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Research Article

COMPARATIVE EFFECT OF LIDOCAINE SPRAY, COLD PACKS, AND FLASHLIGHT DISTRACTION ON ARTERIOVENOUS FISTULA CANNULATION PAIN IN HEMODIALYSIS PATIENTS: A PROSPECTIVE WITHIN-SUBJECT CONTROLLED TRIAL

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ABSTRACT

Background: Arteriovenous fistula (AVF) cannulation pain remains a major challenge in the care of hemodialysis (HD) patients. This study aimed to compare the effectiveness of three non-pharmacological interventions – lidocaine spray, cold packs, and flashlight distraction – in reducing AVF cannulation pain in Iraqi HD patients.

Methods: A prospective within-subject controlled trial was conducted at Al-Kadhmia Hospital in Baghdad. Thirty-five male HD patients with AVFs participated in a 4-week within-subject design study. Week 1 served as the control with no intervention, while lidocaine spray, cold packs, and a flashlight were applied, respectively, in weeks 2, 3, and 4 before cannulation. Pain was assessed using the Visual Analog Scale (VAS) after each session.

Results: A significant difference was observed between the four conditions ($F[3,102]=23.687$, $p<0.001$). Mean VAS scores were highest in the control group (6.11±1.05), followed by flashlight (5.71±0.86), cold packs (5.11±1.05), and lidocaine (5.00±1.14). All three interventions significantly reduced pain compared with control ($p<0.001$), with lidocaine demonstrating the greatest reduction.

Conclusion: Lidocaine spray, cold packs, and a flashlight can significantly reduce cannulation pain in HD patients, with lidocaine being the most effective. These findings support incorporating simple, low-cost interventions into HD care to enhance patient comfort.

Keywords: Hemodialysis, Arteriovenous fistula, Cannulation pain, Pain management, Lidocaine spray, Cold pack/Cryotherapy, Flashlight distraction.

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INTRODUCTION

Chronic kidney disease (CKD) is a global health issue posing numerous challenges, eventually ending in severe morbidity and significant mortality rates [1]. It is defined as the presence of permanent damage in the kidneys or a decline in renal function for a period of not <3 months regardless of the cause [1,2]. CKD has been classified according to the "Kidney Disease Improving Global Outcomes" (KDIGO) into five different stages where the first two stages required evidence of declining kidney functions such as proteinuria with minimal changes in the glomerular filtration rate (eGFR) whereas stages 3–5 occur when eGFR drop below 60–15 mL/min/1.73 m^2 with some patients such as those with nephrotic syndrome might exhibit earlier etiology [3,4]. The prevalence of CKD globally is estimated to be around 13.4% across all five stages, with around 10.6% between stages 3 and 5. The incidence is expected to increase, and the estimated number of affected individuals is around 500 million, with those patients ultimately requiring hemodialysis (HD). 80% of these patients are from low to middle-income countries [5-7].

At the last stage of CKD, termed end-stage renal disease, eGFR falls below 15, in which (HD) is mandated to remove excess water, electrolytes, and waste materials [8,9]. Since those patients are subjected to HD, an appropriate access to the vascular system should be established [10]. Often, the arteriovenous fistula (AVF) is recommended by most clinical guidelines, which is done by either the rope-ladder technique or the buttonhole, both having their own advantages and disadvantages with regard to the pain of cannulation [11]. The pain of cannulation in HD patients is mild to moderate and is often managed through different approaches, including psychological support and training nurses on how to manage and reduce the pain from needle punctures [12,13].

