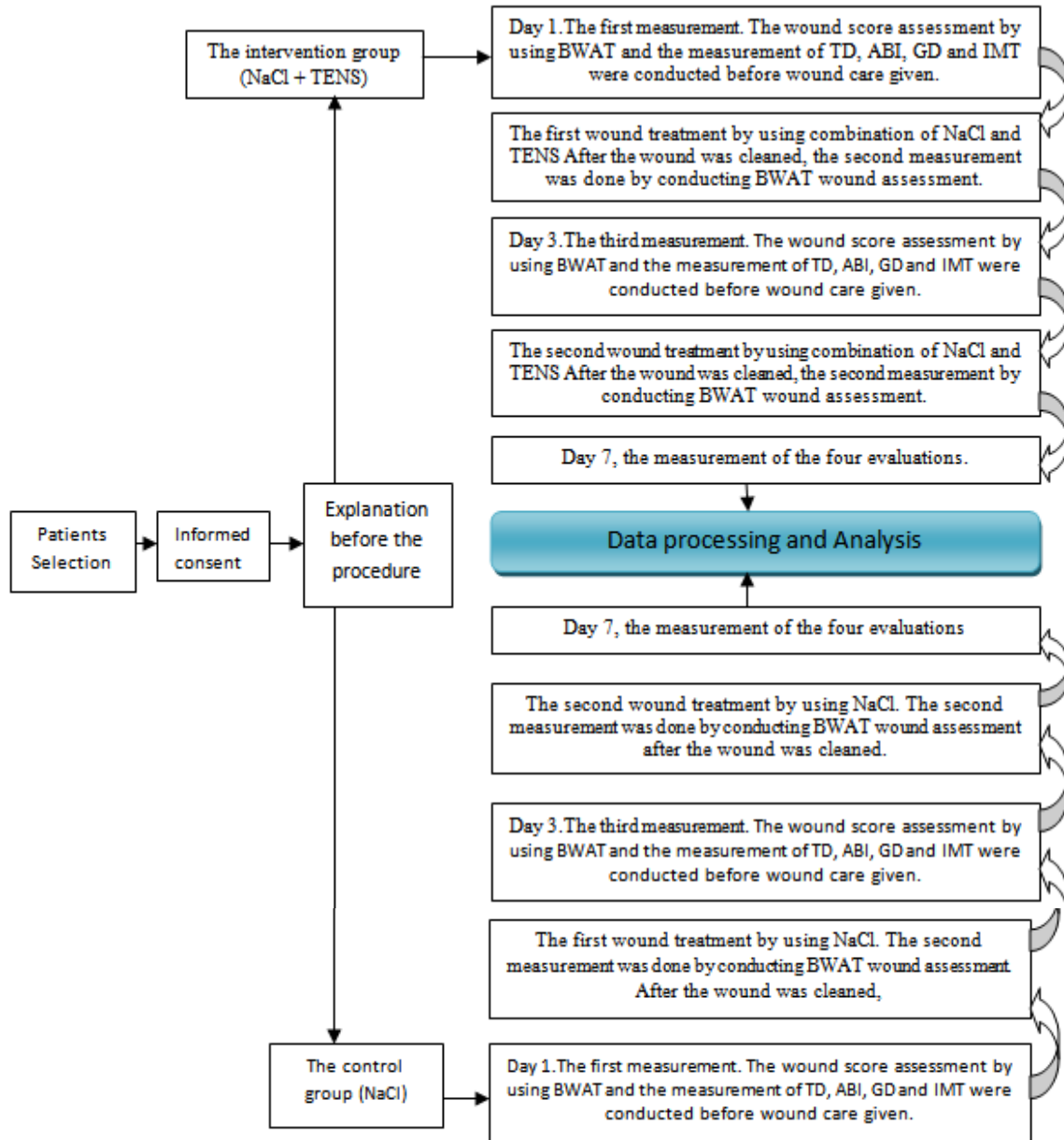
The most common complication of diabetes disease is diabetic foot wounds. Patients with diabetic ulcers in Indonesia are about 15% with risk of amputation by 30%. The result of Basic Health Research in 2007, the data showed that the proportion of causes of death due to diabetes in the age group of 45-54 years in urban areas was in the 2nd rank by 14.7%, and rural areas was in the 6th rank by 5, 8%. Diabetic ulcer contributes to 80% of hospitalization which is the biggest cause. Generally to cope with diabetic wounds in hospital is by giving foot diabetic ulcer care (3). Nurses also use liquid materials such as NaCl and fluid D40% and the result was the medical treatment by using NaCl only is not enough. If there is a good vascularization on the wound then it will be able to accelerate the process of wound healing. On the contrary, the wound healing will have problems if the vascularization around the wound is not good enough (4).

