EMERGENCIAS Pediátricas

(ENGLISH EDITION)

Vol. 3 | No. 1 | 2024

ergon

SEUP
SOCIEDAD ESPAÑOLA DE URGENCIAS DE PEDIATRÍA

EMERGENCIASPediátricas

Vol. 3. No. 1. January - April 2024

EDITORIAL BOARD

Edit:
ergon
C/ Arboleda, 1. 28221 Majadahonda (Madrid)

Electronic ISSN: 3020-8661

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Cover design: Gemma Fernández y Carlos Fábrega. *Servei Mitjans Audiovisuals. Hospital Sant Joan de Déu. Barcelona.*

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Vol. 3. No. 1. January - April 2024

Summary / *Sumario*

SEUP
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SCIENTIFIC LETTERS / *CARTA CIENTÍFICAS*

SEUP
SOCIEDAD ESPAÑOLA DE URGENCIAS DE PEDIATRÍA

EMERGENCIASPediátricas
Vol. 3. No. 1. January - April 2024

Emerg Pediatr. 2024; 3(1): 1-3

EDITORIAL

What is the role of Pediatric Emergency Departments in a Hospital-at-Home program? Is it a current priority for pediatric emergencies?

Abel Martínez Mejías[1], Paula Vázquez López[2]

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On November 27th, the Spanish Society of Pediatric Emergency Medicine (SEUP) held its traditional SENIOR day. The conference was attended by a total of 42 pediatricians recognized for their contributions to Pediatric Emergency Departments (PEDs), the scientific community, or their expertise in the field. The objective was to explore the significance of a Hospital-at-Home (HaH) program and its impact on patients, families, and PEDs. The discussion aimed to determine whether an HaH program should be regarded as a strategic initiative by the SEUP and a direction for PEDs to pursue.

After delving into the theoretical aspects of the subject, we aimed to discuss the following four basic questions:

- Is it possible to implement an HaH Unit through a PED?
- Which patients can be admitted to an HaH program directly from a PED?
- Is coordination between the HaH team and the PED feasible?
- What priorities should PEDs have for the implementation of an HaH program?

IMPLEMENTATION OF AN HaH PROGRAM

Hospital at Home[(1)] emerged with the objective of providing care for patients, including those with acute or chronic conditions experiencing exacerbations, in their own homes—patients who would traditionally have been admitted to a hospital. An HaH program is a resource that offers patients and their families an alternative to conventional hospitalization.

The World Hospital at home community defines HaH as "an acute clinical service that takes staff, equipment, technologies, medication, and skills usually provided in hospitals and delivers that hospital care to selected people in their homes...". It is not to be confused with a hospital prevention program, primary care check-ups, or specialized outpatient follow-up.

This innovative alternative in healthcare brings benefits to the child, the family, and the health care system and attempts to:

- Improve the quality of life of patients and their families through a comprehensive biopsychosocial approach (providing humanization and promoting well-being, health education, and better doctor-patient/family communication).
- Ensure safety (by reducing risks associated with hospitalization).
- Enhance efficiency (by providing greater economic and resource management benefits)[(2)].
- Avoid the negative emotional and behavioral impacts that conventional hospitalization may cause, both immediately and in the long term, particularly in the pediatric age group[(3,4)].
- Increase family empowerment and understanding of the disease, providing greater security, comfort and, overall, a more humanized care experience.

An HaH program should be developed by a multidisciplinary team consisting of pediatricians and nurses with experience in conventional hospitalization. The program should be integrated within the general care activity of the hospital from its start, supported by specialists, and establish strong interrelationships and partnerships with other services. Additionally, it will require the cooperation of families and caregivers (identifying and training a responsible caregiver before admission will be crucial in every aspect). All partic-

Received on April 12, 2024
Accepted on April 12, 2024

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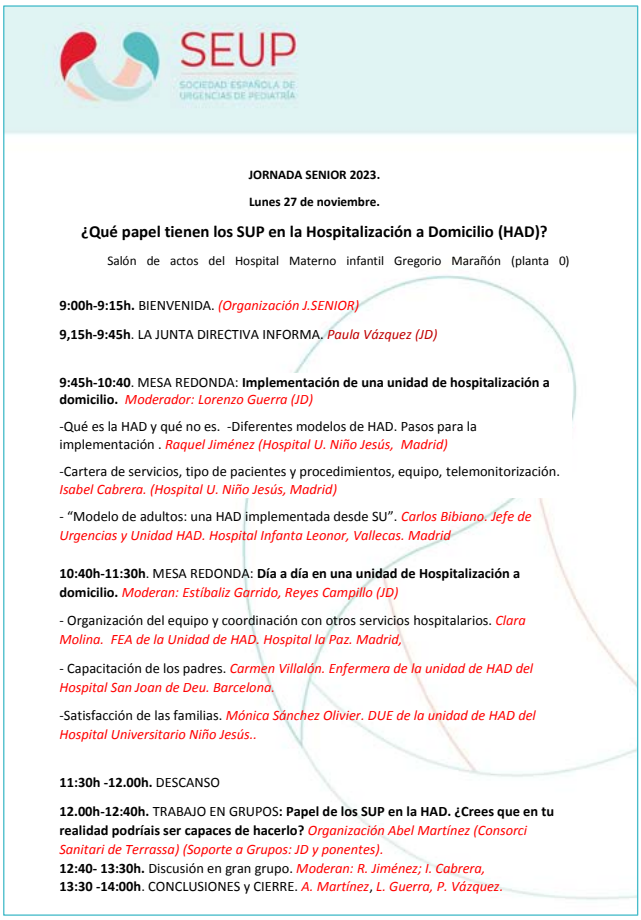