A new approach of using the lidocaine spray, cold packs, or flashlights to minimize the pain sensation has been investigated, with cold packs showing good results [14,15]. Bond *et al.*, a systematic review, had reviewed the use of different anesthetics before cannulation, showing that anesthetics can reduce the pain effectively [16]. While the use of cold packs resulted in a significant reduction in pain and more venous dilatation after 1 min of application, according to Yilmaz and Yilmaz [17]. Flashlight had been tested in a randomized control trial by Shivashankar *et al.*, who found that it can somewhat reduce the pain when compared to control, although the pain scoring system was not the same as cold packs and lidocaine [18]. However, there is still limited data that compares all three methods. Therefore, the aim of this study is to investigate whether the use of lidocaine, cold packs, or flashlights may minimize the pain sensation during HD cannulation on Iraqi CKD patients.

METHODS

Study design and settings

This study was conducted as a prospective within-subject controlled trial in HD units in Al-Kadhmia Hospital, Baghdad, Iraq. Data collection was done from March 1 to 30, 2025.

Subjects

The study included 35 patients undergoing conventional HD. Eligible patients were adults 18 years and older of male gender who were

diagnosed with CKD, undergoing hemodialysis with an AVF of the upper extremity, either radio-cephalic, radio-basilic, or brachio-cephalic, currently used for hemodialysis.

Exclusion criteria included any known allergies or sensitivities to lidocaine or other local anesthetics, cold therapy, damaged, or broken skin at the designated site; concomitant use of an analgesic within the previous 24 h or previous use of local anesthetic products. Patients were also excluded if they did not complete the remaining weeks of treatment.

Ethical consideration

The study was approved by the Ethics Committee of the College of Pharmacy, Al-Nahrain University (Approval No.: nah.co.pha.H3, dated 5 May 2024). Written informed consent was obtained from all individual participants included in the study.

Study control and interventions

Patients were identified from the HD centers. A total of 35 patients were then included using convenience sampling and were planned for control during week 1 and interventional assessments at weeks 2, 3, and 4. The intervention was performed at each dialysis session day (HD days 1, 3, and 5).

Week 1: Control group: Routine care without additional intervention

The patients were cannulated with HD needles, which were inserted in the vessels of the fistula area by the attending nurse after disinfecting the fistula area with 70% alcohol-soaked cotton pads, as per standard practice.

Week 2: Lidocaine group: Intervention with the use of lidocaine 5%

Two puffs of lidocaine 5% (lidocaine topical aerosol U.SP.38), each puff delivering approximately 10 mg of lidocaine (as per manufacturer specifications), resulted in a total estimated dose of 20 mg per session. They were sprayed on the dermal surface close to the needle insertion point. After 10 min, the skin surface was sprayed with 70% alcohol. Then, appropriate HD needles were put into the vessels of the fistula area by the attending nurse.

Week 3: Cold pack group: Intervention with the use of cold packs

A cold pack was placed on the fistula site for 5 min. The cold pack was stored at 4–8°C before application to ensure consistent temperature across sessions before making the puncture. Following this, specific HD needles were inserted into the vessels of the fistula area by the attending nurse after disinfecting the fistula area with 70% alcohol-soaked cotton pads.

Week 4: Flashlight group: Intervention with the use of flashlights

An LED light was directed toward the fistula site immediately before cannulation for approximately 5–10 s as a distraction technique. Cannulation was then performed according to routine clinical practice.

Data collection and outcome measurement

All patients underwent a full physical examination by the nephrologist. A thorough history was obtained from the participating patients (age, weight, height, occupation, cause of illness, duration of HD onset, and comorbidities) through interviews by a clinical pharmacist and from patient files. Before the first intervention, the patients were informed about the study drugs and were introduced to the Visual Analog Scale (VAS) for pain assessment. VAS scores were used to grade the cannulation pain based on a 10 cm line marked 0 at one end and 10 at the other end (0=no pain, 10=worst pain) [19].

During the 1st week of the study, which served as a baseline pain assessment (control) (week 1) on HD days 1, 3, and 5, venipuncture was performed based on normal clinical practice with the use of 70% alcohol-soaked cotton pads without any additional intervention. Each patient's cannulation site was observed for local skin reactions, and patients were asked about any undesirable effects experienced with normal clinical practice. During week 1, after needle puncture, VAS assessment was performed at each dialysis session. The average score was then used for analysis and comparison.