As the number of DM case is increased significantly and the researches on TENS intervention by nurse in the hospital as wound healing process management in Indonesia which have not been conducted yet so far, the researcher was then encouraged to conduct the research on the effect of TENS intervention towards DM wound healing process.

The purpose of the research is to find out the effects of TENS on the process of wound healing in diabetic patients who have the treatment of diabetic foot ulcers.

II. Material and Method

This research is a quantitative experimental. The method used is Quasy Experiment Pretest-Posttest Control Group Design. There are 16 respondents consisting of 8 intervention and 8 ontrol groups. The measurement of the wound was done before and after the intervention of TENS for 15 minutes and it was also performed twice with 100Hz frequency using BWAT measurement. The implementation research procedure



III. Univariate Analysis Results

Table 1 .The Characteristics of Respondents Based on the distribution of sex, ethnicity, and employment in the control group and the intervention group.

| Variables | Intervention | | Control | | Total (%) |
|-----------|--------------|------|---------|------|-----------|
| | N | % | N | % | |
| Sex | | | | | |
| -Women | 6 | 75.5 | 5 | 62.5 | 11 (75.0) |
| -Man | 2 | 25 | 3 | 37.5 | 5 (25.0) |
| Ethnicity | | | | | |
| -Java | 8 | 100 | 8 | 100 | 16 (100) |
| -Non Java | 0 | 0 | 0 | 0 | 0 (0) |

| | | | | | |
|---------------------------|---|------|---|------|----------|
| Employment | | | | | |
| -Private Company Employee | 3 | 37.5 | 2 | 25.0 | 5 (31.3) |
| -Housewife | 2 | 25.0 | 2 | 25.0 | 4 (25.0) |
| -Labor | 2 | 25.0 | 2 | 25.0 | 4 (25.0) |
| -Businessman | 1 | 6.3 | 0 | 0 | 1 (6.3) |
| -Civil Servants | 0 | 0 | 1 | 6.3 | 1 (6.3) |
| -Driver | 0 | 0 | 1 | 6.3 | 1 (6.3) |

The description of the average age, duration of suffering from diabetes mellitus (DM), ABI classification, BMI classification and GDS classification will be described in Table 2, as follows.

Table 2. The description of the average age, duration of suffering from diabetes mellitus (DM), ABI classification, BMI classification and GDS classification of the control group and the intervention group.

| Variables | | Intervention | Control |
|-------------------------------|---------|---------------|---------------|
| Age | Mean | 59.00 | 57.25 |
| | Median | 58.00 | 58.00 |
| | SD | 4,175 | 6902 |
| | Min-Max | 54-67 | 48-67 |
| | 95% CI | 55.51-62.49 | 51.48-63.02 |
| Duration of suffering from DM | Mean | 7:38 | 7:25 |
| | median | 5:00 | 6:00 |
| | SD | 6,022 | 4,621 |
| | Min-Max | 3-21 | 3-15 |
| | 95% CI | 2.34 to 12.41 | 3:39 to 11.11 |
| ABI Classification | Mean | 1:25 | 1.75 |
| | median | 1:00 | 2:00 |
| | SD | 0463 | 0707 |
| | Min-Max | 1-2 | 1-3 |
| | 95% CI | 0.86-1.64 | 1:16 to 2.34 |
| BMI Classification | Mean | 2.75 | 2:38 |
| | median | 1:00 | 2:00 |
| | SD | 0463 | 1,188 |
| | Min-Max | 1-2 | 1-4 |
| | 95% CI | 0.86-1.64 | 1.38 to 3.37 |
| GDS Classification | Mean | 552.2 | 590.8 |
| | median | 535.6 | 590 |
| | SD | 209.7 | 183.6 |
| | Min-Max | 303-938 | 374-826 |
| | 95% CI | 376-727 | 437-744 |

IV. Bivariate Analysis Results

The description of the wound measurement results by using BWAT scale will be described in Table 3, as follows:

Table 3. The Result of Wound Measurement by using BWAT

| | Intervention | | | | Control | | | |
|---------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|
| | pre | Post 1 | Post 2 | Evaluation | pre | Post 1 | Post 2 | Evaluation |
| Mean | 30.13 | 26.75 | 23:00 | 20.88 | 39.63 | 39.38 | 37.75 | 37.50 |
| Median | 29.50 | 27.50 | 23:50 | 21:50 | 39.00 | 38.00 | 36.00 | 35.00 |
| SD | 4,486 | 4,166 | 4,140 | 3,227 | 8717 | 8733 | 8582 | 8,602 |
| Min-Max | 22-36 | 18-32 | 16-28 | 16-26 | 28-56 | 28-56 | 28-55 | 28-55 |
| 95% CI | 26.37-33.88 | 23.27-30.23 | 19.54-26.46 | 18.18-23.57 | 32.34-46.91 | 32.07-46.68 | 30.58-44.92 | 30.31- 44.69 |

The description of the different test results between the intervention and control groups before and after the intervention and the measurement will be described in Table 4, as follows:

Table 4. The result of the difference between the intervention group and the control group

| The process of wound healing | mean (average) | Std. Deviation | p-Value |
|--|----------------|----------------|---------|
| Before-after of the control group | 1.00000 | 3.92792 | .495 |
| Before-after of the intervention group | 9.25000 | 3.01188 | .000 |

The description of the influence test results between the intervention group and control groups before and after the intervention and the measurement will be described in Table 5, as follows:

Table 5. The result of the influence test between the intervention and control groups before and after the intervention and the measurement

| Variables | Group | mean | SD | n | CI 95% | p-value |
|------------------------------|-----------------------------|-------|-------|---------------|--------------|---------|
| The process of wound healing | Intervention | | | 8 | | |
| | before intervention | 30.13 | 4,486 | | 26.3-33.88 | 0.011 |
| | After the intervention of 1 | 26.75 | 4,166 | | 23.27-30.23 | |
| | After the intervention of 2 | 23.00 | 4,140 | | 19.54-26.46 | |
| | Evaluation | 20.88 | 3,227 | 18.18 - 23.57 | 0.001 | |
| | Control | | | 8 | | |
| | Before | 39.63 | 8717 | | 32.34-46.91 | 0.038 |
| | After the intervention 1 | 39.38 | 8733 | | 32.07-46.68 | |
| | After the intervention 2 | 37.75 | 8582 | | 30.58-44.92 | |
| | Evaluation | 37.50 | 8,602 | | 30.31- 44.69 | |
| | | | | 0.005 | | |

V. Discussion

Based on the different test results shows that the average process of wound healing in the control group is 1.00000 compared to the intervention group, which is 9.25000. From the analysis of the research results by Paired T-test, it was obtained p-value in the intervention group was $0.000 < \alpha (0.05)$, so it can be concluded that there are differences in the wound healing process in the intervention group and the control group. This means that there is significant TENS intervention towards the wound healing process in patients with diabetes mellitus who get the treatment of diabetic foot ulcers.

The result of wound assessment using BWAT in the intervention group experienced significant change compared to the control group, there is a difference in the form of the type of tissue necrosis, reduced the amount of exudate, discoloration of the skin around the wound, the presence of granulation tissue and epithelialization.

This is appropriate with to research conducted by Pranata (2016) which stated that TENS is also capable of stimulating the peripheral nerves to work optimally and improve blood circulation in the vicinity of the electrode is applied. Theoretically, if the blood circulation is good then wound healing can be good as well (5). Giving low-frequency TENS intervention can stimulate the body to release endorphins and it will increase the relaxation, then followed by decrease in pain (6). Giving TENS intervention also may affect the pain reduction. This resulted in an increased immune system so that wound healing can be maximum (7).

Other research conducted by Franco (2014) stated that the administration of 100Hz dose of TENS intervention can improve the reactivity of venous blood circulation well. The effect of TENS therapy on post-mastectomy patients showed that the incidence of postoperative wound necrosis in the control group was higher than the intervention group (8). Research conducted by Cytokines, Gül, Say, & Çetin, (2013) explained that TENS lead to changes in temperature and skin blood flow, the electrical implus of TENS increases the proliferation and fibroblast migration, macrophages and phagocytosis movement. TENS also accelerates protein synthesis in fibroblasts, reduces edema and prevents the growth of bacteria by increasing blood flow to the wound. TENS is able to slow down the inflammation of the dermis and granulation tissue that causes re-epithelialization. After TENS intervention is given around the edges of the wound, it will experience healing cutaneous through inhibition of pro-inflammatory cytokines, re-epithelialization and formation of granulation (9).

VI. Conclusion

TENS can affect the process of diabetic foot ulcers wound healing, there is a difference starts from the type of necrosis tissue, reduced the amount of exudate, discoloration of the skin around the wound, and the presence of granulation tissue and epithelialization.

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