Scientific Research Publishing

Open Journal of Epidemiology, 2022, 12, 231-239
https://www.scirp.org/journal/ojepi
ISSN Online: 2165-7467
ISSN Print: 2165-7459

Evaluation of the Effects of Venous Cannulation Sites on Postoperative Delirium in Children: Hand or Foot?

Ezgi Erkiliç*, Tülin Gümüş, İrem Kocabaş, Mecit Sancak, Orhan Kanbak

Ankara City Hospital, Ankara, Turkey
Email: *eerkilic72@yahoo.com, gumustulin@yahoo.com, iremkocabas@hotmail.com, drmecitsancak@gmail.com, orhankan@ttmail.com

How to cite this paper: Erkiliç, E., Gümüş, T., Kocabaş, İ., Sancak, M. and Kanbak, O. (2022) Evaluation of the Effects of Venous Cannulation Sites on Postoperative Delirium in Children: Hand or Foot? *Open Journal of Epidemiology*, **12**, 231-239.
https://doi.org/10.4236/ojepi.2022.123019

Received: May 10, 2022
Accepted: July 31, 2022
Published: August 3, 2022

Abstract

Introduction: Choosing an appropriate cannulation site is important for doctors and patients. In our clinical practice, we have observed that agitation and pain were less in the postoperative period when the cannula was inserted site. Cannulation anxiety in adults and especially in children may increase the failure of interventions by activating the sympathetic system in varying degrees we aimed to investigate whether the site of the cannula inserted following the induction of inhalation is associated with postoperative agitation and pain in preschool children who would undergo an otolaryngology operation. **Methods:** Pediatric patients who would undergo adenoidectomy-tonsillectomy surgery between the ages of 3 - 7 were included in our study regardless of their genders. The patients have been randomly distributed into groups (***Group E***—*hand*, ***Group A***—*foot*). The evaluation was performed 0 and 30 minutes after extubation by FLAAC Pain Scala and PAED. **Results:** When the hand and foot groups were compared in terms of P0 (PAED 0 min. rating) values, hand group results were statistically significantly higher. Similarly, at the time of P30 (PAED 30. min rating), The Hand group was determined to be high. **Conclusion:** As a result of the study, we believe that choosing the feet as the cannulation site may be useful in appropriate cases in pediatric patients.

Keywords

Pain on Cannulation, Sites of Venous Cannulation, Children

1. Introduction

Intravenous cannulation (IV) interventions are a routine part of modern clinical

practices. It is an invasive intervention that is frequently used in all patient groups in hospitals and especially in operating rooms [1]. It is one of the most disturbing (pain, anxiety) parts of hospital admissions, especially for children [2]. It is known that pediatric in-patients feel almost the same degree of (IV) pain during procedure as in the post-operative period [3]. Cannulation anxiety in adults and especially in children may increase the failure of interventions by activating the sympathetic system in varying degrees [4]. Unfortunately, the number of studies evaluating the selection of peripheral veins in children is almost minimal. However, when choosing a cannulation site, it is important to evaluate patients separately by reviewing all factors that may affect them.

Delirium, which is observed in children during the postoperative period is considered one of the major complications that develops after pediatric anesthesia. There are still many unknown points as to why and how it happens. Despite the lack of strong evidence, delirium is typically thought to happen in preschool children due to a high intensity of anxiety after inhalation anesthesia procedures. Although it is thought to be triggered by pain [5]; this situation can also be observed after anesthesia procedures conducted for painless imaging methods [6]. If the necessary precautions are not taken during the perioperative period, the child may harm himself/ herself and his/her surroundings. It is also natural for families to experience this anxiety. Analgesics, sedative agents (opioids, benzodiazepines, clonidine and dexmedetomidine) and dexamethasone may be used in order to prevent this situation [7].