In the 2nd week of dialysis sessions, each patient then received lidocaine spray only once before venipuncture. Each patient's cannulation site was observed for local skin reactions, and patients were asked about any undesirable effects experienced with the use of lidocaine. After the needle puncture of each HD session (days 1, 3, and 5) during week 2, the VAS assessment was performed. The average score was then used for analysis and comparison.

In the 3rd week of the study, each HD patient received ice packs for 5 min before venipuncture. Each patient's cannulation site was observed for local skin reactions, and patients were asked about any undesirable effects experienced. After the needle puncture of each HD session, a VAS assessment was performed. The average score was then used for analysis and comparison.

In the final week (week 4) of the study, each patient received LED flash only once before venipuncture. Each patient's cannulation site was observed for local skin reactions, and patients were asked about any undesirable effects experienced. VAS assessment was performed. The average score was then used for analysis and comparison.

Sample size calculation

Sample size was calculated using G*Power (version 3.1) for repeated-measures analysis of variance (ANOVA) (within-subject design). A moderate effect size (f=0.25) [20] was assumed in accordance with Cohen's conventional benchmarks for ANOVA when precise prior local effect size estimates were unavailable. With an alpha level of 0.05, statistical power of 90%, four repeated measurements, correlation among repeated measures of 0.5, and non-sphericity correction (ε=1), the minimum required sample size was 30 participants. To account for a potential 15% attrition rate, 35 patients were recruited.

Data analysis

Normality was assessed using the Shapiro–Wilk test. Repeated-measures ANOVA was conducted to compare pain scores across the four conditions. Mauchly's test was used to assess sphericity; since sphericity was violated ($p<0.05$), the Greenhouse–Geisser correction was applied. *Post hoc* pairwise comparisons were performed using Holm-adjusted p-values to control for multiple comparisons across six pairwise contrasts. A $p<0.05$ was considered statistically significant.

RESULTS

Demographics

Characteristics	Value {mean±standard deviation/no. (%)}
Age (years)	57.48±13.74
Body mass index (kg/cm^2)	30.88±3.36
Occupation	
Employed	20 (57.14)
Unemployed	15 (42.86)
Marital status	
Married	30 (85.71)
Unmarried	5 (14.29)
Education	
None	7 (20)
Bachelor	13 (37.14)
University	13 (37.14)
Diploma	2 (5.71)
Dialysis duration (years), median (range)	6 (1–15)

The patients had been grouped into 4 weeks of testing (n=35 patients), with the initial week used as a control group, in which the standard practice of 70% alcohol swabs was used for preparation. This was then

