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The effect of transcutaneous electrical nerve stimulation on the pain intensity during insertion of vascular needles in hemodialysis patients

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ABSTRACT

Aims: Although hemodialysis has an important role in prolonging the life expectancy of patients with chronic renal failure, the patients are facing further complications. Pain during insertion of vascular needles is the most high stress part of a hemodialysis treatment, so it is important to find ways to reduce pain in these patients. This study was conducted to determine the effect of transcutaneous electrical nerve stimulation (TENS) on the pain intensity when the needles are inserted into vascular access for hemodialysis.

Methods: A semi-experimental and double blind study was performed on 30 patients in hemodialysis ward of Semnan Fatemieh hospital. In this study, pain intensity during insertion of hemodialysis vascular needles was measured by a numerical pain scale in a one group by using TENS and TENS placebo. The pair T test was used to determine pain intensity mean difference in two conditions.

Results: Overall, the results showed that the mean pain intensity was 3.3±2.13 and 3.56±2.16 in two conditions using TENS and TENS placebo, respectively. However, no significant difference was found between the mean pain intensity in two conditions statistically by using pair T test (p=0.55).

Conclusion: Results showed that it cannot say, TENS is effective in reducing pain during insertion of vascular needles. The reason for this finding may be related to neuropathy and skin changes present at the insertion site of hemodialysis needles. It is recommended that nurses investigate the other methods for reducing pain in these patients.

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1. Introduction

Pain is considered as a significant hygienic issue and is the most common reason for the people to come to medical centers [1]. Pain can be generated due to different causes. In clinical situations, pain is produced in the course of

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different diagnosis and therapeutic measures. One of the most prevalent pains is the one generated due to the insertion of the venous catheter for therapeutic reasons in hospitals [2]. The studies have demonstrated that %5.3 of adult patients have a terrible fear and %22 have a moderate fear of the needles [3]. The pain resulting from the insertion of the needles and catheter into the blood vessels is problematic when it is frequently repeated and the need for them becomes recurrent. For example in treating patients suffering from chronic renal failure, hemodialysis is counted as a maintaining treatment which often involves the continual use of arterial and venous needles for the patients [4]. These patients usually undergo hemodialysis three times a week and each time for 3-4 hours [5]. The recurrent pain resulting from the frequent insertion of hemodialysis needles is a common experience which hemodialysis patients share. This can lead to their depression and decline of their quality of life. More than one-fifth of hemodialysis patients describe this pain as excruciating [6].

Although the improvement of medical technology especially hemodialysis has prolonged the life of those suffering from chronic renal failure [7], despite all these improvements, they are still affected by physiologic stresses due to the disease itself and its maintaining treatment (hemodialysis). Among the stress is the pain during and after hemodialysis [6]. Considering that undergoing hemodialysis involves the continual use of arterial and venous needles to reach vessels [4], these patients experience needle pain at least 300 times a year [8]. The studies have depicted that %47 of hemodialysis patients are afraid of needles [9] and believe that the insertion of vascular catheters are the most stressful part of the treatment and the biggest worry during hemodialysis [10]. The recurrent painful insertions and continuation of the pain in these patients are not only considered as bitter and harmful experience but also can affect their quality of life in a negative way and gradually lead to their feeling of irritation and depression [11]. Thus the considerable issue about them is that they should be supported against these troubles [1].

At the moment, the spread of chronic renal failure all over the world is increasing. In 2000 the number of the patients under treatment for chronic renal failure was 1100000 throughout the world, at the end of 2009 this number reached 2654000, which with 6-7 percent of the increase, had a more significant growth rate than that of world population growth [12]. It is estimated that in 2020 the number of hemodialysis patients reaches 3500000 [13]. In Iran the rising rate of this disease is more than the global average growth rate and is about %12 in the year [14]. Considering the importance of the pain, in most studies controlling pain during insertion of vascular needles in these patients has been emphasized and alleviating pain should be a part of the treatment of these patients [6]. Nurses, due to their key role in caring for the patients suffering from chronic renal failure, can be effective in alleviating these patients' pain [15].

At present there have been a lot of improvements in pain elimination and so many medicinal and non-medicinal methods to reduce pain have been introduced. In some cases the effect of these methods for reduction of patients' pain is in question, though [16]. Regarding the drug side-effects, today employing non-medicinal methods to control and alleviate pain is increasing [2]. Among non-medicinal methods we can refer to mind distraction, relaxation, self-suggestion, touch-therapy, hypnotism, skin stimulation [5]. Skin stimulation itself includes: massage, pressure therapy, using heat and cold, acupuncture, and using electrical stimulation to control pain [17]. From methods of electrical stimulation, Transcutaneous Electrical Nerve Stimulation (TENS) uses the most for lessening pain [18]. Employing electrical current to reduce pain is not something new. In ancient Egypt and Greece eels were used to relieve pain. By 19th century using electricity became common and in 1965 the physiological basis of electricity in

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pain reduction was introduced by Wall and Melzack [19]. Now TENS is used to control mild and moderate pains and in severe pains it is used as a complementary method to lessen the need for painkillers especially narcotics, and to prevent their complications such as respiratory depression, nausea, vomit, and hemodynamic disorders [20].

