

Management of puncture pain in hospitalized children

Manejo del dolor por punción en niños hospitalizados

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What do we know about the subject matter of this study?

There is considerable evidence demonstrating the usefulness of various methods to reduce the pain produced by punctures in children. These can be pharmacological and non-pharmacological and have a positive impact on the hospitalization experience. However, experience in their use is limited in Latin America, even more so with the multimodal implementation of these strategies.

What does this study contribute to what is already known?

The multimodal application of strategies to reduce the pain caused by punctures is associated with low scores on pain scales and with a favorable parental perception. Our results are intended to motivate different pediatric care centers to incorporate these preventive strategies in the management of pain associated with punctures.

Abstract

Punctures are the main cause of pain during hospitalization in pediatrics. The application of a protocolized management improves the hospitalization experience. **Objective:** To describe the introduction of different strategies aimed at relieving pain associated with punctures in a pediatric middle care unit. **Patients and Method:** Descriptive retrospective study carried out between October 2018 and May 2020 in a pediatric intermediate care unit of the HCUC (Santiago, Chile). Data analysis included demographic information, type of painful procedure, therapeutic intervention, duration of the procedure, pain scales (CHEOPS and Frankl), and parent/caregiver opinion survey. **Results:** 89 procedures, in 72 children, mean age 4.5 years. The most frequent painful procedure was Peripheral venous catheter insertion in 41.6% ($n = 37$) of children, with a mean duration of 7.5 min. The most used therapeutic intervention was the application of topical 4% lidocaine in 76% ($n = 68$); 73% of the patients presented an evident positive behavior according to the FRANKL scale and, according to CHEOPS, 77.5% presented mild pain. The parent/caregiver survey showed that 79% reported less pain compared with previous puncture episodes, and 98% would request the same measures next time. **Conclusions:** The application of different strategies to manage pain caused by punctures is associated with low pain scores and favorable parental acceptance. The use of standardized management protocols could allow better approaches and experiences for patients and their parents/caregivers at low cost and easy applicability.

Keywords:

Pain;
Pain Prevention;
Painful Procedures;
Punctures

Introduction

Pain is defined as “any unpleasant sensory and emotional experience associated with actual or potential tissue damage”¹. In pediatric hospitalizations, there are multiple sources of pain²⁻⁵; one of the main and most intense is that associated with punctures (vaccinations, blood extraction, venous cannulation, among others)⁶⁻¹¹.

Exposure to pain in children, together with inadequate management, has a long-term negative impact on their health^{12,13}. The evaluation, study, and planning of continuous improvement in pain management is a relevant topic, and international organizations, such as the Joint Commission, consider the use of pain management strategies as an accreditation requirement¹⁴.

Evidence and literature show that pharmacological interventions, such as the use of topical anesthetics¹⁵⁻¹⁸, and non-pharmacological interventions¹⁹, such as distraction²⁰⁻²³, non-nutritive sucking with sucrose or breastfeeding²⁴⁻²⁷, vibration and cold^{28,29}, and patient positioning^{20,30,31}, among others, are useful to reduce the pain associated with punctures, their multimodal use is recommended^{32,33}, and their feasibility is supported by quality studies³⁴⁻³⁶.

The objective of this study is to describe the experience of introducing measures to reduce pain associated with punctures and to determine the impact of pain assessment and the perception of parents or caregivers.

Patients and Method

Descriptive cohort study, developed at the *Hospital Clínico Universidad Católica*, in the Pediatric Intermediate Care Service. The protocol was approved by the MEDUC Scientific Ethical Committee (act N°190328019) with informed consent.

Information was collected from secondary data from local surveys and tables, used to monitor the use of the different interventions in the unit. Convenience sampling was used. All punctures recorded in daily surveys, performed in children under 18 years of age, admitted for more than 24 hours, between October 2018 and May 2020 were included, excluding those procedures in which concomitant sedation-analgesia techniques were used and patients who did not receive any preventive measures.