During our clinical practice, we have observed that in pediatric patients undergoing tonsillectomy-adenoidectomy operations, agitation and pain were less in the postoperative period when the cannula was inserted from the back of the foot due to previous failure in the back of the hand and forearm. In the literature review, the number of studies investigating the relationship between delirium and vascular cannulation area is almost negligible. Based on this hypothesis, we aimed to investigate whether the site (back of the hand or back of the foot) of the cannula inserted following the induction of inhalation is associated with postoperative agitation and pain in preschool children who would undergo an otolaryngology operation.

2. Material Method

For our prospective, randomized, double-blind study, we have first received the approval of the Ethics Committee of the Ankara City Hospital of the Ministry of Health of the Republic of Turkey. The total number of patients has been determined as 100 (50 for hand group, 50 for foot group) according to the power analysis study conducted earlier. Pediatric patients who would undergo adenoidectomy-tonsillectomy surgery between the ages of 3 - 7 in the operating room of the Otolaryngology department and who had no additional diseases were included in our study regardless of their genders. Children with syndromic, metabolic, or other chronic diseases and children who preferred cannulation instead

of inhalation induction have not been included. Children did not receive any additional intervention or medication other than standard. Patients who were not scheduled for premedication were first tried to be contacted by giving toys, puppets and a certificate of courage next to their parents in the preoperative waiting room. The transfer to the operating room was accompanied by an anesthesiologist. Patients taken into the room were monitored by game method (electrocardiogram, pulse oximeter, non-invasive blood pressure arterial measurement). The patients have been randomly distributed into the groups (***Group E***—*hand*, ***Group A***—*foot*). Following the inhalation (sevoflurane) induction with the mask, the necessary drugs for intubation (1 mg/kg 2% lidocaine, 1 microgram/kg fentanyl, 0.6 mg/kg rocuronium bromide) were administered by means of cannulation in accordance with the appropriate size of the catheter group. Patients were intubated with a spiral tube of the appropriate size. Anesthesia was maintained with 50%/50% Oxygen-Air and Sevoflurane. At the end of the case, they were extubated by using 2 mg/kg of sugammadex in accordance with the awakening criteria. First the "0-Minute" evaluation was conducted on the operation table after extubation. Patients with stable vital signs were transferred to the recovery units. The second evaluation was performed 30 minutes after extubation. Parameter evaluations were performed by the second anesthesiologist who did not know where the cannula was inserted during the operation. The patient's extremities were covered in order to avoid directing the doctor making the evaluation. The study was terminated when the number of patients participating in the study was completed.

3. Scales of Evaluation

The FLACC (Face, Legs, Activity, Cry, Consolability Score) Pain Scale is an observational behavior scale developed by Merkel *et al.* in 1997 [8]. It is used to evaluate procedural and postoperative pain in children aged from 2 months to 7 years. FLACC rates five pain-related behaviors with points 0, 1, or 2. The total score is between 0 and 10 points. The scale is used by means of observation in awake patients for a period of 1 to 5 minutes. The interpretation of the total score received is as follows: 0 points = *relaxed and comfortable*, 1 - 3 points = *slightly uncomfortable or mild pain*, 4 - 6 points = *moderate pain*, 7 - 10 points = *severe discomfort or pain*, or both [9]. The adaptation to Turkish culture was performed by Şenaylı *et al.* in 2005 with the name "YBAAT" pain scale. In the study hereby, this scale was used in postoperative pain evaluations of children aged from 1 month to 9 years and the results of the study demonstrated the validity-reliability of the scale in Turkish [10].

Regarding the diagnosis of postoperative delirium, Sikich and Lerman developed a special pediatric scale PAED (Pediatric Anesthesia Emergence Delirium). The sensibility and specificity analysis using the receiving operator characteristics found an area under the curve of 76.6% with a threshold of 10 or more, giving a sensibility of 64% and a specificity of 86% [11].