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JORNADA SENIOR 2023.

Lunes 27 de noviembre.

¿Qué papel tienen los SUP en la Hospitalización a Domicilio (HAD)?

Salón de actos del Hospital Materno infantil Gregorio Marañón (planta 0)

9:00h-9:15h. BIENVENIDA. *(Organización J.SENIOR)*

9,15h-9:45h. LA JUNTA DIRECTIVA INFORMA. *Paula Vázquez (JD)*

9:45h-10:40. MESA REDONDA: **Implementación de una unidad de hospitalización a domicilio.** *Moderador: Lorenzo Guerra (JD)*

-Qué es la HAD y qué no es. -Diferentes modelos de HAD. Pasos para la implementación . *Raquel Jiménez (Hospital U. Niño Jesús, Madrid)*

-Cartera de servicios, tipo de pacientes y procedimientos, equipo, telemonitorización. *Isabel Cabrera. (Hospital U. Niño Jesús, Madrid)*

- "Modelo de adultos: una HAD implementada desde SU". *Carlos Bibiano. Jefe de Urgencias y Unidad HAD. Hospital Infanta Leonor, Vallecas. Madrid*

10:40h-11:30h. MESA REDONDA: **Día a día en una unidad de Hospitalización a domicilio.** *Moderan: Estíbaliz Garrido, Reyes Campillo (JD)*

- Organización del equipo y coordinación con otros servicios hospitalarios. *Clara Molina. FEA de la Unidad de HAD. Hospital la Paz. Madrid.*

- Capacitación de los padres. *Carmen Villalón. Enfermera de la unidad de HAD del Hospital San Joan de Deu. Barcelona.*

-Satisfacción de las familias. *Mónica Sánchez Olivier. DUE de la unidad de HAD del Hospital Universitario Niño Jesús..*

11:30h -12.00h. DESCANSO

12.00h-12:40h. TRABAJO EN GRUPOS: **Papel de los SUP en la HAD. ¿Crees que en tu realidad podríais ser capaces de hacerlo?** *Organización Abel Martínez (Consorci Sanitari de Terrassa) (Soporte a Grupos: JD y ponentes).*
12:40- 13:30h. Discusión en gran grupo. *Moderan: R. Jiménez; I. Cabrera,*
13:30 -14:00h. CONCLUSIONES y CIERRE. *A. Martínez, L. Guerra, P. Vázquez.*

FIGURE 1.

ipants in the program should clearly understand their roles and perceive themselves as part of a unified effort.

LET'S TALK ABOUT THE PATIENTS

The screening and selection of HaH patients is usually carried out jointly by physicians and nurses from the HaH and conventional hospitalization teams. Patients who are candidates for HaH are usually admitted to the hospital or come directly from the PED; in the latter case, PED pediatricians should be involved and be in charge of screening candidate patients and managing referral to the HaH program. The most common conditions of pediatric acute patients in an HaH setting include acute respiratory diseases and parenteral antibiotic therapy for certain bacterial infections, such as cellulitis, urinary tract infection/pyelonephritis, infected eczema, pneumonia, and lymphadenitis.

The criteria for a PED patient to be eligible for entry into an HaH program should include:

- A clear diagnosis.
- Adequate patient conditions: clinical (acute but stable disease), social and geographic (distance, accessibility).
- Treatments that allow for referral to the program, together with family compliance and education, including once or twice/day treatment administrations (e.g., ceftriaxone and gentamicin) or short interventions.
- Minimal risk of serious/urgent complications that are rapidly and safely resolved (e.g., septic shock, hypoxemia).
- Supervision by parents/caregivers who accept the care plan, in a "home-like" environment that is gentle and familiar to the child.

Home treatment does not appear to be less safe than hospital treatment[5,6]. Studies show that the programs are satisfactory for patients and families and less costly per episode than inpatient treatment (by 30-75%).