Each recorded procedure was considered for the analysis, regardless of whether it was more than one procedure in the same child, as long as there was a 24-hour difference between the two.

The team integrated by a physician of the unit and the coordinating nurse selected different cost-effective strategies applicable to the local reality:

- Topical 4% lidocaine on the area to be punctured, covered with a Tegaderm Film® for approximately 30 minutes, proceeding with the puncture after its removal.
- Buzzy Bee®: bee-shaped device that combines vibration and cold, applied about 5 cm proximal to the area to be punctured, with an interval of 30-60 seconds between its application and the puncture, remaining in place until the puncture is done. The mechanism of action is based on potentiating the inhibitory effect of pain by blocking the afferent nerve fibers and stimulating the inhibitory interneurons²⁷.
- Positioning: achieve a comfortable position for the patient, avoiding limb restraint, forced prone position, and the use of force. Ideally, parents/caregivers can be involved and can contribute by hugging patients and promoting physical contact with them. Their presence is recognized as a fundamental element in coping with painful procedures, reducing the pain and stress generated by venous punctures^{29,30}.
- Non-nutritive suction: oral administration of glucose serum or breastfeeding, applicable only to children under 1 year of age.
- Distraction: a cognitive-behavioral method that diverts the child's attention. It can be active (games with interactive objects) or passive (use of screens, didactic toys, others), increasing pain tolerance by decreasing stress levels²². Various techniques were used, such as bubbles, music, toys, and the use of electronic devices of the families, such as cell phones or tablets, so that the patients could interact with them at the time of the puncture. In some cases, it was also possible to have the support of a childcare assistant.

The nursing staff was trained in these techniques before starting the study, with educational presentations and modeling to explain the different management strategies and evaluation scales by the research nurse.

Before the puncture, based on the knowledge of the patient, the type of procedure, and in conjunction with the parents, the nursing team customized the measure(s) to be applied (Figure 1). Subsequently, the team completed a record that included the type of procedure (subcutaneous, intramuscular, arterial or venous puncture, peripheral intravenous catheter (PIV) placement, gripper, etc.), type of intervention received, duration of the procedure, number of attempts, and pain assessment according to Frankl rating scale and the Children's Hospital of Eastern Ontario Pain Scale (CHEOPS). Frankl scale is validated for the behavioral evaluation of the child in dental

care³⁷, and it was decided to use it due to the similarity of the procedures and its easy applicability. The behavior was classified as positive (4), slightly positive (3), slightly negative (2), or negative (1) (Table 1). The CHEOPS is a behavioral observation scale, validated in Spanish for postoperative pain³⁸. The observer evaluated different items and, according to the score, it was classified as no pain (score 4), mild pain (score 5-8), moderate pain (score 9-11), and severe pain (score 12-13) (Table 2).

In addition, an appreciative survey was administered to parents/caregivers about pain management compared with previous situations (in case they had received similar procedures before), the performance of the health care team (Excellent, Very good, Good, Sufficient, Bad), and whether they would apply the same techniques in future procedures. The survey was applied by convenience, depending on availability and local dynamics at the time of the procedure, not including all parents/caregivers of the registered patients. It was assumed that the previous procedure was not performed using the techniques applied in the present protocol.

The data were entered into an Excel® spreadsheet and subsequently, the demographic characteristics of the population, the type of puncture, and the interventions indicated for pain management and their association with the pain scales were analyzed descriptively with SPSS® software. Means and standard deviations (SD) were calculated for frequency counts, and proportions for categorical data.

Results

A total of 1260 children were admitted to the unit, with a register of 99 procedures in 82 different patients. Two procedures were excluded due to the use of concomitant sedation-analgesia and 8 due to the absence of preventive measures (3 due to patient refusal, 2 due to parents' refusal, 2 due to emergency procedures, and 1 due to omission). The definitive analysis was performed with 89 procedures in 72 patients. The age was 52 ± 58 months and 59.8% were male. Figure 2 shows the frequency of painful procedures, highlighting that the most frequent procedures were PIV placement (41.6%) and venous puncture (40.4%).