There are different theories about the TENS mechanism in reducing pain but most of them unanimously believe that TENS relieves acute and chronic pains through two mechanisms; gate control and endorphin secretion [19]. Of the advantages of TENS we can refer to its simplicity, harmlessness, accessibility, and repeatability, and it is widely used by physiotherapists and nurses in medical centers to relieve acute and chronic pains [19, 21]. In medical centers, it is the nurses' duty to determine and control pain. Nurses as the member of health team have a key role in pain relief [22]. One of the basic duties of the nurses is to make every effort to eliminate or at least minimize the patients' pain [18]. If nursing personnel can control the pain during insertion of the catheter through undertaking some measures, besides the patients' satisfaction, they can have faster access to the vessels [23].

Thus, finding ways to control pain during insertion of catheter or needle into the vessels is of great importance [24]. That being so, considering the necessity of doing research in relation to pain relieving methods and nurses' role as the main provider of the care especially for hemodialysis patients, this study has been conducted to determine the effect of TENS on pain intensity during insertion of vascular needles in hemodialysis patients.

2. Methods

This study is a semi-experimental research of clinical experimentation and double-blind type. In this study, 30 hemodialysis patients from hemodialysis ward in Fatemieh hospital of Semnan were assigned after their consent was taken. These patients were qualified to enter the study and the ethical considerations were also accounted. The sampling method in this research was purposive and accessible simple sampling.

The criteria employed to assign the cases to enter this research include: being conscious, having not taken painkillers, narcotics or sedatives at least six hours before hemodialysis, having no traces of severe pain in other parts, having no peacemakers, starting hemodialysis at least three months before, being 20 years old or older, and having no traces of skin abnormalities or analgesia in vessels access point.

The tools for collecting data where the questionnaire sheet and checklist which had two sections. The first part was related to demographic information such as: age, sex, marital status, occupation, address, education level, and duration of hemodialysis. The second part was related to the assessment of pain intensity in patients.

The patient's pain intensity was assessed by a numerical rating scale for pain measurement, which was numbered between 0-10. Number 0 indicated no pain and number 10 indicated the most severe pain which the patient could feel. The scientific validity and reliability of numerical rating scale for pain measurement has been examined in various studies. The results of the study by Williamson and Hoggart (2005) demonstrate that this instrument has the proper validity and relaiability and can be used practically in treatment [25]. This instrument has also been used in Iran in different studies and it was confirmed that it has the proper validity and constancy to assess pain intensity [26]. In this study the pain intensity during insertion of vascular needles was assessed in one group of hemodialysis patients with two methods of TENS and placebo TENS. The assessment was done in two consecutive sessions in a two-day interval. In the first case (using placebo TENS) TENS unit was off. After cleansing the skin, TENS electrodes were applied by the researcher 6 centimeters apart, close up and down the skin area for insertion of the needle. One minute after the placement of

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electrodes on the skin, after we had sterilized the skin area of insertion of the arterial needle by Betadine and when the TENS machine was still off, hemodialysis needle was inserted into fistulae by the ward nurse.

In the second case (using TENS); after cleansing the skin, the TENS electrodes were applied by the researcher 6 centimeters apart closely up and down the skin area for insertion of the needle. Then the TENS machine (which had been set) was switched on by the researcher and the current intensity was gradually increased so that the patient could feel a sense of pins and needles in the skin area where the electrodes were placed. Then the current intensity was increased closely up to the patient's tolerance threshold.

In both cases mentioned above, to observe the consistency of the job, the16 gauge arterial needle for hemodialysis was inserted into the vessels of the area at least 5 cm apart from fistulae with an angle of 30-45 degrees by an expert hemodiaysis ward nurse. This was done while the slanted edge of the needle faced upward. One minute after insertion of arterial needle, the pain intensity of the patient was measured by the nurse, using a numerical rating scale for pain measurement. In this study neither the patient nor the nurse who inserted the hemodialysis needle were aware of the type of intervention and it was only the researcher who knew the intervention type and thus switched the TENS machine on or off. The model of the TENS machine used in this research was ES-420 made by ITO factory in Japan.