The training of patients and especially caregivers is a fundamental requirement and is usually performed by the nurses of the HaH program. Ensuring care, proper patient follow-up, and clinical stability is imperative. The schedule of in-person visits (medical and/or nursing visit) should be flexible and adapted to the conditions. Telephone or telemedicine support should be provided to the families whenever possible (ideally 24/7). In necessary cases, the PED could be a good resource to complement the ongoing care of the patients. Coordination with other hospital services is essential.

LET'S TALK ABOUT COORDINATION

In addition to accurately selecting patients, the success of the program's implementation depends on having competent, motivated, trained, and adaptable healthcare professionals, establishing a network with adequate circuits within the healthcare center and throughout the territory, and promoting effective communication and coordination among the various services and levels of care involved.

PEDs and HaHs should establish collaboration systems and circuits for patient transfer or referral. It must be ensured that the patient's condition permits it, that there is proper planning, and that the family consents. The benefits and limitations of each option should be clearly understood and evaluated; healthcare teams should make collaborative decisions to ensure a rational use of resources, which, although limited in time, can provide greater comfort and well-being for patients and families.

The factors to consider for the implementation and operation of an HaH program should include a series of more "internal" aspects, such as those related to the team (who, what training) or to the patients (inclusion/exclusion criteria, origin, age, disease, need for complementary tests, risk of incidents), or what resources are available (financing, telemonitoring, types of therapies), and other more "external" aspects involving other departments, such as the service portfolio (number of patients to be treated, maximum mean length of stay, hours of care, and care modalities), the interrelations between specialties and other units (pharmacy, admissions, radiology, laboratory, primary care, and the 112 emergency system), responsibility assignment, patient transportation circuits, or other aspects that should involve the hospital direction and management, such as program design, training, and fostering a culture of HaH.

PRIORITIES FOR A PED TO START AN HaH PROGRAM

The SEUP is a national society representing and involving the majority of Spanish PEDs. One of its notable features is its significant heterogeneity, evident in its diverse composition,

organization, and even geographical locations (urban/rural; differences in levels of care; number and specialty of human resources; belonging to exclusively pediatric hospitals; autonomy of pediatric emergency units, etc.). This diversity presents challenges for developing and implementing unified plans.

Currently, PEDs are engaged in the analysis and improvement of their own needs and significant deficits impacting daily pediatric care persist and are considered a priority. An HaH program that depends on pediatric emergency care will require different resources and partnerships, many of which the PEDs presently lack. Consequently, although the implementation of an HaH program from the PEDs is recognized as an important opportunity to improve the quality of care, it does not appear feasible for the majority of PEDs at this time, nor is it considered as a current strategic direction of the SEUP as a society.

Nevertheless, and for the benefit of the patients, their families, and the improvement of the quality of care, SEUP acknowledges the need to raise awareness on the subject, to promote the culture of HaH, to encourage partnerships, and to provide information and support to those PEDs that, due to their capacity and circumstances, prioritize HaH programs.

IN CONCLUSION

In pediatrics, HaH is an adequate alternative resource and equivalent to conventional hospitalization; it is efficient, safe, and greatly satisfying for both users and healthcare teams.

HaH requires an expert and multidisciplinary team, a specific patient selection process, and the involvement of family members and caregivers.

Interrelationships, partnerships, hospital involvement, and coordination between levels of care are essential to implement an HaH program.

Previous experiences both in adult and pediatric settings support the feasibility of implementing an HaH program from an emergency department; however, due to the amount and variability of resources and coordination required, the process should be tailored to the specific circumstances of each PED.

REFERENCES

1. Batlle A, Aldemira A, Agúndez B, Cabrera I, Esquerdo E, López S, et al; Grupo de Trabajo de Hospitalización a Domicilio de la SEPIH. Home hospitalization of the acute patient: a new approach to care. An Pediatr (Engl Ed). 2023; 99(5): 329-34.
2. Bibiano Guillén C. Direct admission to home hospitalization from the emergency department: feasible, efficient, and necessary. Emergencias. 2023; 35(3): 163-4.
3. Brennan TA, Leape LL, Laird NM, Hebert L, Localio AR, Lawthers AG, et al. Incidence of adverse events and negligence in hospitalized patients. Results of the Harvard Medical Practice Study I. N Engl J Med. 1991; 324(6): 370-6.
4. De Mula-Fuentes B, Quintana M, Rimbau J, Martínez-Mejías A, Úriz MS, Rivera-Pérez C, et al. Anxiety, hospital fears and conduct and behavioral alterations during pediatric hospitalization. Actas Esp Psiquiatr. 2018; 46(2): 42-50.
5. Bryant PA, Katz NT. Inpatient versus outpatient parenteral antibiotic therapy at home for acute infections in children: a systematic review. Lancet Infect Dis. 2018; 18(2): e45-54.
6. Norris AH, Shrestha NK, Allison GM, Keller SC, Bhavan KP, Zurlo JJ, et al. 2018 Infectious Diseases Society of America Clinical Practice Guideline for the Management of Outpatient Parenteral Antimicrobial Therapy. Clin Infect Dis. 2019; 68(1): e1-35.

