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ORIGINAL ARTICLE

PREVALENCE OF FACTORS ASSOCIATED WITH DIFFICULT PERIPHERAL VENOUS ACCESS IN A PAEDIATRIC POPULATION IN A CHILEAN HOSPITAL

PREVALENCIA DE FACTORES ASOCIADOS AL ACCESO VENOSO PERIFÉRICO DIFÍCIL EN POBLACIÓN PEDIÁTRICA EN UN HOSPITAL CHILENO

PREVALÊNCIA DE FATORES ASSOCIADOS AO ACESSO VENOSO PERIFÉRICO DIFÍCIL EM UMA POPULAÇÃO PEDIÁTRICA EM UM HOSPITAL CHILENO

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ABSTRACT

Introduction: Half of the insertion attempts for peripheral intravenous catheters in pediatric patients result in difficult intravenous access, defined as a failed peripheral intravenous catheter insertion at the first puncture. Currently, the DIVA score is used as a predictive tool for difficult intravenous access; however, there is research that proposes new factors associated with Difficult Intravenous Access (DIVA), revealing a need to analyze them in depth. **Aim:** To identify the prevalence of factors associated with difficult intravenous access in pediatric patients treated in the surgery service of a hospital in Chile, in 2022. **Methodology:** Cross-sectional, descriptive, and quantitative research with purposive sampling. Patients aged 0 to 14 years with difficult intravenous access were included. To analyze their medical history, 5 of the factors that are most mentioned in the literature were selected: Obesity, Diabetes, Sickle Cell Anemia, Chemotherapy, and Dialysis. An Ad Hoc comparison grid was used, the results were analyzed using software and the confidence interval was 95%. **Results:** The median age was 1 year, with an interquartile range of 3. The most prevalent medical history found in patients with difficult intravenous access was obesity, present in 31% of the sample. The second was Sickle Cell Anemia, with 5%. **Conclusions:** A significant difference was found between the

variables, with obesity being the most prevalent. This research achieved its purpose of providing evidence that facilitates decision-making for the care of patients' venous system.

Keywords: Pediatrics; Catheterization, Peripheral; Vascular access devices; Nursing care; Evidence-Based Nursing.

RESUMEN

Introducción: La mitad de las instalaciones pediátricas de un catéter venoso periférico resultan ser en el contexto de un paciente, un acceso venoso difícil, definido como instalación de un catéter venoso periférico frustrado en la primera punción. Actualmente se utiliza como herramienta predictiva de acceso venoso difícil el DIVA score, sin embargo, existen investigaciones que proponen nuevos factores asociados, surgiendo la necesidad de estudiarlos en profundidad. **Objetivo**: Identificar la prevalencia de factores asociados al acceso venoso difícil en pacientes pediátricos atendidos en el servicio de cirugía de un hospital en Chile, 2022. **Metodología**: Investigación cuantitativa descriptiva transversal con muestreo intencionado. Fueron incluidos pacientes de edad entre 0 a 14 años cumplidos con acceso venoso difícil. Para investigar estos antecedentes clínicos, se seleccionaron 5 de los más mencionados en la literatura: Obesidad, Diabetes, Anemia de Células Falciformes, Quimioterapia y Diálisis. Se utilizó una grilla de cotejo realizada Ad Hoc, los resultados fueron analizados mediante un software y el intervalo de confianza fue de 95%. **Resultados**: La mediana de edad fue de 1 año, con un rango intercuartílico de 3. El antecedente evaluado más prevalente en los pacientes con acceso venoso difícil fue obesidad, presente en el 31% de la muestra y el segundo, fue anemia de células falciformes, presente en un 5%. **Conclusiones**: Se evidenció una amplia diferencia entre las variables estudiadas, siendo obesidad la de mayor prevalencia; la investigación logró el propósito de aportar evidencia que ayude a la toma de decisiones para el cuidado del capital venoso del paciente.

Palabras claves: Pediatría; Cateterismo periférico; Dispositivos de acceso vascular; Atención de enfermería; Enfermería basada en la evidencia.