The data after collection entered software spss17 and descriptive and deductive statistics were used to analyze the data. Then description and categorization, and comparison was done through determining percentages and creating the tables for absolute and relative frequency of the research data. To make the statistical calculations and description of data and also creation of tables easier, pains were categorized as follows: pain intensity 0 (indicating no pain), pain intensity 1-3 (indicating mild pain), pain intensity 4-6 (indicating moderate pain), pain intensity 7-9 (indicating severe pain), and pain intensity 10 (indicating the most severe pain possible).

In order to approve the normality of data distribution, Kolmogorov -Smirnov test was used and the outcome proved that the data have a normal distribution. Therefore, to compare the mean pain intensity in study units in two methods of TENS and placebo TENS, paired T-test was deployed. Moreover, significant statistical level was considered $p<0.05$.

In this study the ethical considerations were accounted for the effect that sampling was started just when the ethics committee of Semnan University of Medical Sciences and the authorities of the hospital and dialysis ward granted their consent. The researcher first introduced himself to the study cases and then fully explained to them the research aims, procedure, optional participation in the study, and confidentiality of the information, and then their consciously written consent for participating in the study was taken.

3. Results

The participants of this research were composed of 30 hemodialysis patients. 21 persons (%70) were male and 9 persons (%9) were female. The average age of the patients was 46-52 and most of the patients (%36.7) aged 45-59. The mean duration of hemodialysis treatment for the study cases was 20-36 months. Along with the aims of this research, the acquired findings have been presented in tables 1 and 2. Table 1, illustrates absolute and relative frequency distribution of study units according to their pain intensity in different methods during insertion of vascular hemodialysis needles. The findings depicted that when TENS method was used, the pain intensity in most cases (%50) was mild. In this condition the mean pain intensity was 3.3±2.13. The pain intensity in most study cases (%50), when placebo TENS were used, was reported mild, and the mean pain intensity in this situation was 3.56±2.16.

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Table 2, demonstrates the outcome of comparing pain intensity in study units in different methods during insertion of arterial hemodialysis needles. In the mentioned table the outcomes of statistical paired T-test show that the pain intensity, when TENS method was used, did not have a significant variation compared to that during placebo TENS (p=0.55).

4. Discussion

Although the researches on the pain resulting from hemodialysis needles is sparse, there has been a great many studies on the impact of medicinal and non-medicinal methods on the patient's pain intensity during insertion of vascular needles. This study has also been conducted to determine the effect of TENS on pain intensity during insertion of vascular needles in hemodialysis patients. Regarding this subject, it can be said that although medicinal methods are the most common ways of alleviating pain, considering the complications resulting from drugs and skin diseases for hemodialysis patients, we decided to investigate another less harmful method to reduce the pain during insertion of hemodialysis vascular needles. Among non-medicinal methods, TENS were chosen and it was allocated the most portion of research in non-medicinal methods of reducing pain. Of the advantages of TENS method one can refer to its simplicity, harmlessness, accessibility, and repeatability. At present TENS is used to control mild and moderate pains and in severe pains it is used as a complementary method to reduce the need for painkillers.

In this research, to eliminate the effect of intervening variables such as age, sex, etc. the study has been carried out on a single group with two methods of TENS and placebo TENS.

The findings of the research demonstrated that most research cases were male. In other relevant studies too, as is the case in this study, the number of male hemodialysis patients was higher than that of females [27]. The reasons of this excess of males compared to females are various. Monfared et al. (1382) in a study which dealt with chronic renal failure in hemodialysis patients in Gilan revealed hypertension as the most prevalent cause of renal failure [28]. The study by Noblat et al (2004) demonstrated that the spread of renal failure subsequent to hypertension was wider in males laid up in intensive care units than females [29], therefore considering the influential factors in the outbreak of chronic renal failure and other relevant studies, the higher number of male hemodialysis patients in the present study is justifiable. The average age of study cases was 46-52. Vosoughi reported the average age of the hemodialysis patients in his study 50-55 [30]. Considering the issue that the most prevalent causes of the outbreak of renal failure in the last phase are diabetes and hypertension and that these diseases are more likely to happen as the individual ages [31], the outbreak of chronic renal failure increases as the person gets older. So, most patients suffering from chronic renal failure are in their old age.

Relevant to the aims of this study, based on the determination of the pain intensity during insertion of vascular needles, the mean pain intensity in hemodialysis patients was 3.56±2.16 when placebo TENS were used. Lander and Kerry (1993) in a study under the title "TENS for children's procedural pain" reported the mean pain intensity of 3.02 while using placebo TENS. In the mentioned study pain in the group treated with placebo TENS was moderate and less than the control group, which can be as a result of self- suggestion in patients [32].