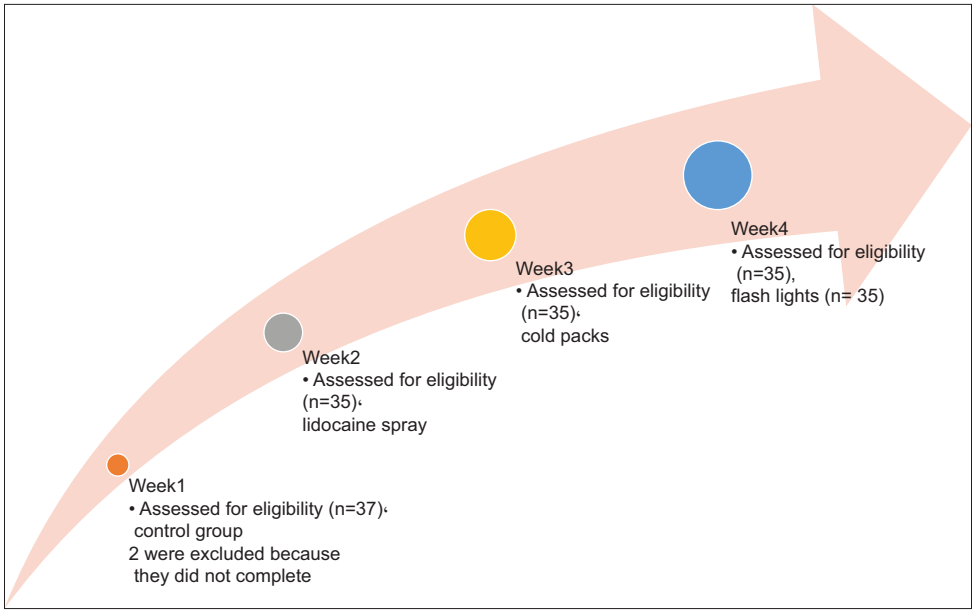

Fig. 1: Flow diagram of patients

followed by lidocaine, ice packs, and flashlights in subsequent weeks. Repeated-measures ANOVA demonstrated a significant difference in VAS pain scores across the four conditions, $F(3,102)=23.687$, $p<0.001$. Mauchly's test indicated violation of the sphericity assumption ($p<0.05$); therefore, the Greenhouse–Geisser correction was applied.

Groups	No.	Mean±standard deviation	Median (min–max)	p-value
Control	35	6.114±1.051	6 (4–8)	<0.001
Lidocaine	35	5.000±1.138	5 (3–7)	
Cold packs	35	5.114±1.051	5 (3–8)	
Flashlight	35	5.714±0.860	6 (4–8)	

Post hoc pairwise comparisons with Holm-adjusted p-values (six comparisons) revealed that lidocaine and cold packs significantly reduced pain compared with control ($p<0.001$), whereas flashlight also demonstrated a smaller but significant reduction ($p=0.006$). No significant difference was observed between lidocaine and cold packs ($p=0.353$).

DISCUSSION

HD patients are exposed to the insertion of needles into the fistula regularly in view of the need for dialysis. One of the major concerns in relation to this is the pain from the insertion of the AVF that HD patients face each week. HD patients feel that the pain is unbearable and is considered one of the most challenging issues that should be addressed to optimize HD patients' care [15]. This study was conducted to address this issue by comparing standard practices with alcohol swabs with the use of lidocaine spray, cold packs, and flashlight applications before the insertion of the AVF to examine which could minimize the discomfort.

Different studies have investigated the use of lidocaine, cold packs, and flashlights, with varying degrees of success. Mirzaei *et al*. investigated the use of lidocaine spray among many other options to minimize the pain of AVF cannulation, which resulted in a significant reduction of the VAS from 5.000±1.138 in controls to 4.22±1.13. This emphasized the advantage of using lidocaine before cannulation to reduce pain for HD patients [19]. Rüsch *et al*. found that lidocaine can reduce the pain before cannulation significantly (3.5±2.2), whereas Dalvandi *et al*. found that a lidocaine-containing mixture of local anesthetics can be better than coolant vapors, despite the patient group and disease state being different in the two studies [21,22]. The current work also