RESUMO

Introdução: Metade das instalações pediátricas de um cateter venoso periférico acaba por ser no contexto de um paciente, um acesso venoso difícil, definido como a instalação de um cateter venoso periférico frustrado na primeira punção. Atualmente, o DIVA score é utilizado como ferramenta preditiva para acesso venoso difícil, entretanto, há pesquisas que propõem novos fatores associados, surgindo a necessidade de estudá-los a fundo. **Objetivo:** Identificar a prevalência de fatores associados à dificuldade de acesso venoso em pacientes pediátricos atendidos no serviço de cirurgia de um hospital no Chile, 2022. **Metodologia:** Pesquisa quantitativa descritiva transversal com amostragem intencional. Foram incluídos pacientes de 0 a 14 anos com acesso venoso difícil. Para investigar esses antecedentes clínicos, foram selecionados 5 dos mais citados na literatura: Obesidade, Diabetes, Anemia Falciforme, Quimioterapia e Diálise. Uma grade de comparação Ad Hoc foi usada, os resultados foram analisados usando software e o intervalo de confiança foi de 95%. **Resultados:** A mediana de idade foi de 1 ano, com intervalo interquartil de 3. O antecedente mais prevalente avaliado em pacientes com acesso venoso difícil foi a obesidade, presente em 31% da amostra e o segundo, foi a anemia falciforme, presente em 5 %. **Conclusões:** Evidenciou-se ampla diferença entre as variáveis estudadas, sendo a obesidade a mais prevalente; A pesquisa atingiu o objetivo de fornecer evidências que auxiliem na tomada de decisão para o cuidado com o capital venoso do paciente.

Palavras Chaves: Pediatria; Cateterismo Periférico; Dispositivos de acesso vascular; Cuidados de enfermagem; Enfermagem baseada em evidências.

INTRODUCTION

It is frequent in hospital settings in tertiary care that pediatric patients require peripheral vascular access. Moreover, it has been described that at least half of hospitalized children require a Peripheral Intravenous Catheter (PIVC) to be placed in order to meet their healthcare needs.[1] Peripheral intravenous catheterization is usually a complex procedure; in children younger than 3 years, the first puncture attempt fails half of the time, which entails repeating the procedure, thus resulting in a frustrating process for the professionals, infants, and their guardians.[2,3] Nursing professionals are responsible for placing PIVCs, monitoring posterior complications, their maintenance, and the use of adequate techniques that help reduce the number of insertion attempts.[4,5]

Regarding Difficult Intravenous Access (DIVA), there is no consensus on the number of puncture attempts or defining characteristics to define intravenous access as difficult. One study carried out on adults considered DIVA to be cases with 2 or more failed attempts. In a different study, the need for multiple punctures to achieve catheterization is described as DIVA.[6] For the theoretical purposes of this research, the definition established by the most recent version of the Difficult Intra-Venous Access Score (DIVAscore) will be used, where DIVA is defined as a failed PIVC insertion after the first attempt.[7]

The DIVAscore is a tool that predicts failure or success for PIVC insertion; therefore, it can indicate the presence of DIVA.[8] This rating scale has been validated in the United States and Italy, and recommended in the Best Practice Guidance, Vascular Access, by the Registered Nurses Association of Ontario (RNAO), which is implemented currently in Chile.[7,9,10] The DIVAscore is a sum of values, associated with four variables related to the characteristics of the patient and associated with DIVA. These variables are the age of the pediatric patient, a history of prematurity (gestational age at birth < 38 weeks), vein visibility, and palpability after tourniquet placement.[8] It has been established that patients with a score equal to or higher than 4 have a 50% probability of presenting DIVA.[9]

The cost of hospital stays in Latin America increases in the presence of complications and failed PIVC insertions. A study performed in Brazil revealed that 31% of the funding provided by *Sistema Único de Saúde* (Unified Health System) is used for the placement of venous devices due to the patient's vascular fragility.[11] The American Academy of Pediatrics (AAP) has reported that the average cost of intravenous cannulations is US $41 and that in pediatric patients for whom more than three puncture attempts were necessary, the cost of PIVC ranged from US$69 to US$125.[12] A study analyzed the spendings of Medical-Surgical Units (UMQ for their acronym in Spanish, *Unidades de Hospitalización Médico Quirúrgico*) and Intermediate Care Units (UCM for their acronym in Spanish, *Unidad de Cuidados Medios*) in Chile, finding that the indirect annual cost of PIVC procedures in UMQs is CLP$62,020,583, with 35,174 punctures, and CLP$67.519.141 in UCM, where 16,913 punctures are performed annually.[13] Lastly, one study shows that in patients with DIVA, the process of inserting a venous catheter is between 118 and 135 minutes longer than in patients with easy intravenous access who do not require the use of advanced techniques (64 minutes), being more time-demanding for the staff and therefore using more human resources.[14,15]

