Original Article

Analgesia for Pediatric Arteriovenous Fistula Cannulation in Hemodialytic Patients: A Comparison of Lidocaine Gel, Lidocaine Spray, and Needle Plate

Abstract

Background: Children undergoing hemodialysis (HD) via arteriovenous fistula (AVF) experience approximately 300 painful punctures per year which may lead to non-compliance with HD. This study was conducted to show the effect of local anesthetics on pain perception in AVF cannulation. **Methods:** This randomized clinical trial included 20 children under HD via AVF in Sheikh Children's Hospital Hemodialysis Center in February 2014. The first intervention was conducted as the baseline pain assessment (control), then every patient randomly received all three other interventions: Lidocaine gel, lidocaine spray, and needle plate, before venipuncture. Pain perception was expressed and recorded by patients using the visual analogue scale (VAS). VAS scores were compared, and a *P* value of <0.05 was considered significant. **Results:** The VAS mean in lidocaine spray state, lidocaine gel state, and needle plate state was respectively 47.87, 51.31, and 49.43, which were significantly less than the control state with the VAS mean of 60.06 (lidocaine spray vs. control *P* value = 0.001, lidocaine gel vs. control *P* value = 0.001, and needle plate vs. control *P* value = 0.003). **Conclusion:** Our study showed that the use of needle plate, lidocaine spray, and lidocaine gel are all equally effective ways in controlling the degree of pain in AVF needling in children undergoing HD.

Keywords: *Arteriovenous fistula, hemodialysis, lidocaine, pain*

Yalda Ravanshad, Mohaddeseh Golsorkhi[1], Sahar Ravanshad[2], Anoush Azarfar[1], Mohammad Esmaeeli[3], Alireza Ghodsi[4]

Department of Community Medicine, Mashhad Branch, Islamic Azad University, [1]Kidney Transplantation Complications Research Center, Mashhad University of Medical Sciences, [2]Department of Internal Medicine, Faculty of Medicine, Mashhad University of Medical Sciences, [3]Department of Pediatrics, Mashhad University of Medical Sciences, [4]Student Research Committee, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

Received: 12-04-2020
Revised: 14-07-2020
Accepted: 11-08-2020
Published: 07-11-2020

Address for correspondence:
Dr. Anoush Azarfar, Kidney Transplantation Complications Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.
E-mail: azarfara@mums.ac.ir

Access this article online

Website: www.indianjnephrol.org

DOI: 10.4103/ijn.IJN_151_20

Quick Response Code:

Introduction

End-stage kidney disease (ESKD) is considered a major public health problem whose prevalence and associated costs are increasing.[1] Nearly two million patients worldwide are dialysis-dependent, and of these, approximately 90% receive hemodialysis (HD) thrice weekly.[2] HD is the most frequently used renal replacement therapy for ESKD patients, and arteriovenous fistula (AVF) is the gold standard for vascular access in these patients.[3] Pain caused by the entrance of cannula into the AVF is a major root of concern and pain in children undergoing HD. On average, a patient undergoing regular HD experiences 20 AVF punctures a month and would have it throughout her life. Therefore, patients' comfort is an important factor for long-term compliance with the treatment.[4] There are several ways to reduce the pain inflicted by the insertion of cannula. Researchers showed that cutaneous stimulation is associated with pain reduction in patients.[5] The effect of cutaneous stimulation is best explained by the gate control theory. In this theory, repeated stimulation of the skin can be effective in reducing the flow of pain and relieving it.[6] Cutaneous stimulation modalities, such as needle plate, can be clubbed with acupressure to increase its effectiveness in pain management.[7] Previous research has also shown that topical local anesthetic creams and sprays are effective in reducing pain during AVF cannulation.[8] The eutectic mixture of local anesthetics (EMLA) was formulated to penetrate intact skin. EMLA significantly reduces puncture pain and represents an acceptable alternate method for topical anesthesia in venous cannulation.[9] This study was therefore undertaken to investigate the effect of needle plate, lidocaine gel, and spray on pain due to AVF cannulation in children undergoing chronic HD.

Methods

This randomized clinical trial included children under chronic HD via AVF

How to cite this article: Ravanshad Y, Golsorkhi M, Ravanshad S, Azarfar A, Esmaeeli M, Ghodsi A. Analgesia for pediatric arteriovenous fistula cannulation in hemodialytic patients: A comparison of lidocaine gel, lidocaine spray, and needle plate. Indian J Nephrol 2021;31:349-52.

in Sheikh Children's Hospital Hemodialysis Center in February 2014. Informed consent was obtained from all patients or their parents prior to the study after the local ethics committee approved the research protocol with the code IR.MUMS.fm.REC.1394.368. Samples were selected by a purposive non-probability method according to the inclusion and exclusion criteria. Inclusion criteria consisted of: Children at least 8 years old under weekly HD, having informed consent, having full consciousness, having the ability to determine pain and respond to it, having a healthy hearing and vision system, receiving no pain-killers, opioid or sedative 6 h prior to the trial, absence of severe pain elsewhere in the body, and started HD at least 3 months before. Exclusion criteria consisted of: Known neuropathy, skin problems or numbness at the vascular access site, lidocaine hypersensitivity, and any pain at the injection area before starting the study, infectious signs at the injection site, and patient's inaccessibility during 4 weeks of study. Before the first intervention, the patients were informed about the study drugs and on how to use the visual analogue scale (VAS) for pain assessment. Demographic information such as age and gender, and severity of HD needle pain after cannulation were recorded. Patients were studied for almost 4 weeks and were evaluated in four different modes: In the first week (every week contained three sessions), they went under the routine protocol of HD (control mode). Then cannulation was randomly administered at the injection site after lidocaine spray, lidocaine gel (EMLA), and an elliptical plate containing numerous plastic needles.