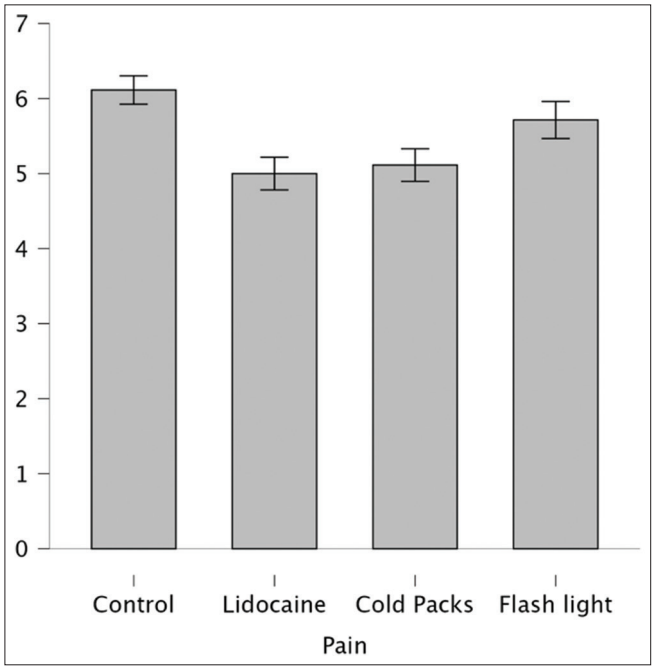

Fig. 2: The mean and standard deviation of visual analogue scale pain scores between control, lidocaine, cold packs, and flashlight

demonstrated a significant improvement in VAS scores when using lidocaine compared to control.

Bastami *et al.* examined the use of ice packs 5 min preceding the cannulation with a significant reduction in the VAS score 3.12±1.68, whereas Mirzaei *et al.* found that ice packs significantly reduced the VAS score 5.38±0.83 [19,23].

The use of cold packs has also been largely researched. Tapia González *et al.* studied the use of cold packs on radio-cephalic fistula, showing a significant improvement in the pain measured by VAS score 3.9±2.4 compared to our study 5.114±1.051, although the site of fistula, disease state, and the number of patients were different [24]. Similarly, an Iraqi study that utilized cold packs before insertion into the AVF found that the VAS was significantly reduced from 45±18.4 in controls to

5.114±1.051, with the use of a scoring system from 0 to 100 instead of 0 to 10 to measure the pain score [25]. The use of flashlight distraction before cannulation resulted in a significant reduction in the perceived pain as measured by the VAS, which is consistent with the results of the current study [26]. The current study also highlights the significant improvement of flashlight management on VAS scores compared to the control that used 70% alcohol swabs in reducing pain during cannulation of the AVF in HD patients.

The current work showed consistent results with those previously conducted across different countries that targeted different patients and various diseases, all of which required cannulation, with the aim of minimizing pain related to the cannulation procedure. In addition to this, at present, no Iraqi studies have compared all three approaches. Therefore, to the best of our knowledge, this is the first to show that all three methods utilized, lidocaine spray, cold packs, and flashlights, were able to reduce the AVF cannulation pain compared to standard 70% alcohol swabs. This study may be used as a guide for a more extensive study to develop new strategies to minimize pain during AVF cannulation among HD patients.

Despite this, there were a few limitations to the study. First, the sample size was small, as only 35 patients were recruited. Furthermore, patients were included through convenience sampling, which could be improved through randomization of patients during inclusion into the study. Larger studies, with multiple HD centers, should be performed in the future.

CONCLUSION

The use of alternative methods such as lidocaine, ice packs, and flashlight therapy may be potentially useful for reducing pain during cannulation in HD patients. Specifically, the use of lidocaine was found to reduce the AVF cannulation pain in most Iraqi HD patients, although cold packs and flashlights similarly reduced pain when compared to standard practice.

Limitations

Several limitations should be acknowledged. The fixed-sequence intervention design may have introduced potential period effects. Blinding was not feasible due to the nature of the interventions. In addition, only male participants were included, which may limit the generalizability of the findings to female HD patients. Future studies with randomized intervention order and inclusion of both sexes are recommended.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the Ethics Committee of the College of Pharmacy, Al-Nahrain University (Approval No.: nah.co.pha.H3, dated May 5, 2024). Written informed consent was obtained from all individual participants included in the study.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The datasets generated during the current study are not publicly available due to patient confidentiality, but are available from the corresponding author on reasonable request.

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Not applicable.