SEUP
SOCIEDAD ESPAÑOLA DE URGENCIAS DE PEDIATRÍA

EMERGENCIASPediátricas
Vol. 3. No. 1. January - April 2024

Emerg Pediatr. 2024; 3(1): 4-8

ORIGINAL

Firearm injuries seen at a Pediatric Emergency Department in Uruguay

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Received on March 27, 2023
Accepted on October 27, 2023

Key words:
Injuries
Firearms
Children
Emergencies

Abstract

Firearm injury (FAI) is a growing concern in the pediatric population. In 1995, the first data on severe FAI in Uruguayan children were published, revealing a predominantly male distribution with a mean age of 14, and mostly occurring as unintentional incidents in the home. In 2012, a second case series identified a change in the profile of these injuries, now predominantly affecting male adolescents with a mean age of 13, occurring in violent circumstances outside the home. A considerable increase in FAI was observed at the same center.

Objectives: To describe the characteristics of FAI seen at the Pediatric Emergency Department (PED) of Centro Hospitalario Pereira Rossell (CHPR) over a 5-year period and to compare cases of severe FAI with data from a historical cohort seen at the same PED.

Methods: A descriptive, retrospective, cross-sectional study was conducted including patients < 15 years seen at PED-CHPR. Data source: Electronic medical records. We analyzed age, sex, circumstances surrounding the incident, location of injury, destination from PED, and severity.

Severe FAI was defined as requiring admission to intensive care or emergency surgery. Circumstances of the incident were categorized as intentional or unintentional (projectile not intentionally directed at the victim).

The research protocol was registered with the Ministry of Health and submitted to the Institutional Ethics Committee for approval. For statistical analysis EPIINFO 7 was used.

Results: 66 cases were included; 55 of whom were males. Mean age was 12 years. Overall, 38 cases occurred outside the home. Circumstances were intentional in 24, and unintentional in 21, weapon manipulation in 3, and unknown in 18. Of the cases, 40 were mild and 26 severe among a total 25,9974 visits to this PED.

Destinations after treatment at the PED were moderate care in 19, home in 21, intensive care or operating room in 25, and the morgue in 1. Two patients died.

Conclusions: The reported profile remained consistent, characterized by a predominance of underage male adolescents involved in violent situations outside the home. An increase in severe FAI is observed in this population.

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Palabras clave:
Lesiones
Arma de fuego
Niños
Urgencias

HERIDAS POR ARMA DE FUEGO ASISTIDAS EN UN DEPARTAMENTO DE EMERGENCIA PEDIÁTRICA EN URUGUAY

Resumen

Las heridas por arma de fuego (HAF) constituyen un problema en la población pediátrica. En 1995 se publicaron los primeros datos sobre HAF graves en niños uruguayos, presentándose mayoritariamente en varones, media 14 años, predominando mecanismo no intencional en domicilio.

En 2012, una segunda serie, observó cambio de perfil en las circunstancias de estas lesiones: adolescentes varones, media 13 años, contextos violentos, extradomicilio.

Se percibe un incremento de las HAF en el mismo centro.

Objetivos: *Describir las características de consultas por HAF, durante un período de 5 años, Departamento de Emergencia Pediátrica (DEP), Centro Hospitalario Pereira Rossell (CHPR).*

Comparar las HAF graves con datos previos del mismo DEP.

Metodología: *Estudio descriptivo, retrospectivo. Población: < 15 años asistidos en DEP-CHPR. Fuente de datos: historia clínica electrónica. Variables: edad, sexo, circunstancias del evento, sitio de lesión, destino desde DEP, severidad.*

HAF grave: ingreso a Cuidados Intensivos o Cirugía de Emergencia. Circunstancia del evento: intencional, no intencional (proyectil no dirigido voluntariamente a la víctima). Se registró el protocolo de investigación en el Ministerio de Salud. Se presento al Comité de Ética de la Institución.

Análisis estadístico: programa EPIINFO 7.

Resultados y discusión: *n= 66. Varones: 55/66. Media edad: 12 años. Extradomiciliario 38/66. Circunstancias: 24 intencional-violencia, 21 no intencional-violencia, 3 manipulación arma, 18 desconocida. Severidad: leves 40, severas 26. Hubo 26 HAF graves para un total de 259.974 consultas en este DEP. Destino: 19 cuidados moderados, 21 domicilio, 25 cuidados intensivos o quirófano, 1 morgue. Dos fallecidos.*

Conclusiones: *Se mantiene el perfil reportado previamente, predominando adolescentes varones, situaciones violentas, extradomicilio, menor edad.*

Se evidencia aumento de las HAF graves en esta población.

