

Original Article

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The Effect of Infrared Vein Finder on Fear of Pain During Peripheral Venous Catheterization at the Emergency Department

Uğraş et al. Effect of Vein Finder on Catheterization

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Abstract

Objective: Peripheral venous catheterization (PVC) is one of the most common and invasive procedure in the Emergency Department (ED). The use of technologies to improve efficiency and reduce pain is important. This study aims to reveal the effect of infrared vein finder on pain and fear of pain during PVC.

Materials and methods: This prospective randomized study was conducted with 200 patients who underwent for PVC at emergency department. The patients were randomized into two groups as infrared vein finder (IVF) and control group. PVC was applied to the control group with the conventional method. In IVF group before PVC, patient informed about IVF devices and PVC performed with it. Fear of Pain-3 questionnaire (FPQ-3) before the procedure and numerical pain scale (NRS) after the procedure were applied for both groups. FPQ-3, NRS scores, PVC success rates were analyzed.

Results: Two hundred patients participated to study. Mean age was, 33.3±11.2 for IVF and 32.5±10.2 for control group. The success rate in the first attempt was 92% (n=92) in the IVF group, 97% (n=97) in the control group (p=0.121). The mean total scores were; 78.8±21.5 8

in the IVF group and 85.8 ± 22.0 in the control group ($p=0.025$). The groups were compared in terms of severe pain, minor pain, and medical pain scores, and there was only difference in minor pain scores ($p=0.021$). The mean NRS score in the IVF group was 2.56 ± 1.25 , control group was 2.94 ± 1.58 ($p=0.121$). The correlations between NRS and subgroups were; “severe pain” ($r=0.407$, $p<0.001$), “Minor pain” ($r=0.534$, $p<0.001$) and “Medical pain” scores ($r=0.390$, $p<0.001$) in IVF group.

Conclusion: Although use of IVF for venous catheterization reduces the fear of pain in adults but not reduce pain and severe pain fear, it only reduces the fear of minor pain and not affect the success of the procedure.

Keywords: pain, fear of pain, vein, catheterization, infrared vein finder

Introduction

Peripheral venous catheterization (PVC) is one of the most common procedures in the Emergency Department (ED) and approximately 1.2 billion intravenous cannulation procedures are performed annually around the worldwide [1]. Peripheral venous catheterization is an invasive procedure performed by inserting a sterile catheter through the patient's skin into the peripheral vein. The peripheral venous catheter is crucial for fluid-electrolyte therapy, blood and blood product transfusion, intravenous (IV) drug administration and nutritional support [2]. Also, peripheral venous catheterization has various complications such as phlebitis, dislodgement, occlusion and pain [3]. One of the most important factors affecting complications in peripheral vein catheterization is the experience of the healthcare provider [4]. Rapid IV catheterization is important for effective resuscitation in patients with trauma, shock, and burns admitted to ED. Conditions such as vascular problems due to IV drug use, age (elderly, child), peripheral edema, hypothermia, dehydration can cause obstacles in IV catheter procedure [5,6]. In such patients, emergency team members may not be able to localize the vein and insert the catheter blindly. Intravenous cannulation is a painful procedure that affects cognitive abilities by increasing pain and fear of pain and this blind intervention may increase the number of attempts and increase the patient's pain [7,8]. Pain is a condition that negatively affects a person's physical, psychosocial and social life. Therefore, controlling the patient's pain, increasing the patient's comfort, and minimizing the complications related to pain are important in reducing the length of stay in ED [9]. Fear of pain (FOP) was evaluated as a condition affected by pain and can be defined as a verbal, behavioral and physiological response to the possibility of current or potential pain [10]. In recent years, the use of technologies to improve efficiency and reduce pain in painful procedures such as PVC has become more important. In this regard, infrared vein finder devices have been started to be used especially in patients whom peripheral catheterization is difficult [11]. This study was conducted to reveal the effect of infrared vein finder on pain and fear of pain in patients who underwent peripheral venous catheterization in the emergency department.