Repeated attempts of PIVC insertion can increase the risk of complications such as medication extravasation, infections, and blood vessel perforation, resulting in blood draw and intravenous treatment delays, which is linked to slower laboratory test results, decreased therapeutic effects (lower efficacy and slower recovery) and, therefore, prolonged hospital stays.[2,3,15]

A Central Venous Catheter (CVC) is considered an alternative to PIVC when the latter cannot be placed due to DIVA. Therefore, a significant percentage of CVCs are used due to the impossibility of placing a PIVC, rather than for treatment purposes.[6] The use of CVC increases the number and severity of complications compared to PIVC, such as infection, thrombosis, and pneumothorax. Thus,

improving the management of DIVA would allow potentially unnecessary CVC to be avoided, which can have a significant impact on the patient's health by reducing the risk of complications.[6]

Factors related to the environment (light, temperature, space, and noise), the patient (personal characteristics and medical background), and the professional (experience and skills) may influence how difficult intravenous cannulation is.[6] Various risk factors should be considered for better care when assessing peripheral intravenous access in pediatric patients since the DIVAscore does not consider the patient's medical background when evaluating intravenous access. Consequently, a more in-depth inquiry is necessary regarding pediatric patients where there has been a failed first attempt for PIVC insertion.[3]

Due to the above, there is a need to study patients with DIVA, in search of personal factors that make them more susceptible to difficulties during intravenous cannulation.[6] The risk factors defined by the Chilean Anesthesiology Association for DIVA are obesity, musculoskeletal malformations of the limbs, edema of the limbs due to pharmacological or surgical treatments, a history of substance use that damages the venous pathways, chemotherapy, dialysis, Diabetes Mellitus, moderate to severe dehydration, a history of multiple punctures, and anxiety on the part of the patient.[3] Other research indicate additional factors deemed relevant as predictors for DIVA such as vascular pathology, intravenous substance use, Sickle Cell Disease, and Diabetes, the latter in adult patients.[15,16] Variables that are not considered specific to the patient are excluded for the purposes of this study, due to their acute nature and the uncertain persistence over time. Additionally, those related to potentially subjective psychological characteristics or detected only once in the bibliographic review were also excluded. The factors most mentioned in the literature and selected for this study are obesity, chemotherapy, Diabetes Mellitus, dialysis, and Sickle Cell Anemia.[3,6,15-17]

Selected Medical History

Obesity: An infant is considered obese if their body weight exceeds the average weight and size for children between 0 and 5 years, 29 days by 2 or more standard deviations, and if their Body Mass Index or BMI (kg/m2)/age is 2 or more standard deviations above the BMI for children between 5 years, 1 month and 19 years, according to the charts proposed by the World Health Organization (WHO) and the Chilean Department of Health (MINSAL).[18-20] It is described that obesity, being a chronic disease, contributes to a progressive deterioration of the peripheral vascular tree.[6] A high proportion of adipose tissue can be associated with difficulties in finding a visible and palpable vein where a line can be inserted.[16,21]

History of Chemotherapy: Chemotherapy is included among the risk factors for DIVA in studies on adult patients. Here, peripheral access availability is reduced due to the need to perform repeated punctures for diagnostic procedures and administering medicines.[22] Moreover, the antineoplastic agents administered during chemotherapy can cause phlebitis, extravasation, local tissue damage, and a reduction in the number of available veins.[23,24]

Diabetes Mellitus: Diabetes Mellitus is described as an illness where the insulin hormone loses its efficiency, resulting in high blood glucose levels.[25] Diabetes was a significant predictor of difficult cannulation in a study conducted in Italy.[24] The relationship between Diabetes and DIVA could be explained by an increase in morbidity that makes patients require frequent medical care and vascular access.[16] In addition, chronic hyperglycemia produces macro and microvascular complications in children with Diabetes Mellitus and is a risk factor for peripheral vascular diseases and venous thromboembolism.[26,27] These reasons can explain its relationship with DIVA.[16]

History of Dialysis: Dialysis is a treatment aimed at partial renal function replacement. It can be Peritoneal Dialysis or Hemodialysis, both of which clear waste products that intoxicate the

organism.[28,29] More than half of the patients with stage 3 or higher chronic kidney disease who have been dialyzed show elevated levels of C-Reactive Protein.[30,31] The cells involved in this inflammatory process suggest a link between blood flow and vascular inflammation.[32,33] This generates a vascular access dysfunction which is commonly caused by stenosis of the arteriovenous access, which is considered to significantly limit the patient's quality of life regarding future venous access.[34]