INTRODUCTION

Firearm injuries (FAI) are currently an increasing problem in the pediatric population worldwide, and one of the leading causes of death in the pediatric population in the United States, ranking between the first and third cause[1-5]. What was once considered an unusual and dramatic event is now a situation that pediatricians face relatively frequently at the pediatric emergency department (PED).

In recent years, there has been a steady increase in the number of FAI occurring in violent circumstances. The greater and easier access to weapons for adults, children and adolescents, inadequate control of arms possession by authorities, smuggling, criminal activities, addictions, the need for security and the growing violence in society are factors that are described as contributing to these injuries[1-10].

FAI pose a burden on healthcare systems and cause morbidity and mortality at all ages. In 2010 in the United States, it was estimated that the total cost (medical costs and decreased productivity) of all FAI in children under 18 years of age exceeded $3.6 billion. The hidden costs of FAI are reflected in the fear and worry that is experienced in suburban neighborhoods where the majority of the population lives below the poverty line. The serious consequences of these events range from death to both functional and psychological consequences, not only for the victims themselves, but also for those who witness these acts of violence.

In the United States, firearm injuries are observed to be more common in violent contexts in schoolchildren and adolescents of African and American descent in suburban neighborhoods of low socioeconomic levels[2-4]. Non-fatal injuries are twice as common as fatal injuries. Most injuries and deaths occur in violent circumstances[5].

Regarding unintentional cases, although they are less frequent than intentional ones, the vast majority involve young children at home who are shot by a family member carrying a weapon or by another minor during play[2]. The true impact of unintentional FAI is unknown and difficult to characterize due to underreporting[2].

Prevention strategies are essential to reduce the impact of FAI on the population. Gun ownership in the home is associated with increased risk of homicide, suicide, and unintentional injuries[1,3-7].

In Uruguay, according to the latest data published by the National Arms Registry - Arms and Weapons Service (RNA-SMA), there is one weapon for every six Uruguayan citizens, of which 89% are owned by civilians[11].

Access to firearms increases the risk of peer violence and the risk of suicide. Nearly half of the suicides in males aged 14-19 years and 20% of suicides in females of the same age are associated with firearms[1,4].

Pediatricians have the opportunity to get involved in this issue through primary prevention by discouraging the presence of weapons in the home and identifying groups exposed to violent situations where individuals may be injured, either voluntarily or involuntarily[1,3-5,8].

Secondary prevention and timely and appropriate treatment once an injury has occurred are part of the necessary skills of every physician caring for children in the PED[4,12].

The first data on severe FAI in Uruguayan children were published in 1995, in a study conducted at the (PED) of the Centro Hospitalario Pereira Rossell (CHPR), Montevideo, Uruguay, a third level pediatric hospital. At that time, FAI occurred more frequently in males, with a mean age of 14 years, and mostly as unintentional incidents at the home[13].

In 2012, a second series was studied at the same center, recording a frequency of one severe FAI every 18,567 consultations. The profile of the adolescent male was maintained, with a decrease in the mean age (13 years) and a change in the setting, as most of them occurred in violent circumstances outside the home[9].

In recent months, a sustained increase in FAI has been observed in society and healthcare centers across the country. Ten years after the last publication, an update study on these injuries was conducted at the same PED.

PRIMARY OBJECTIVE

To describe the characteristics of consultations for FAI at the DEP-CHPR in Montevideo, Uruguay between 2016 and 2020.

SECONDARY OBJECTIVE

To compare severe FAI cases with data from a historical cohort seen at the same PED.

MATERIALS AND METHODS

A descriptive, retrospective study was conducted. Patients under 15 years of age who were seen at the PED-CHPR for FAI between January 1, 2016, and December 31, 2020, were included. Electronic medical records were reviewed.

The following variables were included: age (quantitative), sex, circumstances surrounding the incident, location of injury, patient destination from the PED, and severity (qualitative).

Severe FHA was defined as those requiring admission to intensive care or emergency surgery.

Circumstances surrounding the incident were categorized as intentional (aggression by third parties) or unintentional (projectile not intentionally directed at the victim, individual located in the line of fire), without a context of intentional injury (self-harm), and without a context of unintentional injury (unintentional firearm manipulation). Continuous variables are described as mean, median, and ranges, and discrete variables as absolute and relative frequencies. The chi-square test was used for the comparison of proportions. A $p< 0.05$ was considered statistically significant.

TABLE 1. Population characteristics and incident circumstances. DEP-CHPR 1/1/2016 – 31/12/2020.