Material and Methods

Patients and Study Design

This prospective randomized observational study was conducted between 2 June and 30 September 2019 in the emergency department of XXX Training and Research Hospital which is a tertiary hospital and has approximately 150000 admissions to ED annually. The study was approved by the local ethics Committee of XXXX Training and Research Hospital (approval date and number 14.05.2019-2402). The inclusion criteria were; older than 18 years old, patients with PVC indication in the emergency department, conscious, patients with at least one previous PVC experience and no communication barrier. Exclusion criteria were; younger than 18 years old, infection, burn, vascular disorder, neurological sequelae in the extremity planned for catheterization. There were two groups formed: the infrared vein finder (IVF) group and the control group according to simple randomization. The

researchrandomizer.com website was used for randomization. Power Analysis (G*Power 3.1.9.2) was used to determine the size of the sample in the study. The α value was 0.05, the power of the study was 80%, and the effect size was between low-medium (0.40) [12]. According to power analysis, it was planned to include 100 patients in the IVF group and 100 patients in the control group. A total of 312 patients were evaluated for eligibility and 112 patients were excluded because of not meeting the inclusion criteria or refusing to participate in the study. A total of 200 patients participating in the study were analyzed.

Control group: Peripheral catheterization was performed with the conventional method to the patients in the control group. The following steps were applied according to the conventional method; the patient was informed about the procedure and informed consent was obtained. The Fear of Pain Questionnaire 3 (FPQ-3) [13] and the Numeric Pain Rating Scale (NRS) [14] were explained to the patients, and the Fear of Pain III Scale was performed. Antecubital skin antiseptics provided. A tourniquet was applied 10-15 cm above the area where the procedure will be applied, and an appropriate peripheral venous catheter was placed. Numeric pain rating scale was asked to the patients after the procedure.

IVF group: The following steps were performed; before intervention the patient was informed about the procedure and informed consent was obtained. The use and function of the infrared vein finder was explained. The Fear of Pain Questionnaire 3 (FPQ-3) and the Numeric Pain Rating Scale (NRS) were explained to the patients, and the Fear of Pain 3 Scale was performed. Then, routine peripheral venous catheter insertion was performed with the AccuVein AV400 infrared vein finder. Numeric pain rating scale was asked to the patients after the procedure. In both groups, PVC was administered by a nurse with 7 years of emergency room experience.

Fear of Pain Questionnaire (FPQ-3): The FPQ is a 30-item self-report measure of pain-related fear designed to tap fear related to severe pain (e.g. 'Breaking your leg'), minor pain (e.g. 'Getting a paper-cut on your finger'), and medical pain (e.g. 'Receiving an injection in your hip/buttocks'). Items are scored on a 5-point Likert scale ranging from 1 (not at all) to 5 (extreme) [13].

Numeric Pain Rating Scale (NRS): The NRS is one of the most preferred and easily applied scales in pain assessment. Absence of pain is scored 0 (zero), and extreme pain is scored 10 (ten). In this way, the patient is asked to express the appropriate pain score [15].

Statistical Analysis

The statistical analysis was performed with the SPSS 21 package program. Mean, standard deviation, median, minimum and maximum values were used for descriptive statistics for continuous variables, and numbers and percentages were used for categorical variables. Compliance with normal distribution was checked with the Kolmogorov-Smirnov test. T-test (Student's t test) was used in independent groups with normal distribution and Mann-Whitney U test was used in cases not showing normal distribution. The differences in three or more groups were used for ANOVA in the variables that provided the normality assumption, and the Kruskal Wallis test in the variables that did not provide the normality assumption. Correlation analysis was applied while examining the relationship between continuous variables. Statistically, $p < 0.05$ was considered significant.

Results

The flow chart of the study is shown in figure 1 and the demographic characteristics of the patients participating in the study are given in the table below (Table 1).

Information about the PVC, patients previous experience about PVC, inserted catheter sizes, discomfort with the idea of PVC, fear of pain while catheterization and number of attempts were summarized at Table 2.