The most frequent preventive measures were topical lidocaine administration (75%) and distraction (73%) (Table 1). No adverse events to lidocaine were recorded. The mean number of procedural attempts was 1.4, with a duration of 7.5 ± 4.2 minutes.

Pain assessment by the Frankl scale was recorded in 82 procedures, with a score of 3.1 ± 0.9 , 73% of them with a positive categorization (Table 2). Regarding the CHEOPS, it was recorded in 67 procedures, with a score of 7.5 ± 2.1 . A total of 78% had a score less than or equal to 8 on the scale (9% no pain and 69% mild pain) (Table 3).

48.3% of parents/caregivers were surveyed and 79% reported less pain, none reported more pain, and 21% did not know/not answer. Regarding the evaluation of the health care team's performance, 37% of the parents/caregivers described it as Excellent, 37% as

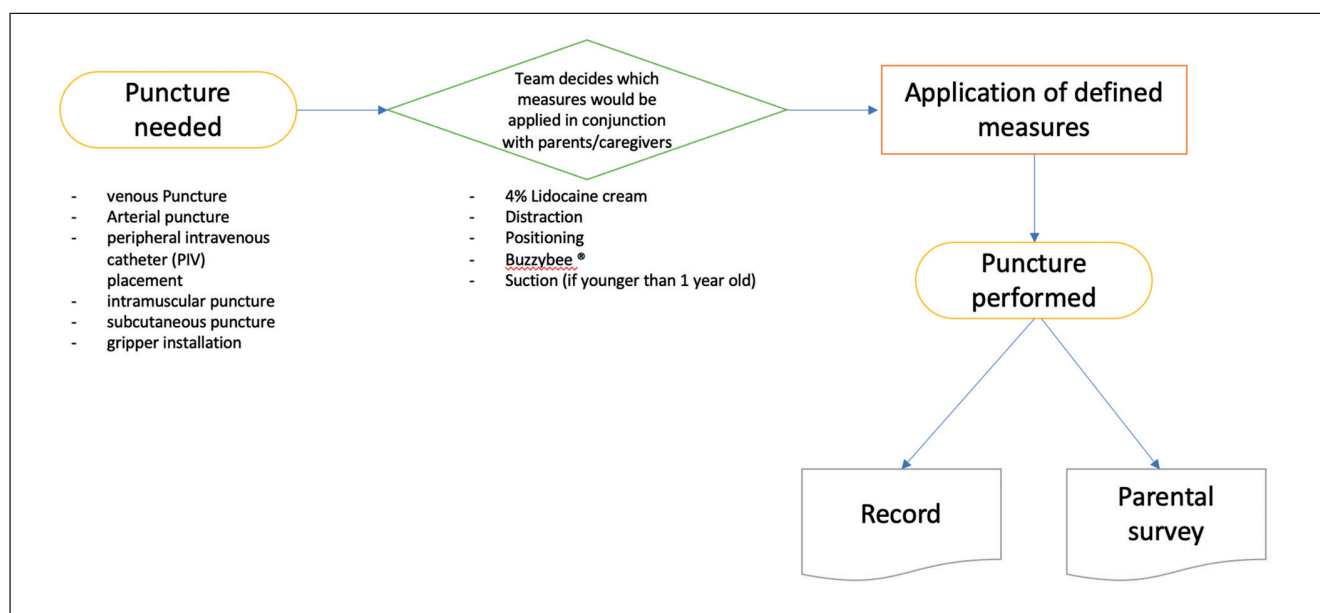


Figure 1. Process Map: measures applied to reduce pain associated to punctures.

Very good, 19% as Good, 7% as Sufficient, and none perceived it as Bad. In relation to the experience, 98% would apply the same techniques when faced with a new painful procedure.