AUTHORS' CONTRIBUTIONS

MMH designed the study, collected and analyzed the data, and drafted the manuscript. AM and SH contributed to patient recruitment and data collection. HM assisted in statistical analysis. FI supervised the study, reviewed, and critically revised the manuscript. All authors read and approved the final manuscript.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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REFERENCES

1. Liu P, Quinn RR, Lam NN, Elliott MJ, Xu Y, James MT. Accounting for age in the definition of chronic kidney disease. JAMA Intern Med. 2021 Oct;181(10):1359-66. doi: 10.1001/jamainternmed.2021.4813, PMID 34459844
2. Wilson S, Mone P, Jankauskas SS, Gambardella J, Santulli G. Chronic kidney disease: Definition, updated epidemiology, staging, and mechanisms of increased cardiovascular risk. J Clin Hypertens (Greenwich). 2021 Apr;23(4):831-4. doi: 10.1111/jch.14186, PMID 33455061
3. Kampmann JD, Heaf JG, Mogensen CB, Mickley H, Wolff DL, Brandt F. Prevalence and incidence of chronic kidney disease stage 3-5 - results from KidDiCo. BMC Nephrol. 2023;24(1):17. doi: 10.1186/s12882-023-03056-x, PMID 36658506
4. Talib AF, Anwer M. The role of clinical pharmacist in reducing drug related problems in hemodialysis patients. Iraqi J Pharm Sci. 2020 Dec;29(2):223-30. doi: 10.31351/vol29iss2pp223-230
5. Suriyong P, Ruengorn C, Shayakul C, Anantachoti P, Kanjanarat P. Prevalence of chronic kidney disease stages 3-5 in low- and middle-income countries in Asia: A systematic review and meta-analysis. PLoS One. 2022 Feb;17(2):e0264393. doi: 10.1371/journal.pone.0264393, PMID 35213610
6. Mills KT, Xu Y, Zhang W, Bundy JD, Chen CS, Kelly TN. A systematic analysis of worldwide population-based data on the global burden of chronic kidney disease in 2010. Kidney Int. 2015 Nov;88(5):950-7. doi: 10.1038/ki.2015.230, PMID 26221752
7. Stanifer JW, Muiru A, Jafar TH, Patel UD. Chronic kidney disease in low- and middle-income countries. Nephrol Dial Transplant. 2016 Jun;31(6):868-74. doi: 10.1093/ndt/gfv466, PMID 27217391
8. Vadakedath S, Kandi V. Dialysis: A review of the mechanisms underlying complications in the management of chronic renal failure. Cureus. 2017 Aug;9(8):e1603. doi: 10.7759/cureus.1603, PMID 29067226
9. Lee KY. A unified pathogenesis for kidney diseases, including genetic diseases and cancers, by the protein-homeostasis-system hypothesis. Kidney Res Clin Pract. 2017 Jun;36(2):132-44. doi: 10.23876/j.krcp.2017.36.2.132, PMID 28680821
10. Goel A, Grewal H, Dua A. Intradialytic complications in patients of end-stage renal disease on maintenance hemodialysis. Int J Curr Pharm Res. 2024;16(5):92-5. doi: 10.22159/ijcpr.2024v16i5.5080
11. Van Loon MM, Goovaerts T, Kessels AG, Van Der Sande FM, Tordoir JH. Buttonhole needling of haemodialysis arteriovenous fistulae results in less complications and interventions compared to the rope-ladder technique. Nephrol Dial Transplant. 2010 Jan;25(1):225-30. doi: 10.1093/ndt/gfp420, PMID 19717827
12. Thenmozhi P. Quality of life of patients undergoing hemodialysis. Asian J Pharm Clin Res. 2018;11(4):219-23. doi: 10.22159/ajpcr.2018.v11i4.24007
13. Duncanson EL, Chur-Hansen A, Le Leu RK, Macauley L, Burke AL, Donnelly FF. Dialysis needle-related distress: Patient perspectives on identification, prevention, and management. Kidney Int Rep. 2023;8(12):2625-34. doi: 10.1016/j.ekir.2023.09.011, PMID 38106606
14. Ibrahim MB, Abdelaal Badawi SE, Alameri RA. Assessment of pain and anxiety during arteriovenous fistula cannulation among hemodialysis patients: A cross-sectional study in Saudi Arabia. J Multidiscip Healthc. 2022 Apr;15:705-18. doi: 10.2147/JMDH.S344256, PMID 35411149
15. Gouda K, El Said T, Fahmy SF. The effect of cold packs, lidocaine spray, and flashlights on cannulation pain in patients undergoing hemodialysis: A randomized controlled trial. Futur J Pharm Sci. 2023;9(1):100. doi: 10.1186/s43094-023-00539-4
16. Bond M, Crathorne L, Peters J, Coelho H, Haasova M, Cooper C. First do no harm: Pain relief for the peripheral venous cannulation of adults, a systematic review and network meta-analysis. BMC Anesthesiol. 2016;16(1):81. doi: 10.1186/s12871-016-0252-8, PMID 27716082