Sickle Cell Anemia (SCA): SCA is a chronic disease caused by the expression of homozygous hemoglobin S,[35] resulting in abnormal erythrocytes that are less deformable and have a crescent moon shape. This makes circulation difficult and causes a series of events that result in activation of the coagulation system and greater thrombotic activity, which means that patients with SCA are at risk of numerous complications such as microvascular and arterial thrombosis.[36,37] Platelet activation has also been observed, meaning that patients with SCA have a chronic state of hypercoagulability that may increase their tendency to develop venous thromboembolism.[38] Lastly, multiple IV insertions due to medical treatment cause stenosis, which could explain the relationship between SCA and DIVA.[16]

Considering the above, the purpose of this research is to generate valid and updated information that reveals the clinical factors that may be present in pediatric patients with difficult intravenous access. This would allow nursing professionals and other researchers to have knowledge of this issue before performing procedures, and to create new rating scales for pediatric venous access in the future, thus contributing to the evidence available on actions or recommendations for better management of PIVC insertion in children. Furthermore, this aligns with the rights of hospitalized children, which would be respected by taking the necessary precautions to reduce stress, unjustified procedures, and the pain caused by these treatments.[39] The objective of this research is to identify the prevalence of factors associated with difficult intravenous access in pediatric patients who were treated in the surgery service of a hospital in Chile in 2022.

METHODOLOGY

This is a descriptive, quantitative, and cross-sectional study with a purposive sampling method. The universe for this research was pediatric patients with DIVA admitted to the pediatric surgery service at a Chilean hospital, the total being 97 patients. The sample was comprised of pediatric patients between the ages of 0 and 14 years, 11 months and 29 days, presenting DIVA defined as a failed peripheral venous cannulation on the first attempt, between September and November, 2022.[7] The research team personally recorded the data over a period of 7 working days.

The sample selection was carried out according to the following inclusion criterion: Patients with a failed first attempt for cannulation with a traditional short peripheral venous catheter, according to their clinical record. The following exclusion criteria were defined: Patients whose file did not completely include the required information, this being the number of attempts made to insert an intravenous catheter, age, weight/height, and medical history, if applicable.

To calculate the sample size, a 50% probability of finding DIVA, indicated in the study "*Acceso venoso difícil en pediatría*" (difficult venous access in pediatrics), and a 95% confidence level were considered, with a population size of 107 patients in the selected period.[3] This calculation determined that 81 patients with DIVA needed to be recruited.

The selected variables were a) Obesity, b) History of Chemotherapy, c) Diabetes Mellitus, d) History of Dialysis, and e) Sickle Cell Anemia. The obesity variable was included based on the definition by WHO using the variables of age, weight, and height.

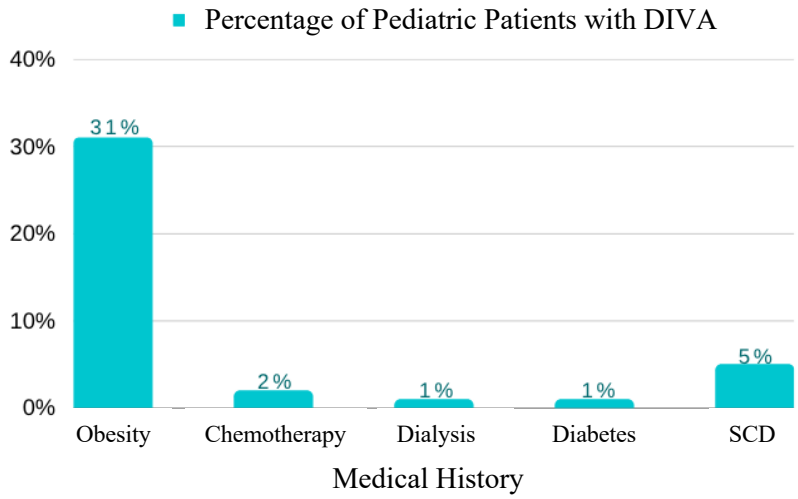
To extract and collect the data, each variable was searched in the clinical record of pediatric patients with DIVA. Tablet devices were used to extract the data, which allowed typing errors to be reduced,

and an instrument created by the authors was used for data collection, where each child was assigned an identifying code. This was reviewed by experts (a methodologist, a pediatrics academic, and a clinical nurse), who approved the instrument without recommending modifications. The data were kept anonymous, and no sensitive data were collected. Subsequently, they were recorded and analyzed using Excel in its 17.0, 2019 version.