HD needle injection protocol, consisting of syringe type, solution volume, air bubble, injection site, and physical state of patients at the time of injection, disinfectant, and injection angle for all patients were the same. We used arterial HD needle number 16 at least 5 cm away from the AVF site at an angle of 30–45° with the diagonal edge of needles superior.

The order of interventions for each patient was determined randomly. In the first state, lidocaine spray was sprayed two puffs (20 mg) from a pressure pack, at a distance of ~5 cm for 2 s. Liquid on the skin was allowed to evaporate for 10 s, and the venipuncture was performed 5 min later after the disinfection of the skin. In the second state, 2 ml of lidocaine gel were applied on the targeted area, and cannulation was performed 5 min later. In the last intervention, we used an elliptical plate (60 × 80 mm) consisted of multiple plastic needles (6 pins per cm) containing a central hole for dialysis needle passage. At the time we used the device, the injection was performed slowly and without plate removal.

The degree of pain was expressed as a pain score. Pain perception was expressed by patients 1 min after cannulation on a VAS, consisting of a non-graduated 100 mm horizontal line ranging from "0 = did not hurt at all" to "10 = as painful as it could be." VAS scores over 3 were considered as moderate pain and over 5 as severe pain.[10]

We used one-sample Kolmogorov–Smirnov test for variables' distribution, and results showed that data were not normally distributed; therefore, Wilcoxon test was performed to compare pain intensity in four case groups. A P value of <0.05 was considered statistically significant.

Results

This study was performed to compare different types of analgesics for venous cannulation in children undergoing chronic HD. A total of 20 patients were included. Out of them, 13 (65%) were male and 7 (35%) were female. The average age of patients was 12.12 ± 4.61 years. VAS mean in the lidocaine spray state was 47.87, in the lidocaine cream state was 51.31, and in the needle plate state was 49.43, which were significantly less than the control state with VAS mean of 60.06 (lidocaine spray vs. control P value = 0.001, lidocaine gel vs. control P value = 0.001, and needle plate vs. control P value = 0.003).

VAS mean in lidocaine spray and lidocaine gel after injection had no significant difference (P value = 0.267). Also, VAS mean in lidocaine spray after injection and needle plate had no significant difference (P value = 0.394). Similarly, VAS mean in lidocaine gel after injection and needle plate had no significant difference (P value = 0.509).

Discussion

Based on the results of this study, the utility of lidocaine gel, lidocaine spray, and needle plate before venous cannulation in children undergoing chronic HD is effective in reducing pain. Arab *et al*. conducted a similar study to assess the effect of lidocaine gel on intravenous cannulation during hemodialysis. They reported that 2% lidocaine gel can lower the pain in these patients. The mean pain score was also significantly lower in the 2% lidocaine gel group compared with the control group.[11]

In a study performed on 160 patients requiring an insertion of intravenous cannula, I R Selby *et al*. concluded that using commonly available local anesthetics like lignocaine, ethyl chloride spray, and eutectic mixture of local anesthetics cream (EMLA) can reduce both pain and fear during venipuncture.[12] In another study by MR Nott *et al*., the effectiveness of local anesthesia after 5 min of topical application of lignocaine-prilocaine cream was evaluated. They concluded that the agent can be used to reduce the pain of all routine injections.[13]

Gülperi Çelik *et al*. compared the use of ethyl chloride vapocoolant spray and lidocaine/prilocaine cream for reducing the pain of venipuncture in adults undergoing chronic HD.[8] They showed that venipuncture for AVF cannulation can cause mild to moderate pain in HD patients which affects their quality of life. They indicated

that vapocoolant spray is as effective as EMLA cream in preventing cannulation pain in patients undergoing chronic HD.[8] Similarly, Dalvandi *et al*. conducted another study to assess the effect of EMLA cream and vapocoolant spray in reducing intravenous cannulation in children. They reported that both EMLA and vapocoolant were effective in reducing pain in these patients.[14] However, our study showed no notable difference regarding the use of lidocaine gel as a local anesthetic agent in reducing patients' pain. This difference can be due to the combination form of this anesthetic agent as it is composed of lignocaine and procaine.[15] Moreover, as Vapocoolant is presented in spray form, it has rapid action and thus acts more effectively.[16]