Variable	Category	AF (n= 66)	RF
Sex	Male	55	83%
	Female	11	17%
Age	Mean	12 years	
	Median	13 years	
	Range	1-14 years	
Setting	Home	17	26%
	Outside the home	38	57.4%
	Unknown	11	16.6%
Circumstances	Intentional injury	23	35%
	Unintentional injury	21	32%
	Intentional self-harm	1	1.5%
	Unintentional non-violent	3	4.5%
	Unknown	18	27%

The presentation "10 years of severe firearm injuries" (period: 2002-2011) was considered for comparison[7].

The research protocol was registered with the Ministry of Health and submitted to the Institutional Ethics Committee for approval. EPIINFO 7 statistical software was used for data processing and statistical analysis.

RESULTS

A total of 66 patients with FAI were included, and their demographic characteristics are presented in Table 1. The overall mean age was 12 years, with a median of 13 years (range 1 to 14). The mean age of children with intentional FAI was 13 years, while the mean age of children with unintentional FAI was 11 years. The details of the lesions are provided in Table 2.

In 41 patients (66%), the initial care was provided at a primary care center. The following location of severe FAI was observed: upper-lower limb vascular bundles in 5 (19%), thorax in 4 (15%), abdomen in 5 (19%), head and neck in 8 (31%), fractures in 3 (11%), and skin and soft tissues (pelvis) in 1 (4%). The incidence rate of severe FAI during this period (n= 26) was 1 in 10,000 consultations.

Two deaths were recorded: one due to thoracic injury with subsequent hemorrhagic shock in the PED and the second due to severe head injury resulting in death in the operating room. Severe FAI in this period was compared with that of the period 2002-2011. The results are presented in Table 3.

DISCUSSION

FAI have become a serious health concern in children. In our study, changes were observed compared to previous studies, showing an increase in severe FAI compared to

TABLE 2. Injury characteristics. DEP-CHPR 1/1/2016 – 31/12/2020.

Variable	Category	AF	RF
Location	Limbs	39	59%
	Head and neck	13	20%
	Thorax	7	11%
	Abdomen	3	4,5%
	Pelvis	1	1,5%
	More than one location	3	4.5%
Severity	Mild	40	61%
	Severe	26	39%
Destination (on PED discharge)	Intensive care/surgery room	25	38%
	Home	21	32%
	Intermediate care	19	29%
	Morgue	1	1,5%
Final outcome	Discharge from hospital	64	97%
	Death	2	3%

the previous study, from 1/18,567 to 1/10,000 visits (p 0.01) in the same PED. A breakdown of the 2002-2011 period already showed this trend, with a frequency at the beginning of the period of 1/19,643 visits and at the end of the period of 1/12,250 visits. This finding is consistent with that reported worldwide[1-5,8,9].

Similar to findings by other national and international studies, these lesions were more common in male adolescents[1,3,8-10,13]. The present study shows a sustained decrease in the mean age of the population, based on the findings of previous studies in the same PED[9,13]. It was observed that patients who suffered unintentional injuries were younger than those who suffered intentional injuries, coinciding with the findings of other studies[1,2,5,8].

The 1995 report found that FAI occurred within the home, mostly linked to the possession of weapons in the home and in unintentional circumstances[13].

The second series documented changes in the circumstances and locations of events. The most common scenario differed, with an increase in FAI occurring in violent situations outside the home, accounting for 43%, while unintentional incidents accounted for 21% of cases[9]. In the present study, a statistically significant increase in violent incidents was observed, reaching 68.5% (p< 0.02), while non-violent incidents decreased to 4.5% (p< 0.03). This phenomenon is observed globally and may be attributed to various socio-cultural and economic factors, including the worldwide production and trade of arms, inadequate control of arms possession by authorities, smuggling, criminal activities, and a sense of security associated with firearm ownership, among others[2-7].

Although less frequent, when comparing FAI with other injuries, the former are often more severe with a higher rate of hospital admissions[2]. In our study, more than one third of the FAI were severe, resulting in death in 2 patients. Two-thirds of the patients required hospital admission, with the majority being admitted to intensive care. In the United States, although FAI constitutes a small proportion of the total reasons for emergency department visits, the death rate is higher among children under 15 years compared to other industrialized countries[3,5,14].

Regarding the location of severe FAI, injury to the head, neck, thorax, and abdomen predominated in previous studies and international publications[9,10]. Nevertheless, in our series, severe lesions in the limbs were the most common, accounting for 31% (p 0.03).