Regarding ethical aspects, Ezequiel Emanuel's requirements and the four fundamental principles of professional bioethics (beneficence, non-maleficence, justice, and autonomy) were used, which enabled the creation of a rational and systematic framework that determined the ethics of the study. Respect for the principles and values of people was also considered throughout the entire research process.[40] This study was approved by the Scientific Ethics Committee of *Servicio de Salud Metropolitano Sur* and the Research Ethics Committee of the hospital (code 101-03102022). Additionally, a waiver of informed consent was validated by the institution's management.

RESULTS

A sample of 81 pediatric patients with DIVA, hospitalized during the second semester of 2022 in a surgery service, was analyzed, which corresponded to a prevalence of 51.26% of DIVA. The sample of patients with DIVA was mostly made up of male subjects (57% of the sample). The median age was 1 year, with an interquartile range of 3. In addition, 50% of the patients were aged between 0 and 1 year, with few patients being close to the upper limit of the range set for this study, considering that the youngest patient was 0 years old and the oldest 14 years old. Moreover, 44.38% of the records failed to include information on the number of puncture attempts. A high prevalence (22.22%) of acute febrile syndrome as an admission diagnosis was found. On the other hand, the most prevalent of the selected factors found in patients with DIVA was obesity, present in 31% of the sample, and the second most prevalent was Sickle Cell Anemia, representing 5%. The rest of the factors showed a significantly low prevalence; Chemotherapy was found in 2% of the sample, and Dialysis and Diabetes Mellitus in 1% each (Graph 1).



Graph 1: Prevalence of medical history factors in pediatric patients with DIVA (n=81).

DISCUSSION

The findings of this research regarding the presence of DIVA in pediatric patients show values that are similar to the tendency found in the bibliographic review, which was carried out following basic guidelines for the quality of the study and year of publication. These findings concur with the study "Acceso venoso difícil en pediatría" (Difficult Intravenous Access), in which it is determined that approximately 50% of pediatric patients under 3 years old present DIVA.[3]

Concerning data analysis, the sample was studied comprehensively (the analysis was not performed by age range). This is because a general characterization of the sample had to be performed first, due to the scarce information available in Chile about pediatric patients with DIVA. Future research should analyze this information focusing on data analysis by age range and/or sex of the patients.

As for the sample analysis, the high prevalence of obesity, present in 31% of pediatric patients with DIVA, can be associated with the high prevalence of this disease in Chile. The latest nutritional map of *Junta Nacional de Auxilio Escolar y Becas* (JUNAEB), which was published in 2020 and evaluates children up to 14 years old (as of March 31), establishes that the percentage of obesity in kindergarten is 29.5%, 27.9% in first and fifth grade, and 13.1% in ninth grade, showing that malnutrition due to excess reaches figures close to 30% at early pediatric ages.[42] According to these data, it would be important to carry out new research that analyzes a possible direct relationship between the pathophysiological processes present in this diagnosis and the presence of DIVA in children, the result of which could create a need to assess this medical background before inserting a PIVC.[41]

The prevalence of SCD found in the sample is considered significant since this is a recessive genetic pathology that has a low probability of appearing in the population.[43] In this regard, it is worth mentioning the low proportion of chemotherapy, dialysis, and Diabetes Mellitus found in this study, even when these have been mentioned in other research as important risk factors for DIVA. This may be due to the age of most patients with DIVA.[3,6,15,16]

Furthermore, it was found that the most common diagnosis on admission was acute febrile syndrome, a pathology that other research on DIVA has not considered influential for this condition, and for which no epidemiological information was found in the bibliographic review in the Chilean population. Therefore, it would be important to consider studying its pathophysiology in order to include new factors for assessment in pediatric patients, before performing procedures such as placing invasive intravenous devices.

A limiting factor highlighted during data collection is that a high percentage of the records did not include information on the number of puncture attempts. This shows that there are no habits or protocols for recording invasive procedures such as PIVC placement by nursing professionals, which could hinder the continuity of patient care.

Limitations

Because this is a prevalence study, it is limited to describing findings and does not establish causation between variables, nor does it generate links between them. In other words, this research does not establish clinical characteristics (obesity, Diabetes, history of chemotherapy, history of dialysis, and/or Sickle Cell Anemia) as the cause of difficult intravenous access. However, it is intended that further research can propose hypotheses and causal relationships using this study as a reference.