Sabitha P. B. *et al*. investigated the effect of cryotherapy on AVF puncture-related pain in HD patients. They assessed 60 patients undergoing HD using AVF in their randomized control trial. They found that pain scores were significantly (P = 0.001) reduced within the experimental group with the application of cryotherapy.[4] In a similar study, Hamad S Al Amer *et al*. discussed the efficacy of cryotherapy intervention on AVF cannulation related pain among HD patients.[13] They concluded that cryotherapy can be considered to relieve AVF cannulation-related pain among adult patients undergoing HD. Therefore, they recommended using cryotherapy as a complementary intervention for reducing pain related to AVF cannulation.[17]

Bond M *et al*., in their systematic review article, tried to discover the most effective local anesthetic for adult peripheral venous cannulation. They found that all applications of local anesthetic were less painful than cannulation without local anesthetic. Therefore, they suggested that local anesthetic prior to cannulation should become a normal practice and a marker of high-quality care.[18]

Conclusion

Our study showed that the use of needle plate, lidocaine spray, and lidocaine gel are all equally effective ways in controlling the degree of pain in AVF needling in children undergoing HD.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

This article has been extracted from the thesis of Ms. Zahra Mesgarian, funded by the Mashhad University of Medical Sciences.

Conflicts of interest

There are no conflicts of interest.

References

1. Zoccali C, Kramer A, Jager K. The databases: Renal replacement therapy since 1989—The European renal association and European dialysis and transplant association (ERA-EDTA). Clin J Am Soc Nephrol 2009;4(Supplement 1):S18-22.
2. Collins AJ, Foley RN, Gilbertson DT, Chen S-C. United States Renal Data System public health surveillance of chronic kidney disease and end-stage renal disease. Kidney Int Suppl (2011) 2015;5:2-7.
3. Abbasi M, Chertow G, Hall Y. End-stage renal disease. Am Fam Physician 2010;82:1512-4.
4. Sabitha P, Khakha D, Mahajan S, Gupta S, Agarwal M, Yadav S. Effect of cryotherapy on arteriovenous fistula puncture-related pain in hemodialysis patients. Indian J Nephrol 2008;18:155-8.
5. Tomasello C, Pinto RM, Mennini C, Conicella E, Stoppa F, Raucci U. Scrambler therapy efficacy and safety for neuropathic pain correlated with chemotherapy-induced peripheral neuropathy in adolescents: A preliminary study. Pediatr Blood Cancer 2018;65:e27064.
6. Melzack R, Wall PD. Pain mechanisms: A new theory. Science 1965;150:971-9.
7. Aval SB, Ravanshad Y, Azarfar A, Mehrad-Majd H, Torabi S, Ravanshad S. A systematic review and meta-analysis of using acupuncture and acupressure for uremic pruritus. Iran J Kidney Dis 2018;12:78-83.
8. Çelik G, Özbek O, Yılmaz M, Duman I, Özbek S, Apiliogullari S. Vapocoolant spray vs lidocaine/prilocaine cream for reducing the pain of venipuncture in hemodialysis patients: A randomized, placebo-controlled, crossover study. Int J Med Sci 2011;8:623-7.
9. Biro P, Meier T, Cummins A. Comparison of topical anaesthesia methods for venous cannulation in adults. Eur J Pain 1997;1:37-42.
10. Collins SL, Moore RA, McQuay HJ. The visual analogue pain intensity scale: What is moderate pain in millimetres? Pain 1997;72:95-7.
11. Arab V, Bagheri-Nesami M, Mousavinasab SN, Espahbodi F, Pouresmail Z. Comparison of the effects of hegu point ice massage and 2% lidocaine gel on arteriovenous fistula puncture-related pain in hemodialysis patients: A randomized controlled trial. J Caring Sci 2017;6:141-51.
12. Selby I, Bowles B. Analgesia for venous cannulation: A comparison of EMLA (5 minutes application), lignocaine, ethyl chloride, and nothing. J R Soc Med 1995;88:264-7.
13. Nott M, Peacock J. Relief of injection pain in adults EMLA cream for 5 minutes before venepuncture. Anaesthesia 1990;45:772-4.
14. 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;35:1064-8.
15. Kumar BS, Krishna S, Hasan A. Evaluation of the effectiveness of topical EMLA cream as local anaesthetic in venepuncture. J Evol Med Dent Sci 2016;5:2314-9.
16. Collado-Mesa F, Net JM, Arheart K, Klevos G, Yepes M. Application of a topical vapocoolant spray decreases pain at the site of initial intradermal anaesthetic injection during ultrasound-guided breast needle biopsy. Clin Radiol 2015;70:938-42.
17. Al Amer HS, Dator WL, Abunab HY, Mari M. Cryotherapy

intervention in relieving arteriovenous fistula cannulation-related pain among hemodialysis patients at the King Khalid Hospital, Tabuk, Kingdom of Saudi Arabia. Saudi J Kidney Dis Transpl 2017;28:1050-6.

18. Bond M, Crathorne L, Peters J, Coelho H, Haasova M, Cooper C, *et al*. First do no harm: Pain relief for the peripheral venous cannulation of adults, a systematic review and network meta-analysis. BMC Anesthesiol 2015;16:81.