



Revista Colombiana de Anestesiología

Colombian Journal of Anesthesiology

www.revcolanest.com.co



Essay

What is the need to place a vascular access for anaesthetic procedures in children?☆



Piedad Cecilia Echeverry-Marín^{a,*}, María Cristina Mondragón-Duque^b,
José Joaquín Meza-Padilla^c

^a Instituto de Ortopedia Infantil Roosevelt, Colombia

^b Third-year Resident of Anaesthesia, Pontificia Universidad Javeriana, Bogotá, Colombia

^c Third-year Resident of Anaesthesia, Universidad de Cartagena, Bolívar, Colombia

ARTICLE INFO

Article history:

Received 28 March 2017

Accepted 17 August 2017

Available online 22 November 2017

Keywords:

Catheters

Anesthesia

Child

Patient safety

Operating room

ABSTRACT

Introduction: Vascular access in children has been considered an essential part of safe in paediatric anaesthesia. However, it requires great skill and it has risks and complications. There is a current controversy about when it is required, especially in patients in whom access is difficult and are scheduled for minor and short-term procedures.

Objective: To reflect on the factors that must be considered regarding the placement of peripheral vascular access in children for peri-operative management, and to provide tools to help with the decision of placing a vascular access.

Methodology: A non systematic review was made to find the indications and risks of vascular access; and a reflection on the main considerations to think about when it is necessary to place a vascular access in children.

Results: The review of the literature resulted in relevant considerations that need to be emphasised when deciding to place a vascular access in children.

Conclusion: The risk and benefit of any intervention in children should be assessed. The final decision to place a venous access for peri-operative management of children depends on patient age, degree of difficulty of the vascular access, type of procedure, duration and, finally, the anaesthetist's own perception of safety. Individual experience counts when it comes to the final decision.

© 2017 Published by Elsevier España, S.L.U. on behalf of Sociedad Colombiana de Anestesiología y Reanimación. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

☆ Please cite this article as: Echeverry-Marín PC, Mondragón-Duque MC, Meza-Padilla JJ. ¿Cuál es la necesidad de colocar un acceso vascular en procedimientos anestésicos en niños?. Rev Colomb Anestesiología. 2017;45:64-68.

* Corresponding author at: Carrera 16 numero 85-66, Bogotá, Colombia.

E-mail address: echeverrypiEDAD@hotmail.com (P.C. Echeverry-Marín).

2256-2087/© 2017 Published by Elsevier España, S.L.U. on behalf of Sociedad Colombiana de Anestesiología y Reanimación. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

¿Cuál es la necesidad de colocar un acceso vascular en procedimientos anestésicos en niños?

R E S U M E N

Palabras clave:

Catéteres
Anestesia
Niño
Seguridad del paciente
Quirófanos

Introducción: El acceso vascular en niños se ha considerado una parte esencial de la seguridad en anestesia pediátrica. Sin embargo, requieren gran destreza y no está exento de riesgos y complicaciones, por lo cual existe una controversia vigente sobre cuándo es necesario colocarlos, sobretodo en aquellos pacientes que son difíciles de canalizar y están programados para procedimientos menores y de corta duración.

Objetivo: Hacer una reflexión de los factores que se deben considerar para colocar un acceso vascular periférico en niños para el manejo perioperatorio y tener herramientas para decidir cuando es conveniente colocar un acceso vascular.

Metodología: se hizo una búsqueda no sistemática en la literatura sobre las indicaciones y riesgos de los accesos vasculares; y se hizo una reflexión de las principales consideraciones que se deben tener en cuenta para decidir cuándo colocar un acceso vascular en los niños.

Resultados: se revisó la literatura y se sacaron algunas conclusiones para enfatizar cuáles consideraciones son relevantes en el momento de decidir si es necesario colocar un acceso vascular en pediatría.

Conclusión: Se debe evaluar el riesgo y el beneficio de cualquier intervención que se realice en los niños. La decisión final sobre colocar o no un acceso venoso para el manejo perioperatorio de los niños depende de la edad, del grado de dificultad para el acceso vascular, del tipo de procedimiento, de la duración y finalmente, de la percepción de seguridad que tiene cada anestesiólogo. La experiencia individual cuenta en la decisión final.