Total and subgroup Fear of Pain III scale scores of the patients were calculated. The mean total score of the patients were; 78.8 ± 21.5 8 (minimum:41.0–maximum:148.0) in the IVF

group and 85.8 ± 22.0 (minimum:44.0–maximum:150.0) in the control group ($p=0.025$). Scale subgroup “Minor Pain” score was compared for all variables. When the groups were compared, this score was found to be different ($p=0.021$) and was higher in the control group. Although the “Severe Pain” score was lower in the IVF group, it was not statistically different ($p=0.088$) (Table 3).

The mean NRS score of the patients in the IVF group was 2.56 ± 1.25 (minimum: 1.00, maximum: 6.00), and the mean score of the patients in the control group was 2.94 ± 1.58 (minimum: 1.00, maximum: 7.00). Considering the NRS score of the IVF and control group, the IVF group score was lower but statistically similar with the control group ($p = 0.121$) (Table 4).

The correlation between the patients' FPQ-3 scores and NRS scores were analyzed. There was a moderate positive correlation between NRS score and the “severe pain” ($r=0.407$, $p<0.001$), “Minor pain” ($r=0.534$, $p<0.001$) and “Medical pain” scores ($r=0.390$, $p<0.001$) in the intervention group (Table 5).

According to the regression analysis; one-point increase in FPQ-3 total score increased NRS 0.03 points in IVF group ($R^2=0.282$, $p<0.001$) and 0.05 points in control group ($R^2=0.464$, $p<0.001$). Considering the subgroups of FPQ-3, it was found that a one-point increase in “Severe pain” score increased NRS by 0.06 point in the IVF group ($R^2=0.167$, $p<0.001$) and 0.09 points in the control group ($R^2=0.270$, $p<0.001$). One-point increase in “Minor pain” score increased NRS 0.09 in IVF group ($R^2=0.297$, $p<0.001$) and 0.11 points in control group ($R^2=0.309$, $p<0.001$). Also, one-point increase in “Medical pain” score increased NRS 0.06 in IVF group ($R^2=0.184$, $p<0.001$) and 0.11 points in control group ($R^2=0.388$, $p<0.001$) (Table 6).

Discussion

Peripheral venous catheter intervention in the emergency department is a condition that causes moderate pain and anxiety. There are several methods such as the use of local anesthetics, ultrasonography, local ethyl chloride to reduce pain and anxiety and increase the success of the intervention [2,5,8]. Although most of the patients in our study had previous PVC experience, they were still afraid of this procedure. The demographic characteristics of the groups were similar in terms of age and gender. In the randomized controlled study conducted by Aulagnier et al. in which the use of infrared vein finder devices in the emergency room was investigated, the average age of the total participants was higher than this study, and the demographic characteristics were similar in the intervention group and the control group [16].

Considering the effect of infrared vein finder on the number of PVC attempts, the number of vascular access in first attempt in the IVF group was 92 (92%), in the control group, the success of the first attempt was 97 (97%), and there was no statistically significant difference between them ($p=0.121$). In the study conducted by Aulagnier et al., no significant difference was found between the intervention group and the control group in terms of the number of interventions [16]. Curtis et al. showed that there was no significant difference in the number of interventions between the use of ultrasonography, IVF and the standard approach in the pediatric population [17]. In the study of Graaf et al. with 1913 pediatric population, it was found that the IVF device had no effect on the number of interventions and PVC success [18]. On the other hand, Demir and İnal have shown that IVF increases the success of the PVC intervention in their studies in the 3-18 and 0-3 age groups [19,20]. As mentioned above, IVF devices seem to be more effective in pediatric population than adults.

The total FPQ-3 scores and the minor pain scores were found to be lower in the IVF group. IVF devices are not effective enough to reduce the fear of severe pain but may help reduce the fear in those with a mild fear of pain. Therefore, although it is seen that IVF provide a decrease in the total pain scores, it is thought that it would not be appropriate to use them to

reduce the fear and anxiety of the patients, especially in those who have severe fear of pain. A moderate positive correlation was found between the FPQ-3 subgroups (minor, severe, medical), total pain scores and NRS scores. There was no strong correlation between NRS and FPQ-3 scores.