CONCLUSION

Significant differences were found in prevalence between variables, where a tendency is observed for pediatric patients with DIVA to present obesity. As a contribution to the discipline of Nursing, the medical history of pediatric patients with DIVA in the local reality was described, with the aim of

including these factors in future patient assessments, thus helping professionals make strategic decisions about the patient's venous system care.

It becomes essential to carry out new studies that include factors for assessment, in order to develop tools that professionals can use to deliver care with a favorable cost-benefit ratio, and that allow stressful procedures to improve for children and their caregivers. In this context, nursing professionals are in charge of inserting, caring for, and handling invasive devices such as PIVCs. Therefore, it is these professionals who should focus their care on preventing multiple and invasive venipunctures that could result both in prolonged hospital stays and an increase in material and human resources used in the process.

A high percentage of the records did not detail the number of puncture attempts made during the PIVC insertion procedures. This is thought to be a common practice within the hospital and therefore is considered an opportunity for improvement so that in the future the process of recording these invasive procedures is deemed fundamental and necessary for patient care continuity.

CONFLICT OF INTEREST

The author Felipe De la Fuente declares his role as associate editor in this journal. The remaining members of the research team declare no conflicts of interest.

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AUTHORSHIP

JPG: Conceptualization, Data curation, Formal analysis, Research, Project management, Resources, Software, Validation, Visualization, Writing – original draft, Writing – proofreading and editing.

JCB, AFM, SBO, FPC: Conceptualization, Data curation, Formal analysis, Research, Methodology, Project management, Resources, Validation, Visualization, Writing – original draft, Writing – proofreading and editing.

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REFERENCES

1. Kleidon TM, Cattanach P, Mihala G, Ullman AJ. Implementation of a paediatric peripheral intravenous catheter care bundle: A quality improvement initiative. J Paediatr Child Health 2019;55(10):1214-1223. https://doi.org/10.1111/jpc.14384
2. Schults J, Rickard C, Kleidon T, Paterson R, Macfarlane F, Ullman A. Difficult Peripheral Venous Access in Children: An International Survey and Critical Appraisal of Assessment Tools and Escalation Pathways. J Nurs Scholarsh 2019;51(5):537-546. https://doi.org/10.1111/jnu.12505
3. Borchert E, Lacassie H, Concha M, Rattalino M, Lema G. Acceso venoso difícil en pediatría. Rev. chil. anest 2021;50(5):685-689. http://doi.org/10.25237/revchilanestv50-03-08
4. Alexandrou E, Ray-Barruel G, Carr PJ, Frost SA, Inwood S, Higgins N, Lin F, Alberto L, Mermel L, Rickard CM. Use of Short Peripheral Intravenous Catheters: Characteristics, Management, and Outcomes Worldwide. J Hosp Med 2018;13(5):e1-7. https://doi.org/10.12788/jhm.3039
5. Dias EF, Viana ACN, Andraus LMS, Pereira MS. Utilização do dispositivo intravenoso periférico intermitente em pediatria. Rev. Eletr. Enferm 2000;2(2). https://doi.org/10.5216/ree.v2i2.685