4. Statistics

The compliance of data with normal distribution was tested by the Shapiro wilk test and the Student t test was conducted to compare characteristics with normal distribution in 2 independent groups and Mann Whitney U test was conducted to compare characteristics without normal distribution in 2 independent groups. Analysis of P0-P30 and F0-F30 repeated measurements was performed by Wilcoxon test. Relations of categorical variables were analyzed by Pearson and Exact Chi square test. The relationship between quantitative variables was studied with the Pearson order correlation coefficient. The mean ± standard deviation for numeric variables and the number and % values for categorical variables were provided as descriptive statistics. For statistical analysis, the SPSS Windows version 23.0 package program was used and $P < 0.05$ was considered statistically significant.

5. Results

When the patients participating in the study were evaluated on the basis of age (year) and weight (kg), no differences were found between 2 groups. When all patients were evaluated, it was observed that the mean age was 5.11 ± 1.28 and the average weight was 20.09 ± 5.08 kg (10 - 37). Anesthesia times (35.8) were similar in both groups.

There was a statistically significant difference ($p = 0.001$) between the P0 mean value (PAED 0 min. rating) (14.64 ± 2.44) and the P30 mean value (PAED 30. min rating) (7.26 ± 2.40) within the hand cannulation (Hand) group. Similarly, it was found that the P0 mean value (12.43 ± 2.75) was significantly higher ($p = 0.001$) in the foot cannulation (foot) group compared to the P30 mean value (4.73 ± 1.64). When the hand and foot groups were compared in terms of P0 values, hand group results were statistically significantly higher. Similarly, at the time of P30, The Hand group was determined to be high.

In the Hand group, F0 mean value (FLAAC "0-Minute" evaluation) (9.26 ± 2.55) was statistically significantly higher ($p = 0.001$) compared to F30 mean value (FLAAC "30-Minute" evaluation) (5.02 ± 2.77). Similarly, the F0 mean value (6.76 ± 2.59) was found to be statistically significantly higher ($p = 0.001$) in the foot group compared to the F30 mean value (2.24 ± 1.93). Similar to the PAED group comparison, the mean values of F0 observed in the Hand group were statistically significantly higher compared to the mean values of F0 and F30 observed in the foot group ($p = 0.001$).

No statistically significant relationships were found between the age and weight variable and parameters P and F ($p > 0.05$).

6. Discussion

In this randomized, prospective double-blind study, we found that postoperative agitation and pain were less in children who had a peripheral intravenous catheter inserted from the back of the foot following inhalation induction.

Children have about half as many viable veins as adults. This sentence does not mean that children have fewer veins it just means that they have less accessible veins. Among the most suitable sites for cannulation in pediatric patients are the scalp, hands, feet and forearms [12]. A review on pediatric IV cannulation sites states that the dorsal veins of the hands and feet should be considered "preferred" option, and that the antecubital veins are among the easiest to perform cannulation [13]. While selecting the appropriate peripheral cannulation site for the child; the factors such as age, type and duration of treatment, the infusion rate of the fluid to be given, and the rotation of the body areas should be taken into account. Some of the publications on this topic do not recommend using a cannulation site on foot in children who can walk as it can lead to a restriction on mobility. However, we thought that cannulation on foot would not cause any problems due to the fact that the group participating in our study was discharged on the same day and the cannulation was terminated after the oral intake started. In the study, there were no patients who were excluded from the study due to restrictions on mobility.

In their study, in which they evaluated the relationship between the site of cannulation and pain, Goudra *et al.* clearly showed that inserting the cannula in the antecubital fossa caused significantly less pain when compared to the back of the hand. The reasons for the difference between the two sites are unclear, but harder skin and higher density of sensory innervation are important factors [14]. However, that research had been conducted in a group of adult patients. There are almost no studies conducted on pediatric patients.

Van Loon *et al.* found that pain experienced during intravenous cannulation depends more on the cannulation site and patient characteristics than on the size of the inserted catheter. Unfortunately, according to the researchers, the differences between pain in different cannulation sites are unclear and unknown [15].