There was no statistically significant difference between the control group and IVF group's NRS scores. Alguiner et al. also showed that IVF has no effect on pain [16]. In a study with 450 patients with hemophilia, IVF reduces pain in patients with difficult vascular access but no effects on pain in patients without difficult vascular access (21). On the other hand, it has been shown that the use of IVF in the pediatric population reduces pain, especially in younger than 3 years of age [20,22,23]. Therefore, IVF devices seem to be more effective to reduce pain in pediatric population than adults.

Conclusion

Although the use of IVF for venous catheterization reduces the fear of pain in adults, it does not reduce the fear of severe pain, it only reduces the fear of minor pain and does not affect the success of the procedure. More studies are needed in adults as most of the studies were conducted in the pediatric population.

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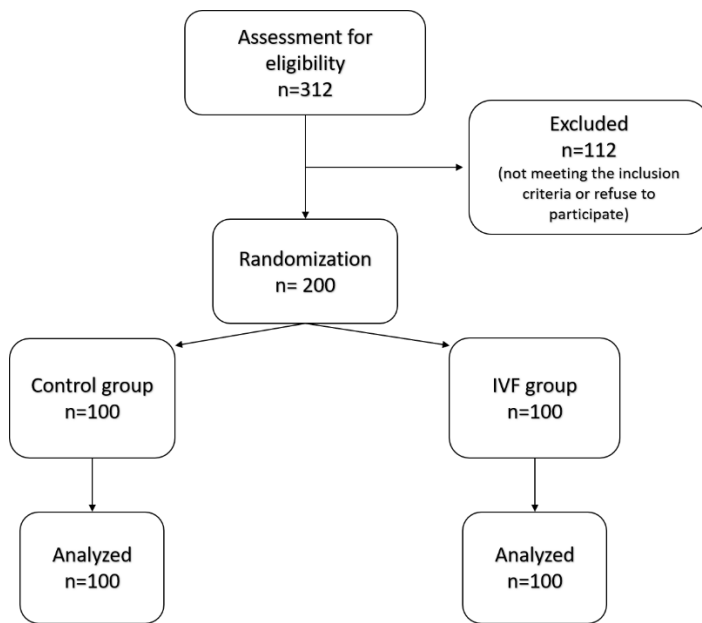


Figure 1. Flowchart of the study

| | | IVF group | | Control group | | statistical test | |
|-------------------------|---------|-----------|------|---------------|------|------------------|-------|
| | | n | % | n | % | χ^2 or t | p |
| Age | | 33.3±11.2 | | 32.5±10.2 | | 0.508* | 0.612 |
| Sex | Female | 63 | 63.0 | 62 | 62.0 | 0.021 | 0.884 |
| | Male | 37 | 37.0 | 38 | 38.0 | | |
| Marital status | Married | 50 | 50.0 | 52 | 52.0 | 0.080 | 0.777 |
| | Single | 50 | 50.0 | 48 | 48.0 | | |
| Comorbidities | Yes | 19 | 19.0 | 30 | 30.0 | 3.271 | 0.071 |
| | No | 81 | 81.0 | 70 | 70.0 | | |
| Number of comorbidities | 1 | 16 | 84.2 | 25 | 83.3 | 0.007 | 0.935 |
| | >1 | 3 | 15.8 | 5 | 16.7 | | |
| Hospitalization history | Yes | 58 | 58.0 | 62 | 62.0 | 0.333 | 0.564 |
| | No | 42 | 42.0 | 38 | 38.0 | | |