© 2017 Publicado por Elsevier España, S.L.U. en nombre de Sociedad Colombiana de Anestesiología y Reanimación. Este es un artículo Open Access bajo la licencia CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

In peri-operative medicine, the availability of a vascular access has been considered part of the safe practice of anaesthesia. Placing a peripheral venous catheter is the easiest and fastest technique for obtaining venous access.^{1,2} However, this idea is controversial among paediatric anaesthetists, some of whom believe that the need for vascular access depends on patient, procedure and anaesthetist-dependent factors.

One of the arguments supporting this controversy is the greater difficulty for achieving venous access in children because of their anatomical characteristics, their physiology and the greater skill required on the part of the healthcare providers.

Objective

The objective of this article is to reflect on the factors that need to be considered before placing a peripheral vascular access for peri-operative management in children, and to gain tools for deciding when placement of a vascular access is warranted.

This reflection article is intended to present arguments in favour and against but not to serve as a clinical practice guideline or to settle the existing controversy.

Methodology

A search was conducted in the literature regarding this topic using Pubmed and Academic Google, as well as the terms

Vascular Access Devices, Vascular Access, Intravenous cannula, Paediatrics and anaesthesia.

Results

Anaesthetic procedures are performed in children in daily clinical practice under controlled conditions or as part of elective procedures in the operating room. Obtaining vascular access in children poses a dilemma because of its huge difficulty in some cases, potential complications, stress, anxiety, and the emotional and physical pain associated with this procedure. Even in experienced hands, the difficulty is apparent. Also, given the short time period during which the vascular access is required for certain procedures, in haemodynamically stable, non-critically ill individuals, or in very short outpatient procedures, an adequate anaesthetic process (analgesia, anaesthesia, immobilisation, unconsciousness and amnesia) may be achieved by means of other alternatives that do not require a venous access.

The main indications for establishing a vascular access in paediatric patients include the intravenous administration of fluids, medications, chemotherapy, contrast media and/or blood products; parenteral nutritional support; drawing of blood samples; and invasive haemodynamic monitoring.^{3,4} There are no absolute contraindications for peripheral intravenous cannulation in paediatrics, but venous access should be avoided in an injured limb with fractures, infections or burns; and when irritating solutions with a pH <5 or >9, or high osmolarity > 600 mOsm/L must be administered through a central vascular access.³

Obtaining peripheral vascular access in children usually requires more than two attempts in 30% of cases.⁵ Moreover, the procedure is not free of complications that range from minor adverse events such as occlusion and loss of the vascular access, haematoma formation, infiltration through extravasation into the soft tissues, and localised pain, to more serious complications such as skin necrosis, cellulitis, arterial puncture, thrombophlebitis and compartment syndrome, all of which are more frequent in children than in adults.³

In the literature, success rates for peripheral vascular access varies. In 2003, Lininger⁶ found that 53% were successful on first attempt and this rate increased up to 91% in the first 4 attempts; and according to Rauch et al.,^{7,8} the average time required by the healthcare team to obtain adequate venous access in paediatric patients is 33 min. For this reason, very short procedures performed in paediatric patients with difficult vascular access may take 25% longer than the estimated surgical time, while a permeable peripheral line is obtained.⁹

There are reports in the literature describing surgical procedures in 6400 ASA 1 and 2 paediatric patients taken to tympanoplasty and tube insertion only under inhalation anaesthesia and no vascular access, with no serious complications reported.¹⁰ There are also reports of 500 cases of Apert syndrome with difficult vascular access because of syndactyly and anticipated difficult airway given anaesthesia for minor surgical procedures, 10% of them without vascular access, with no significant complications reported.¹¹ Therefore, it would appear that the practice performed by a significant number of practitioners becomes accepted practice as long as it is the result of rational clinical judgement and careful patient selection.¹²

Difficult venous access is frequent in children, and it is defined as the need for three or more puncture attempts. Risk factors related with the degree of difficulty include early age, especially children under 1 year of age; non-white race; low weight or overweight; and the anatomical location of the target vessel (the dorsum of the hand and the lower extremity are associated with a more difficult access than the ulnar region).¹³

There are technological tools now available to facilitate vein identification in children, with success rates close to 100%. Ultrasound is one such technology that helps secure vascular accesses effectively and with lower incidence of complications when compared with blind techniques or the use of anatomical landmarks.¹⁴ This tool has been very useful for the placement of central venous lines, and the use of direct ultrasound guidance for central catheter placement is currently considered good clinical practice.¹⁵ Other modern devices that use infrared light and lamps help visualise peripheral veins in children in order to identify puncture sites with a highest potential for successful canalisation.^{16,17} However, these devices have important limitations in that they do not reveal the depth of the blood vessels, they require skill in performing the technique, and the literature reports that they do not result in a significant rate of canalisation success, and there are even reports of a lower success rate

Table 1 – Considerations to bear in mind when deciding whether to omit peripheral vascular access in paediatrics.