Pain is not only a sensation, but also an emotional reaction given to this sensation. Because of previous negative experiences of venous interventions and families' using the syringe as an element of fear, children may experience fear more severely. This fear, on the other hand, can manifest itself more in the form of crying and agitation in children due to the difficulty in expressing themselves. Unknown childhood fear associated with venous interventions can lead to needle phobia in the long term [16]. It can also lead to an increased risk of agitation, sleep disorders, and negative behavior patterns [17]. In a study conducted in Iran, Borhani *et al.* reported that children experience anxiety along with mild or severe pain during venous cannulation. At the same time, they found that the pain after intervention (in the long term) is associated with the fear before the intervention. As a result of the study, they stated that excessive agitation and fear can lead to a child's reluctance to receive medical treatment, causing negative feelings towards medical staff, as well as making medical treatment difficult [18] [19].

Induction with inhalation anesthesia is the method of choice for many ex-

perienced pediatric anesthetists [20]. However, the debate on the benefits and disadvantages of intravenous and inhalation induction in children is still ongoing [21]. Discussions on this issue indicate that a "correct" answer does not exist. We mainly prefer inhalation induction in our own practice. Clinical studies show that only 53% to 76% of children are successfully cannulated on the first attempt [22] [23]. As we conducted peripheral cannulation following inhalation anesthesia in our study, it was not very surprising to find that our success rate in the first attempt was high, unlike in awake children.

Postoperative delirium is a negative picture that can occur after inhalation anesthesia in preschool boys. The condition can be associated with a wide range of cognitive and behavioral disorders in children, including delirium or acute brain dysfunction. This neurodevelopmental recovery period can be further complicated by pain, anxiety, and fear [24]. The distress experienced by a child during the recovery period after surgery can be dangerous: the child may scream and cry, try to stand up unconsciously, move his head violently, or try to remove existing catheters. This condition may also scare and worry parents. Although it is suspected that rapid recovery from anesthesia is a risk factor [25], they may suddenly enter a state of awakening where they cannot be comforted by normal methods usually due to external stimuli, even if they have been quietly awakened from anesthesia [26]. Cases of children developing delirium have been reported even after MRI anesthesia which is a painless procedure [27]. ENT surgery operations are also considered a risk factor for delirium. Our study was directed at tonsillectomy and adenoidectomy attempts of ENT surgery which were among the most common surgical operations conducted in childhood. By standardizing the drugs we used for anesthesia and postoperative pain, we focused on the site of cannulation which we identified as the variable. When we compared the hand and foot group in PAED and FLAC evaluations of the patients, we found that pain and agitation were significantly greater in the foot group at minutes 0 and 30. We observed that the absence of a cannula on the hand when the child was well-recovered in minute 30 was added to the activity of sensory nerve fibers in minute 0. We have noticed that visual stimulation triggers earlier fear in children, even if there is no pain. Our observation, which was already our main hypothesis at the beginning of the study, was also based on the clinic picture in minute 30. However, the fact that there were significantly different values in minute-0 as well as in minute 30 contributed us to prove our hypothesis. Failure to assess children's anxiety during the preoperative period can unfortunately be considered as a limitation of the study.

7. Conclusion

The relation between the cannulation site and delirium in pediatric patients who will undergo daily surgery operations is a subject that is open to research. In addition to the duration of anesthesia and induction technique that causes agitation in the postoperative period in preschool children, we aimed to put forward

that the cannulation site may also be important. As a result of the study, we believe that choosing the feet as the cannulation site may be useful in appropriate cases in pediatric patients.