Previous data on initial prehospital care were lacking. In the present study, 41 of the 66 patients received their first care at peripheral centers. While this allows for initial stabilization, the available resources, infrastructure, and limited human resources make it unfeasible to aim for definitive treatment. In many cases, the goal should be limited to initial stabilization, injury control, and timely transfer under favorable conditions. Pre-hospital care and transfer should take into account the need for blood transfusion and early surgical treatment, resources that are unavailable in peripheral care centers in Uruguay. International guidelines for the initial care of patients with FAI recommend rapid transfer of these patients to a tertiary care center.

TABLE 3. Characteristics of severe FAI. DEP-CHPR 1/1/2016 – 31/12/2020.

Variable	Category	2002-2011 (n= 34)	2016-2020 (n= 26)	P
Age	Mean	13 years	12 years	NS
Sex	Male	73%	83%	0.30
	Female	27%	17%	
Frequency		**34/631244 visits**	**26/241984 visits**	**0.01**
		(1/18,567)	(1/10,000)	
Setting	Home	30%	26%	0.41
	Extra-domicile	70%	57,4%	
Circumstance	**Violent**	**43%**	**68.5%**	**0.02**
	Non-intentional/non-violent	**21%**	**4.5%**	**0.03**
	Unknown	36%	27%	0.34
Injury location	**Head/neck**	**21 (50%)**	**8 (31%)**	0.01
	Thorax/abdomen	17 (40%)	9 (34%)	0.06
	Limbs	**4 (10%)**	**8 (31%)**	0.03
	Pelvis	0	1 (4%)	
Deaths		4	2	0.32

The weakness of this study is that it is a retrospective study, conducted at a single center; however, the DEP-CHPR is a national public pediatric referral center.

CONCLUSIONS

There is evidence of a sustained increase in severe FAI in the population assisted at the DEP-CHPR. The predominant profile continues to be male adolescents, with an increase in violent incidents outside the home. The age of the victims continues to decrease.

Despite the aforementioned weaknesses in this study, it is important to note that the DEP-CHPR is a national public pediatric referral center, making our findings a valuable contribution to the understanding of this type of injuries.

Primary and secondary prevention strategies should take into account these aspects to enhance the impact on this growing health issue.

REFERENCES

1. Fowler K, Dahlberg L, Haileyesus T, Gutierrez C, Bacon S. Childhood Firearm Injuries in the United States. Pediatrics. 2017; 140(1): e20163486.
2. Barry W, Barin E, McLaughlin C, Strumwasser A, Shekherdimian S, Arbogast H, et al. Pediatric firearm injuries in Los Angeles County: Younger children are more likely to be the victims of unintentional firearm injury. J Pediatr Surg. 2019; 54(2): 350-3.
3. Bernardin E, Spectorsky K, Gu H, Fairfax C, Cutler K. Child Firearm Injury Circumstances and Associations With Violence Intervention Program Enrollment. Pediatr Surg. 2023; 285: 67-75.
4. Kaufman E, Richmond T, Hoskins K. Youth Firearm Injury A Review for Pediatric Critical Care Clinicians. Crit Care Clin. 2023; 39(2): 357–71.
5. Naik-Mathuria B, Cain C, Alore E, Chen L, MS†, Pompeii L. Defining the Full Spectrum of Pediatric Firearm Injury and Death in the United States. Ann Surg. 2023; 278(1): 10-6.
6. Gill AC, Wesson DE. Firearm injuries in children. Prevention. 2014; 2015: 1-13.
7. Cosío Lima L, Gamíz González R, Cosío Pascal M. Herida penetrante del tórax por un proyectil de arma de fuego localizado inicialmente en el ventrículo izquierdo y luego en la arteria renal derecha. Acta Med. 2017; 15(1): 57-60.
8. Nordin A, Coleman A, Shi J, Wheeler K, Xiang H, Kenney B. In harm's way: Unintentional firearm injuries in young children. J Pediatr Surg. 2018; 53(5): 1020-3.
9. Mas M, Piñeir S, Parada M, Pizzorno E, Prego J. 10 años de heridas graves por armas de fuego en un hospital pediátrico. Presentado en 7º Congreso Argentino de Emergencia y Cuidados Críticos en Pediatría. (RPD10). 2014. https://www.sap.org.ar/docs/congresos/2014/emergencias/trabajos_libres.pdf
10. Dimitroff. A, Moscone. M, Parodi. V, Pujadas.M, Iglesias.D. Heridas por proyectil de armas de fuego en niños y adolescentes. Presentado en: XV Jornadas Integradas de Emergencia Pediátrica. Radisson Montevideo, Uruguay; 2019.
11. IELSUR. Menos armas, más seguridad. Aportes para la comprensión de la problemática de las armas de fuego en Uruguay. Observatorio de la Plata, banda oriental; 2015.
12. Bruner D, Gustafson C, Visintainer C. Ballistic Injuries In The Emergency Department. Emerg Med Pract. 2011; 13(12): 1-30.
13. Bello O, Mandalos D, Pizzorno E. Niños heridos por armas de fuego. Arch Pediatr Uruguay. 1995; 66(4): 27-30.
14. Rayes R, Dong C, Tovar Hirashima E. Pediatric firearm injuries to the extremity: management in the emergency department. Pediatr Emerg Med Pract. 2022; 19(8): 1-28.