6. Rodriguez MA. Factores de riesgo de dificultad en la canalización venosa periférica en atención hospitalaria. Estudio caso-control multicéntrico [Tesis Doctoral en Investigación traslacional en salud pública y enfermedades de alta prevalencia] Universitat de les Illes Balears. 2021.
7. Girotto C, Arpone M, Frigo AC, Micheletto M, Mazza A, Da Dalt L, Bressan S. External validation of the DIVA and DIVA3 clinical predictive rules to identify difficult intravenous access in paediatric patients. Emerg Med J 2020;37(12):762-767. https://doi.org/10.1136/emermed-2020-209658
8. Yen K, Riegert A, Gorelick MH. Derivation of the DIVA score: A clinical prediction rule for the identification of children with difficult intravenous access. Pediatr Emerg Care 2008;23(3):143-147. https://doi.org/10.1097/PEC.0b013e3181666f32
9. Riker MW, Kennedy C, Winfrey BS, Yen K, Dowd MD. Validation and Refinement of the Difficult Intravenous Access Score: A Clinical Prediction Rule for Identifying Children with Difficult Intravenous. Acad Emerg Med 2011;18(11):1129-1134. https://doi.org/10.1111/j.1553-2712.2011.01205.x
10. Registered Nurses´ Association of Ontario (RNAO). Vascular access. 2nd ed. Toronto (ON): RNAO; 2021. https://rnao.ca/bpg/guidelines/vascular-access-second-edition
11. Martins TS. Survey of the costs of peripheric intravenous device in the composition of the values of the internment in pediatrics unit - a quantitative study. OBJN 2008;7(2):419-421. https://doi.org/10.5935/1676-4285.20081499
12. Goff D, Larsen P, Brinkley J, Eldridge D, Newton D, Hartzog T, Rautt J. Resource Utilization and Cost of Inserting Peripheral Intravenous Catheters in Hospitalized Children. Hosp Pediatr 2013;3(3):185-191. https://doi.org/10.1542/hpeds.2012-0089
13. Neriz L, Cruz-Fernández D, Rodríguez-Araya D, Sawada M. Los costos basados en actividades de Unidades Médico Quirúrgica y de Cuidados Medios en un hospital público. Rev. méd. Chile 2020;148(1):17-29. https://doi.org/10.4067/S0034-98872020000100017
14. Witting M, Moayedi S, Brown L, Ismail A. Predictors and Delays Associated with the Need for Advanced Techniques for Intravenous Access. J Emerg Med 2017;53(2):172-177. https://doi.org/10.1016/j.jemermed.2017.04.002
15. Egan G, Healy D, O'Neill H, Clarke-Moloney M, Grace P, Walsh S. Ultrasound guidance for difficult peripheral venous access: systematic review and meta-analysis. Emerg Med J 2013;30(7):521-526. https://doi.org/10.1136/emermed-2012-201652
16. Fields J, Piela N, Au A, Ku B. Risk factors associated with difficult venous access in adult ED patients. Am J Emerg Med 2014;32(10):1179-1182. https://doi.org/10.1016/j.ajem.2014.07.008
17. Rodríguez M. Definiendo la vía venosa periférica de difícil canalización y los factores de riesgo asociados. Medicina Balear 2019;34(1):11-19. https://doi.org/10.3306/MEDICINABALEAR.34.01.11
18. Perret C, Pérez C, Poblete MJ. Manual de pediatría. Chile; 2018. https://medicina.uc.cl/wp-content/uploads/2018/09/Manual-de-Pediatria.pdf
19. OMS. Obesidad y sobrepeso. 9 de junio de 2021. https://www.who.int/es/news-room/fact-sheets/detail/obesity-and-overweight
20. Ministerio de Salud de Chile. Patrones de crecimiento para la evaluación nutricional de niños, niñas y adolescentes, desde el nacimiento hasta los 19 años de edad (con líneas de corte). Santiago; 2018. 92p. http://www.bibliotecaminsal.cl/wp/wp-content/uploads/2018/07/2018.06.14-PAC_Interior-con-lineas-de-corte-14-juliov3.pdf
21. Sebbane M, Claret PG, Lefebvre S, Mercier G, Rubenovitch J, Jreige R, et al. Predicting Peripheral Venous Access Difficulty in the Emergency Department Using Body Mass Index and a Clinical Evaluation of Venous Accessibility. J Emerg Med 2012;44(22):299-305. https://doi.org/10.1016/j.jemermed.2012.07.051