8. Limitation of Research

As a limitation of our study, we did not evaluate maternal and paternal anxiety and previous vascular access experiences. The difficulty of assessing the preoperative anxiety of children was another limiting factor.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Bregenzer, T., Conen, D., Sakmann, P. and Widmer, A.F. (1998) Is Routine Replacement of Peripheral Intravenous Catheters Necessary? *Archives of Internal Medicine*, **158**, 151-156. https://doi.org/10.1001/archinte.158.2.151

[2] Burling, K.A. and Collipp, P.J. (1969) Emotional Responses of Hospitalized Children. Results of a Pulse-Monitor Study. *Clinical Pediatrics*, **8**, 641-646. https://doi.org/10.1177/000992286900801110

[3] Cummings, E.A., Reid, G.J., Finley, G.A., McGrath, P.J. and Ritchie, J.A. (1996) Prevalence and Source of Pain in Pediatric Inpatients. *Pain*, **68**, 25-31. https://doi.org/10.1016/S0304-3959(96)03163-6

[4] Lenhardt, R., Seybold, T., Kimberger, O., Stoiser, B. and Sessler, D.I. (2002) Local Warming and Insertion of Peripheral Venous Cannulas: Single Blinded Prospective Randomised Controlled Trial and Single Blinded Randomised Crossover Trial. *BMJ*, **325**, 409-410. https://doi.org/10.1136/bmj.325.7361.409

[5] Wells, L.T. and Rasch, D.K. (1999) Emergence "Delirium" after Sevoflurane Anesthesia: A Paranoid Delusion? *Anesthesia & Analgesia*, **88**, 1308-1310. https://doi.org/10.1213/00000539-199906000-00020

[6] Abu-Shahwan, I. (2008) Effect of Propofol on Emergence Behavior in Children after Sevoflurane General Anesthesia. *Pediatric Anesthesia*, **18**, 55-59. https://doi.org/10.1111/j.1460-9592.2007.02376.x

[7] Dahmani, S., Delivet, H. and Hilly, J. (2014) Emergence Delirium in Children: An Update. *Current Opinion in Anaesthesiology*, **27**, 309-315. https://doi.org/10.1097/ACO.0000000000000076

[8] McCarthy, A.M., Kleiber, C., Hanrahan, K., Zimmerman, M.B., Westhus, N. and Allen, S. (2010) Factors Explaining Children's Responses to Intravenous Needle Insertions. *Nursing Research*, **59**, 407-416. https://doi.org/10.1097/NNR.0b013e3181f80ed5

[9] Hockenberry, J.M. and Wilson, D. (2011) Wong's Nursing Care of Infants and Children. 9th Edition, Elsevier Health Sciences, USA.

[10] Şenaylı, Y., Özkan, F., Şenaylı, A. and Bıçakçı, Ü. (2006) Çocuklarda Postoperatif Ağrının FLACC (YBAAT) Ağrı Skalasıyla Değerlendirilmesi. *Türkiye Klinikleri Anesteziyoloji Reanimasyon Dergisi*, **4**, 1-4.

[11] Sikich, N. and Lerman, J. (2004) Development and Psychometric Evaluation of the

Pediatric Anesthesia Emergence Delirium Scale. *Anesthesiology*, **100**, 1138-1145. https://doi.org/10.1097/00000542-200405000-00015

[12] O'Grady, N.P., Alexander, M., Burns, L.A., Dellinger, E.P., Garland, J., Heard, S.O., Lipsett, P.A., Masur, H., Mermel, L.A., Pearson, M.L., Raad, I.I., Randolph, A.G., Rupp, M.E., Saint, S. and the Healthcare Infection Control Practices Advisory Committee (HICPAC) (2011) Guidelines for the Prevention of Intravascular Catheter-Related Infections. *Clinical Infectious Diseases*, **52**, e162-e193. https://doi.org/10.1093/cid/cir257

[13] Stovroff, M. and Teague, W.G. (1998) Intravenous Access in Infants and Children. *Pediatric Clinics of North America*, **45**, 1373-1393. https://doi.org/10.1016/S0031-3955(05)70095-X

[14] Goudra, B.G., Galvin, E., Singh, P.M. and Lions, J. (2014) Effect of Site Selection on Pain of Intravenous Cannula Insertion: A Prospective Randomised Study. *Indian Journal of Anaesthesia*, **58**, 732-735. https://doi.org/10.4103/0019-5049.147166