Descriptive statistics were summarized as mean±standard deviation, other categorical variables as number(n) and percentage (%). *t test was applied, chi-square (χ^2) test was used for other variables. IVF: Infrared vein finder

| Parameters | IVF group | | Control group | | Statistical test | |
|--|-----------|------|---------------|------|------------------|-------|
| | n | % | n | % | χ^2 | p |
| Number of previous PVC experience | | | | | | |
| 1 | 12 | 12.0 | 20 | 20.0 | 5.052 | 0.168 |
| 2 | 14 | 14.0 | 8 | 8.0 | | |
| 3 | 5 | 5.0 | 9 | 9.0 | | |
| ≥4 | 69 | 69.0 | 63 | 63.0 | | |
| | | | | | | |
| Catheter size | | | | | | |
| 22 G-24 G | 26 | 26.0 | 20 | 20.0 | 1.016 | 0.313 |
| 18 G-20 G | 74 | 74.0 | 80 | 80.0 | | |
| Discomfort with PVC idea | | | | | | |
| Yes | 48 | 48.0 | 44 | 44.0 | 0.322 | 0.570 |
| No | 52 | 52.0 | 56 | 56.0 | | |
| Fear of PVC pain | | | | | | |
| Yes | 59 | 59.0 | 52 | 52.0 | 0.992 | 0.319 |
| No | 41 | 41.0 | 48 | 48.0 | | |
| Number of PVC attempts | | | | | | |
| 1 | 92 | 92.0 | 97 | 92.0 | 2.405 | 0.121 |
| ≥1 | 8 | 8.0 | 3 | 3.0 | | |
| Variables are summarized as numbers(n) and percentage (%). Chi-square (χ^2) test was used for analysis. IVF: Infrared vein finder; G: gauge | | | | | | |

| | IVF group | | Control group | | Statistical test | |
|--|-----------|------------------|---------------|------------------|------------------|---------|
| | mean±sd | Median (min-max) | mean±sd | Median (min-max) | t/U | p |
| Severe | 32.5±8.7 | 33.0(14.0-50.0) | 34.4 ± 8.8 | 35.0(15.0-50.0) | -1.531 | 0.127* |
| Minor | 21.7±7.7 | 21.0(10.0-50.0) | 24.3 ± 8.2 | 23.0(11.0-50.0) | 4055.5 | 0.021** |
| Medical | 24.7±8.8 | 23.0(10.0-48.0) | 27.0 ± 9.4 | 27.5(11.0-50.0) | 4302.0 | 0.088** |
| Total | 78.8±21.5 | 75.0(41.0-148.0) | 85.8 ±22.0 | 84.5(44.0-150.0) | -2.261 | 0.025* |
| sd: standard deviation; * t-test, ** Man Whitney U test; IVF: infrared vein finder | | | | | | |

| | IVF group | Control group | Statistical test | |
|-----------|-----------|---------------|------------------|-------|
| | mean±sd | mean±sd | Mann-Whitney U | p |
| NRS score | 2.6±1.3 | 2.9 ± 1.6 | 4380.5 | 0.121 |

NRS: Numeric Pain Rating Scale; IVF: Infrared Vein Finder; sd: standard deviation

Table 5. Correlation between NRS and FPQ-3 scores

| Group | | Severe | Minor | Medical | Total |
|---------|---|--------|--------|---------|--------|
| IVF | r | 0.407 | 0.534 | 0.390 | 0.494 |
| (n=100) | p | <0.001 | <0.001 | <0.001 | <0.001 |
| Control | r | 0.497 | 0.518 | 0.586 | 0.645 |
| (n=100) | p | <0.001 | <0.001 | <0.001 | <0.001 |

FPQ: Fear of Pain Questionnaire, NRS: Numeric Pain Rating Scale; IVF: Infrared vein finder; r: correlation coefficient

Table 6. Effect of FPQ-3 Scale Sub-groups on NRS scores

| Group | Severe | | | Minor | | | Medical | | |
|---------|--------|------|----------------|-------|------|----------------|---------|------|----------------|
| | a | b | R ² | a | b | R ² | a | b | R ² |
| IVF | 0.626 | 0.06 | 0.167 | 0.628 | 0.09 | 0.297 | 1.050 | 0.06 | 0.184 |
| Control | -0.288 | 0.09 | 0.270 | 0.313 | 0.11 | 0.309 | 0.09 | 0.11 | 0.388 |

FPQ: Fear of Pain Questionnaire, NRS: Numeric Pain Rating Scale; IVF: Infrared vein finder a: constant term; b: regression coefficient