Consideration	Description
Minor procedure	Cast exchange Non-invasive diagnostic tests (not requiring the introduction of devices through natural orifices) Examination under sedation or anaesthesia where no vagal reflexes are elicited Botulinum toxin application or diagnostic punctures Radiographs or non-contrast tomography
Type of procedure	Painless or minimally painful
Duration	Less than 30 min
Type of patient	ASA 1 or 2 – not urgent
Age	Over 1 year
Staff	Experienced in paediatrics
Monitoring	Cardioscopy, pulse oximetry, non-invasive blood pressure monitoring, airway pressure and capnography
Source: Authors.	

as compared with the standard approach without the use of devices.^{5,18}

Analysis

There is no right answer regarding when to place or not to place a vascular access in children, particularly in those cases where some degree of difficulty is anticipated and in children scheduled for minor, short (less than 30 min) and not very painful procedures in hospitals with experience in paediatrics. Although inhalation anaesthesia with no vascular access may be considered in those cases, the decision is always a difficult one.

Children have small, mobile veins and excess subcutaneous fat, making visualisation and palpation difficult.⁴ This means that paediatric patients are usually punctured several times in different areas, causing haematomas, ecchymosis and pain that result in more discomfort than the elective procedure itself. These situations result in physical and psychological trauma for the child, the parent and even the healthcare staff.¹⁹ For this reason it is wise to analyse whether interventions requiring mild patient immobilisation might be undertaken without establishing a peripheral line, as long as there is no absolute indication for a vascular access, and as long as all the necessary paediatric monitors are available to allow careful monitoring of cardiovascular and respiratory function.

Table 1 describes the considerations suggested by the authors at the time of deciding when to secure a peripheral vascular access in the anaesthetic management of a paediatric patient. Patients under 1 year of age pose an additional risk because this is the age group that may present more acute

respiratory complications under anaesthesia such as laryngospasm. Consequently, there is a need to assess the risk and benefit of performing procedures without a vascular access in this population.²⁰

Several aspects must be analysed when it comes to making a decision about vein canalisation in a child who will be taken to a procedure under anaesthesia: patient characteristics and general condition (age, ASA, hydration and risk factors for difficult vascular access); type of procedure (risk of bleeding, duration, painful stimulus); and, finally, the care team (skills and experience managing paediatric patients). However, in those cases in which the decision is not to use a vascular access, an effective and safe alternative has to be considered for quick medication administration in the event of an unforeseen emergency, for example, an intramuscular or intra-osseous route.²¹ The latter can be obtained quickly using a 16 or 14 G needle 3–4 cm long, with a high rate of success in the anteromedial region of the tibia, in the distal femur or in the proximal humerus. Although not entirely free from serious complications because it requires technical skill and expertise, the intra-osseous route is an emergency alternative in cases in which anaesthesia is given without a venous access, there is an emergency and it is not possible to gain quick access to a permeable peripheral vein, and cardiorespiratory resuscitation must be initiated immediately.⁷

Conclusions

There is no algorithm or clinical practice guideline to solve the controversy on how to determine when an anaesthetic procedure can be performed in children without establishing vascular access. This article, based on a combined review of the literature and the experience gained by the authors in the practice of paediatric anaesthesia, is intended to analyse each context and make the most favourable decision for each patient.

The anaesthetist and his/her own individual experience are critical factors in making this decision. The practitioner who works with paediatric patients on a daily basis will naturally be more familiar with this population and will have a heightened awareness of potential events that may arise during anaesthesia. With this knowledge, an anaesthetist with experience in paediatrics has good tools to make this kind of decision. Although the controversy is still alive, the arguments in favour and against securing a vascular line in children must be considered in the context of each individual patient, as long as patient safety and wellbeing and peri-operative care quality are not at risk.