17. Yılmaz E, Yılmaz D. The effect of three different nonpharmacological methods on cannulation success during peripheral intravenous catheter placement in the emergency unit: A randomized controlled trial. BMC Anesthesiol. 2024;24(1):362. doi: 10.1186/s12871-024-02723-2, PMID 39385099
18. Shivashankar A, Nalini KB, Rath P. The role of nonpharmacological methods in attenuation of pain due to peripheral venous cannulation: A randomized controlled study. Anesth Essays Res. 2018;12(1):7-10. doi: 10.4103/aer.AER_172_17, PMID 29628545
19. Mirzaei S, Javadi M, Eftekhari A, Hatami M, Hemayati R. Investigation of the effect of EMLA cream, lidocaine spray, and ice pack on arteriovenous fistula cannulation pain intensity in hemodialysis patients. Int J Med Res Health Sci. 2018;7(2):51-7.
20. Cohen J. Statistical Power Analysis for the Behavioral Sciences. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.
21. Rüsch D, Koch T, Spies M, Eberhart HJ, Pain L. Pain during venous cannulation. Dtsch Arztebl Int. 2017 Sep;114(37):605-11. doi: 10.3238/arztebl.2017.0605, PMID 28974291
22. Dalvandi A, Ranjbar H, Hatamizadeh M, Rahgoi A, Bernstein C. Comparing the effectiveness of vapocoolant spray and lidocaine/procaine cream in reducing pain of intravenous cannulation: A randomized clinical trial. Am J Emerg Med. 2017;35(8):1064-8. doi: 10.1016/j.ajem.2017.02.039, PMID 28285862
23. Bastami M, Azadi A, Mayel M. The use of ice pack for pain associated with arterial punctures. J Clin Diagn Res. 2015 Aug;9(8):JC07-9. doi: 10.7860/JCDR/2015/12657.6336, PMID 26435970
24. Tapia González I, Esteve Simó V, Moreno Guzman F, Fulquet Nicolás M, Duarte Gallego V, Saurina Solé A. Thermotherapy: Improving the vascular access cannulation procedure. J Vasc Access. 2018 Nov;20(4):386-91. doi: 10.1177/1129729818809013, PMID 30442083
25. Al-Jubouri MB, Jaafar SA, Abbas MK, Gazi IN, Shawwat MA, Karmoud KF. Using cryotherapy, EMLA (eutectic lidocaine/prilocaine) cream, or lidocaine spray to reduce pain during arteriovenous fistula puncture: A randomized controlled trial. Hemodial Int. 2024 Jul;28(3):270-7. doi: 10.1111/hdi.13152, PMID 38605472
26. Agarwal A, Yadav G, Gupta D, Tandon M, Singh PK, Singh U. The role of a flash of light for attenuation of venous cannulation pain: A prospective, randomized, placebo-controlled study. Anesth Analg. 2008 Mar;106(3):814-6, table of contents. doi: 10.1213/ane.0b013e318163fcc6, PMID 18292424