In relation to determination of pain intensity during insertion of vascular needles in hemodialysis patients in TENS method, the results indicated that the mean pain intensity was 3.3±2.13. In the study by Lander and Kerry (1993) the mean pain intensity in TENS was reported 2.88 [32]. In addition, in the study by Asgari et al. (1387) regarding the effect of TENS on the pain intensity related to the insertion of angiocath, the mean pain intensity

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Table 1. Absolute and relative frequency distribution of study units according to their pain intensity in different methods during insertion of vascular hemodialysis needles.

Method / Pain intensity	TENS		Placebo TENS	
	Subject	Percent	Subject	Percent
No pain	3	10	1	3.3
Mild pain	15	50	15	50
Moderate pain	10	33.3	12	40
Severe pain	2	6.7	2	6.7
Very severe pain	0	0	0	0
Total	30	100	30	100
Pain intensity mean	3.3		3.56	
Standard deviation	2.13		2.16	

Table 2. The outcome of comparing pain intensity in study units in different methods during insertion of vascular hemodialysis needles.

Outcome / Different methods	Pain intensity mean	Standard deviation	P Value
Using TENS	3.3	2.13	P=0.55
Using placebo TENS	3.56	2.16	

of the patients in TENS method with high frequency was 2.48 [33].

In regard to the comparison between the mean pain intensity in TENS and placebo TENS method, the result revealed no significant variation. There have been a great many studies conducted on the effect of TENS on pain intensity. The outcome of some of these researches approves of the result of our study and do not prove any advantages of the TENS method in pain reduction. For example the result of the study by Meechan et al (1996) proved that TENS is not more effective than placebo TENS in reducing the pain resulting from injection [34]. The study by Bendetti (1997) as well, did not manifest any significant difference between the pain intensity in two groups of TENS and placebo TENS [35]. Freynet (2010) in his review, on the effect of TENS on the pain after Thoracotomy, points out that treatment with TENS only is not effective in severe pain [36].

The outcomes of the present study is not compatible with the outcomes of some of the other studies, in such a way that the research by Lander and Kerry (1993), about the effect of TENS on the pain intensity resulting from vascular injection in children, proved that the highest pain intensity went with control group and the lowest has been for a TENS group [32]. In a study carried out by Quarnstrom and Libed (1994), it was proved that the pain intensity resulting from the injection during TENS method has been less than when this method was not used [37]. Besides, parallel with that, Faher in a meta-analysis research reviewed 25 studies conducted between years 1975 and 1990 in relation to the effect of TENS on pain reduction. In this review the number of the studies which proved a positive effect was a little more than those studies which failed to prove or claimed no effect [38].

Considering the mechanism of TENS in reducing pain, perhaps one can say that the other reason of ineffectiveness of TENS in pain reduction during insertion of hemodialysis needles in our study results from neuropathy [5] and skin problems in these patients such as itching and erythema [39]. In regard to the fact that the most prevalent cause of chronic renal failure is diabetes and that diabetes can cause neuropathy and other complications, which have the patient feeling less pain [31], thus the absence of variation in pain intensity in two methods of TENS and placebo TENS is justifiable.

The other reason that there is no effect of TENS in this study can be a result of the fact that TENS is basically used in controlling mild and moderate pains and in severe pain it is used as a complementary method and along with drug [20]. Therefore, by taking into consideration that the pain following the insertion of hemodialysis thick needles is in two states of sever and acute, TENS can not be that much effective in reducing these patients' pain.

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Placebo TENS can also be influential here. Generally there are various theories in relation to the effect of placebo in pain reduction. Placebo is generally a material or an intervention which does not have the considered therapeutic effect. However, on average one third of the patients get better when they receive the placebo. The effect of placebo depends on the patient's expectation and trust in the effect of that drug or intervention in the cure of that disease. The brand of the drug or equipments is also influential in the effectiveness of placebos. The brand-name drugs and equipments are more effective than those which are not [40]. Of the restrictions of this research one can refer to the fact that pain is a subjective entity and there is no objective criterion to measure that. Thus we have to rely on the patient's answer. The other restriction is that the study cases were few and that there was no observation group not to receive any intervention. With regard to these restrictions, it is recommended that subsequent studies be developed to be carried out with a larger population of cases, more statistical ability and presence of the observation group without any intervention, in order to be able to remark more certainly on the effect of TENS on the pain intensity during insertion of vascular needles in hemodialysis patients.

5. Conclusion

The findings of the present study revealed that although the mean pain intensity in TENS was lower than that in placebo TENS, this pain reduction was not so much so that it is considered statistically significant. According to the outcomes of this research, it cannot be said that TENS can reduce the pain intensity while inserting vascular needles.

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