[15] Van Loon, F.H.J., Puijn LAPM, van Aarle, W.H., Dierick-van Daele, A.T.M. and Bouwman, A.R.A. (2018) Pain upon Inserting a Peripheral Intravenous Catheter: Size Does Not Matter. *The Journal of Vascular Access*, **19**, 258-265. https://doi.org/10.1177/1129729817747531

[16] McLenon, J. and Rogers, M.A.M. (2019) The Fear of Needles: A Systematic Review and Meta-Analysis. *Journal of Advanced Nursing*, **75**, 30-42. https://doi.org/10.1111/jan.13818

[17] Kain, Z.N., Mayes, L.C., Caldwell-Andrews, A.A., Karas, D.E. and McClain, B.C. (2006) Preoperative Anxiety, Postoperative Pain, and Behavioral Recovery in Young Children Undergoing Surgery. *Pediatrics*, **118**, 651-658. https://doi.org/10.1542/peds.2005-2920

[18] Borhani, F., Bagherian, S., Abaszadeh, A., Ranjbar, H., Tehrani, H. and Soleimanizadeh, L. (2012) Correlation between Anxiety and Pain Due to Intravenous Catheters in Children with Thalassemia. *Scientic Journal of Iranian Blood Transfusion Organization*, **9**, 170-174.

[19] Li, W.H.C., Chung, J.O.K., Ho, K.Y. and Kwok, B.M.C. (2016) Play Interventions to Reduce Anxiety and Negative Emotions in Hospitalized Children. *BMC Pediatrics*, **16**, Article No. 36. https://doi.org/10.1186/s12887-016-0570-5

[20] Stoddart, P.A., Brennan, L., Hatch, D.J. and Bingham, R. (1994) Postal Survey of Paediatric Practice and Training among Consultant Anaesthetists in the UK. *British Journal of Anaesthesia*, **73**, 559-563https://doi.org/10.1093/bja/73.4.559

[21] Zielinska, M., Holtby, H. and Wolf, A. (2011) Pro-Con Debate: Intravenous vs Inhalation Induction of Anesthesia in Children. *Pediatric Anesthesia*, **21**, 159-168. https://doi.org/10.1111/j.1460-9592.2010.03488.x

[22] Arendts, G., Stevens, M. and Fry, M. (2008) Topical Anaesthesia and Intravenous Cannulation Success in Paediatric Patients: A Randomised, Double-Blind Trial. *British Journal of Anaesthesia*, **100**, 521-524. https://doi.org/10.1093/bja/aen003

[23] Lininger, R.A. (2003) Pediatric Peripheral IV Insertion Success Rates. *Pediatric Nursing*, **29**, 351-354.

[24] Menser, C. and Smith, H. (2020) Emergence Agitation and Delirium: Considerations for Epidemiology and Routine Monitoring in Pediatric Patients. *Local and Regional Anesthesia*, **13**, 73-83. https://doi.org/10.2147/LRA.S181459

[25] Bryan, Y.F., Hoke, L.K., Taghon, T.A., *et al.* (2009) A Randomized Trial Comparing Sevoflurane and Propofol in Children Undergoing MRI Scans. *Pediatric Anesthesia*,

19, 672-681https://doi.org/10.1111/j.1460-9592.2009.03048.x

[26] Johr, M. (1999) Exzitation nach Sevofluran: Ein Problem in der Kinderanästhesie? *Der Anaesthesist*, **48**, 917-918. https://doi.org/10.1007/s001010050807

[27] Bonhomme, V., Boveroux, P., Brichant, J.F., Laureys, S. and Boly, M. (2012) Neural Correlates of Consciousness during General Anesthesia Using Functional Magnetic Resonance Imaging (fMRI). *Archives Italiennes de Biologie*, **150**, 155-163.