Discussion

Our main finding is that the use of preventive measures for pain caused by punctures was associated with a positive behavioral response to the nociceptive stimulus, and a good appreciation of these by parents and caregivers, who would replicate the experience for future punctures.

Although the international literature shows the effectiveness of various strategies to reduce pain associated with punctures, their systematic and multimodal implementation is scarcely reported in Latin America. Zunino, et al.⁶ report that punctures are the major cause of pain accounting for 48.5% of patients. Spanish guidelines on pain management in small procedures in pediatrics recommend a multimodal approach involving pharmacological and non-pharmacological elements, but there are no studies to support these recommendations. This reaffirms the importance of having local experiences regarding implementation models to address these challenges and share strategies that can facilitate their application in diverse settings. The experience detailed in this study is an initial approach to how these recommendations can be included.

The frequency of use of topical lidocaine in this series is high when compared with that published by Rosemberg et al who, through quality improvement strategies, managed to increase its use from 10% to

36.5%³⁵. The high frequency of use in our series of patients is due to its easy applicability and safety.

The frequent use of distraction is explained by the ease of access to audiovisual media, such as cell phones, television, toys, or others, allowing parents/caregivers to be involved in the procedure, which projects it as a viable and widely accepted pain management method. The study published by Ballard et al. demonstrated the effectiveness of its use, showing that both parents and the nursing team considered it useful, improving the hospital experience²¹.

The Buzzy Bee® device (cold and vibration) had a low frequency of use, which we attribute to the difficulty it generates for palpation of anatomical structures, associated with the local vasoconstrictor effect of cold, which can make venous punctures difficult, although it has a greater role in intramuscular punctures (e.g., vaccines).

When comparing the scales applied, both show a low percentage of pain, suggesting that the application of measures allows the maintenance of a comfortable environment for the patient. The parent/caregiver survey reflects positive attitudes towards the use of the measures although it limits the generalization of this conclusion given that we do not have evaluations before the introduction of these measures. However, the positive perception of pain compared with previous procedures reaffirm the lower pain with the introduction of these measures. Although this question is qualitative and may be influenced by various factors, including recall bias, by reflecting a parental perception, it captures the impact that these measures may have on the subjective experience of hospitalization.

The flexibility of the various strategies used re-

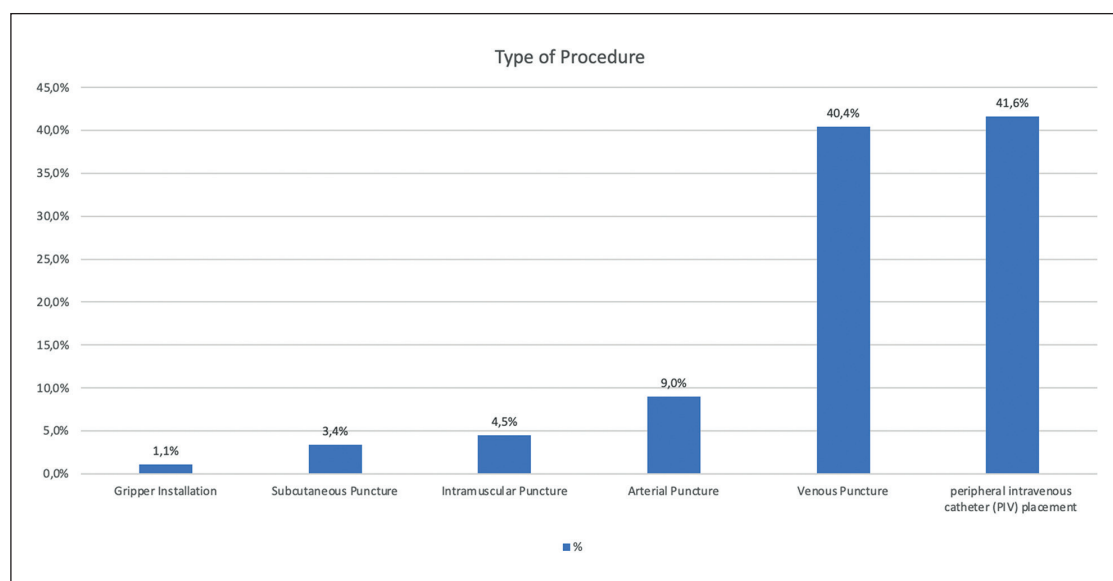


Figure 2. Procedure Performed.