22. Gallieni M, Pittiruti M, Biffi R. Vascular access in oncology patients. CA Cancer J Clin 2008;58(6):323-346. https://doi.org/10.3322/CA.2008.0015
23. Vargas PL. Cáncer en pediatría: Aspectos generales. Rev. chil. pediatr 2000;71(4):283-295. https://doi.org/10.4067/S0370-41062000000400002
24. Piredda M, Biagioli V, Barrella B, Carpisassi I, Ghinelli R, Giannarelli D, et al. Factors affecting difficult peripheral intravenous cannulation in adults: a prospective observational study. J Clin Nurs 2016;26(7-8):1074-1084. https://doi.org/10.1111/jocn.13444
25. Ministerio de Salud de Chile. Guía clínica AUGE Diabetes Mellitus tipo 1. Santiago; 2013. 67p. http://www.bibliotecaminsal.cl/wp/wp-content/uploads/2016/04/Diabetes-Mellitus-tipo-1.pdf
26. Hamilton H, Knudsen G, Vaina C, Smith M, Paul S. Children and young people with diabetes: recognition and management. Br J Nurs 2017;26(6):340-347. https://doi.org/10.12968/bjon.2017.26.6.340
27. Pomero F, Di Minno MND, Fenoglio L, Gianni M, Ageno W, Dentali F. Is diabetes a hypercoagulable state? A critical appraisal. Acta Diabetol 2015;52(6):1007–1016. https://doi.org/10.1007/s00592-015-0746-8
28. Comité Educativo de ASODI, Asociación de Dializados y Trasplantados de Chile. Manual educativo ASODI para el paciente en diálisis y trasplantado. Chile: ASODI; 2017. 91 p. https://asodi.cl/wp-content/uploads/2018/04/Manual-Educativo.pdf
29. Gajardo M, Cano F. ABC de la diálisis peritoneal en pediatría. Rev Chil Pediatr 2020;91(2):265-274. https://dx.doi.org/10.32641/rchped.v91i2.1242
30. Cobo G, Lindholm B, Stenvinkel P. Chronic inflammation in end-stage renal disease and dialysis. NDT 2018;33(3):35-40. https://doi.org/10.1093/ndt/gfy175
31. Aarstad HH, Guðbrandsdottir G, Hjelle KM, Bostad L, Bruserud Ø, Tvedt THA, et al. The Biological Context of C-Reactive Protein as a Prognostic Marker in Renal Cell Carcinoma: Studies on the Acute Phase Cytokine Profile Cancers. Norwegian Cancer Society 2020;12(7):1961. https://doi.org/10.3390/cancers12071961
32. Gameiro J, Ibeas J. Factors affecting arteriovenous fistula dysfunction: A narrative review. J Vasc Access 2020;21(2):134-147. https://doi.org/10.1177/1129729819845562
33. Hartman EMJ, De Nisco G, Gijsen FJH,Korteland SA, van der Steen AFW, Daemen J, et al. The definition of low wall shear stress and its effect on plaque progression estimation in human coronary arteries. Sci Rep 2021;11(1):22086. https://doi.org/10.1038/s41598-021-01232-3
34. Murdeshwar HN, Anjum F. Hemodialysis. Treasure Island (FL): StatPearls Publishing; 2023 https://www.ncbi.nlm.nih.gov/books/NBK563296/
35. Descriptores en Ciencias de la Salud: DeCS [Internet]. ed. 2017. Sao Paulo (SP): BIREME/OPS/OMS; 2017. Anemia de Células Falciformes. https://decs2020.bvsalud.org/cgi-bin/wxis1660.exe/decsserver/
36. Quintero M, Jiménez A. Anemia de células falciformes. Revista Gastrohnup 2012;14(2)Sup1:27-35.
37. Boechat TdeO, do Nascimento EM, Lobo CL, Ballas SK. Deep venous thrombosis in children with sickle cell disease. Pediatr Blood Cancer 2015;62(5):838–841. https://doi.org/10.1002/pbc.25431
38. Lim MY, Ataga KI, Key NS. Hemostatic abnormalities in sickle cell disease. Hemostasis and thrombosis. Curr Opin Hematol 2013;20(5):472-477. https://doi.org/10.1097/MOH.0b013e328363442f
39. Ministerio de Salud de Chile. Orientaciones técnicas para la atención psicosocial de los niños y niñas hospitalizados en servicios de neonatología y pediatría. Chile;2011. 116p. https://www.crececontigo.gob.cl/wp-content/uploads/2015/11/Atencion_Psicosocial_RN.pdf

40. Rodríguez E. Comités de evaluación ética y científica para la investigación en seres humanos y las pautas CIOMS 2002. Acta Bioeth 2004;10(1):37-47. https://doi.org/10.4067/S1726-569X2004000100005
41. Burrows R. Obesidad en niños y adolescentes: sus efectos más allá de la salud física. Santiago de Chile: INTA;2021. https://inta.cl/obesidad-en-ninos-y-adolescentes-sus-efectos-mas-alla-de-la-salud-fisica/
42. Ministerio de Educación de Chile. Mapa Nutricional 2020. Chile: JUNAEB; 2020. https://www.junaeb.cl/wp-content/uploads/2021/03/MapaNutricional2020_.pdf
43. Zúñiga P, Martínez C, González L, Rendón D, Rojas N, Barriga F, et al. Enfermedad de células falciformes: Un diagnóstico para tener presente. Rev. chil. pediatr 2018;89(4):525-529. https://doi.org/10.4067/S0370-41062018005000604