Conflicts of interest

Author Piedad Echeverry-Marín, M.D., is the Coordinator of the Paediatric Anaesthesia Committee of the Colombian Society of Anaesthesia and Resuscitation (S.C.A.R.E.).

Funding

The authors' own resources.

REFERENCES

- Martin LD. Principios básicos de la anestesia neonatal. *Rev Colomb Anesthesiol*. 2017;45:54–61.
- Stovroff M, Gerald Teague W. Intravenous access in infants and children. *Pediatr Clin N Am*. 1998;45:1373–93.
- Shlamovitz GZ, Shlamovitz GZ. Pediatric intravenous cannulation; 2017. Available from: <http://emedicine.medscape.com/article/2008690-overview> [cited 18.03.17].
- Scott-Warren VL, MBChB (Hons) FRCA, Morley RB, BM FRCA. Paediatric vascular access. *BJA Educ*. 2015;15:199–206.
- Farrelly JS, Stitelman DH. Complications in pediatric enteral and vascular access. *Semin Pediatr Surg*. 2016: 371–9.
- Lininger RA. Pediatric peripheral i.v. insertion success rates. *Pediatr Nurs*. 2003;29:351–4.
- Rauch D, Dowd D, Eldridge D, Mace S, Schears G, Yen K. Peripheral difficult venous access in children. *Clin Pediatr (Phila)*. 2009;48:895–901.
- Clinical Practice Guideline: Difficult Intravenous Access. Emergency Nurses Association; 2017. Available from: <https://www.ena.org/practice/CPG/.difficultivaccesscp.pdf> [cited 21.03.17].
- Roushdy A, Abdelmonem N, El Fiky A. Factors affecting vascular access complications in children undergoing congenital cardiac catheterization. *Cardiol Young*. 2012;22:136–44.
- Wilson G, Engelhardt T. Who needs an IV? Retrospective service analysis in a tertiary pediatric hospital. *Pediatr Anesth*. 2012;22:442–4.
- Barnett S, Moloney C, Bingham R. Perioperative complications in children with Apert syndrome: a review of 509 anesthetics. *Pediatr Anesth*. 2011;21:72–7.
- Smith J. The placement of an intravenous cannula is always necessary during general anesthesia in children: a pro-con debate. The case against. *Paediatr Anaesth*. 2012;22: 455–8.
- Petroski A, Frisch A, Joseph N, Carlson JN. Predictors of difficult pediatric intravenous access in a community emergency department. *J Vasc Access*. 2015;16:521–6.
- Cole I, Glass C, Norton HJ, Tayal V. Ultrasound measurements of the saphenous vein in the pediatric emergency department population with comparison to i.v. catheter size. *J Emerg Med*. 2012;43:87–92.
- Ares G 1, Hunter CJ. Central venous access in children: indications, devices, and risks. *Curr Opin Pediatr*. 2017;29:340–6.
- Hosokawa K, Kato H, Kishi C, Kato Y, Shime N. Transillumination by light-emitting diode facilitates peripheral venous cannulations in infants and small children. *Acta Anaesthesiol Scand*. 2010;54:957–61.
- Graaff JC, Cuper NJ, Mungra RA, Vlaardingerbroek K, Numan SC, Kalkman CJ. Near-infrared light to aid peripheral intravenous cannulation in children: a cluster randomised clinical trial of three devices. *Anaesthesia*. 2013;68: 835–45.
- Rothbart A, Yu P, Müller-Lobeck L, Spies CD, Werneck KD, Nachtigall I. Peripheral intravenous cannulation with support

-
- of infrared laser vein viewing system in a pre-operation setting in pediatric patients. *BMC Res Notes*. 2015;8:463.
19. Tripathi S, Kaushik V, Singh V. Peripheral IVs: factors affecting complications and patency. A randomized controlled trial. *J Infus Nurs*. 2008;31:182-8.
20. Bhananker SM, Ramamoorthy C, Geiduschek JM, Posner KL, Domino KB, Haberkern CM, et al. Anesthesia-related cardiac arrest in children: update from the pediatric perioperative cardiac arrest registry. *Anesth Analg*. 2007;105:344-50.
21. Dobson A, Tennuci C. Safe general anaesthesia without secure intravenous access. *Anaesthesia*. 2015;70:634.