Table 1. Measures applied to prevent pain associated to punctures in minor procedures

Measure	Procedure (n = 89)	Percentage
4% Lidocaine topical cream	67	75%
Distraction	65	73%
Positioning	54	61%
Buzzybee®	32	36%
Distraction with childcare assistant	3	3%
Non-nutritive suction in children younger than 1 year of age (n=33)	19	58%*

*non-nutritive suction only applicable to children younger than one year of age.

Table 2. Categorization of procedural pain as per Frankl scale

Positive	Procedure (n = 82)	Percentage
Mild Positive	36	44%
Mild Negative	24	29%
Negative	18	22%
Negativa	4	5%

Table 3. Categorization of procedural pain as per CHEOPS

Categorización	Procedure n = 67	Percentage
No pain	6	9%
Mild pain	46	69%
Moderate pain	13	19%
Intense pain	2	3%

flects the actual practice. Various factors may affect the decision to apply certain measures in a determined procedure over others. By not standardizing the application of all measures to all patients but leaving it to the discretion of the team in charge of the procedure, better results could have been achieved with a strict application of all measures. In these cases, the registry is relevant to detect which are the least used and, in the future, to explore potential opportunities for improvement. For example, only 58% of children under one year of age received non-nutritive suctioning, which is a therapeutic tool with clinical utility²⁴⁻²⁷. Increasing the frequency of using this measure is one of the possible improvements that could be considered after analyzing our results.

Regarding the limitations of our study, we can mention that, first, the sample size reduces the generalizability of the results, considering that the sampling method was by convenience and did not include all the procedures performed in the unit and that not all the parents/caregivers were surveyed. In addition, there could be a selection bias, including patients who may eventually be more cooperative and in less stressful scenarios, leading to more favorable results. Second, this protocol was applied in a pediatric intermediate care unit of a high-complexity hospital, which could also affect the generalization of the conclusions to other settings. Finally, being a descriptive study, it is

difficult to avoid the placebo effect generated by the knowledge that some additional pain management measure derived from the procedure is being received. The greatest challenge would be to carry out prospective studies with a larger number of patients, which would allow us to confirm the findings of this study. However, the easy accessibility and low cost associated with its implementation make its use attractive based on the available evidence.

Conclusions

The application of different measures for puncture pain management is associated with favorable pain measurement scores and positive parent/caregiver appraisals compared with previous experiences. The use of standardized protocols that include both pharmacological and non-pharmacological pain management methods allows for a favorable experience for patients and their parents/caregivers. This study lays the groundwork for future research to evaluate the impact of implementing protocols in different hospital settings and to increase the use of interventions while maintaining a multimodal approach. These results should also motivate different centers to include these elements in pediatric units to allow access to a greater number of hospitalized patients equitably. The

sustainability over time of the application of these measures should also be studied in the future. Puncture-associated pain management has the potential to be a small but significant step toward improvements in the pediatric hospitalization experience for both patients and their parents/caregivers.

Ethical Responsibilities

Human Beings and animals protection: Disclosure the authors state that the procedures were followed according to the Declaration of Helsinki and the World Medical Association regarding human experimentation developed for the medical community.

Data confidentiality: The authors state that they have followed the protocols of their Center and Local regulations on the publication of patient data.

Rights to privacy and informed consent: The authors have obtained the informed consent of the patients

and/or subjects referred to in the article. This document is in the possession of the correspondence author.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

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