SEUP
SOCIEDAD ESPAÑOLA DE URGENCIAS DE PEDIATRÍA

EMERGENCIASPediátricas
Vol. 3. No. 1. January - April 2024

Emerg Pediatr. 2024; 3(1): 9-18

ORIGINAL

Septic shock in children: are the SEPSIS-3 criteria applicable in the Pediatric Emergency Department? A multicenter study in Latin America

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Received on March 14, 2024
Accepted on April 16, 2024

Key words:
Sepsis
Shock septic
SEPSIS-3 definitions
Pediatric

Abstract

In adults, SEPSIS-3 proposed a new definition to identify sepsis in emergency departments. However, data are lacking regarding its application in children.

Objective: To determine the proportion of children presenting with septic shock (SSh) that met the SEPSIS-3 SSh criteria upon admission to the emergency department, and to compare the clinical course and mortality rates between the two groups.

Methods: We conducted a secondary analysis of data from a prospective multicenter study conducted between October 2019 and June 2021. We included children aged 30 days to 18 years from 10 Latin American centers. Demographic and clinical variables were collected. SSh was defined according to the SEPSIS-3 criteria as sepsis plus the use of vasopressors to maintain a mean arterial pressure of ≥ 65 mmHg and a serum lactate level > 2 mmol/L. To assess the mortality risk, a multivariate logistic regression model was used. The findings are reported as odds ratios (OR) with the corresponding 95% confidence intervals (CIs).

Results: Out of 219 children, 150 were included, 43 (29%) of whom met the SEPSIS-3 SSh criteria. The median age was 3.8 years (IQR, 1.2-11). No significant demographic differences were observed between the groups. However, we did identify significant differences in clinical markers of severity, including serum lactate levels and C-reactive protein (CRP). In the SEPSIS-3 SSh group, more patients required intubation in the emergency department (44% vs. 13%, p< 0.01), mechanical ventilation support in the pediatric intensive care unit (PICU) (61% vs. 22%, p< 0.01), and admission to the PICU (93% vs. 45%, p< 0.01). In addition, in the SEPSIS-3 SSh group we observed higher Sequential Organ Failure Assessment (SOFA) scores (median 8 [IQR 4-11] vs. 3 [IQR 1-5], p< 0.01), as well as increased mortality (36% vs. 4%, p< 0.01), with an OR for death of 17 (95% CI 5-63).

Conclusion: Children admitted to the emergency department with SSh who met the SEPSIS-3 criteria had higher rates of morbidity and mortality. The low proportion of patients with a positive quick SOFA score indicates its limited validity for early detection of sepsis.

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Palabras clave:

Sepsis
Choque séptico
SEPSIS-3
Niños

SHOCK SÉPTICO EN NIÑOS: ¿SON APLICABLES LOS CRITERIOS DE SEPSIS-3 EN URGENCIAS? UN ESTUDIO MULTICÉNTRICO EN LATINOAMÉRICA

Resumen

SEPSIS-3 propuso una nueva definición para identificar adultos con sepsis en Urgencias. En niños, los datos son escasos.

Objetivo: *Describir cuántos niños con shock séptico (ShS) cumplieron el criterio de ShS de SEPSIS-3 al ingreso a Urgencias y comparar evolución clínica y mortalidad.*

Métodos: *Análisis secundario de estudio multicéntrico prospectivo (10/2019-06/2021). Incluimos niños de 30 días a 18 años. Participaron 10 centros latinoamericanos. Recolectamos variables epidemiológicas y clínicas. Definimos ShS según SEPSIS-3 como sepsis más uso de vasopresores para mantener la presión arterial media ≥ 65 mmHg y lactato > 2 mmol/L. Para evaluar riesgo de muerte, realizamos un modelo de regresión logística multivariado. Informamos OR e IC95, consideramos significativa p< 0,05.*

Resultados: *De 219 niños, incluimos 150. Cumplieron el criterio de ShS de SEPSIS-3 43 (29%). Mediana de edad 3,8 años (RIC 1,2-11). No encontramos diferencias epidemiológicas entre grupos. Observamos diferencias en los marcadores clínicos de gravedad, niveles de lactato y PCR. El grupo ShS SEPSIS-3 demandó mayor necesidad de intubación en Urgencias (44% vs. 13%, p< 0,01), requerimiento de asistencia ventilatoria mecánica en Cuidados Intensivos (UTIP) (61% vs. 22%, p< 0,01) e ingreso a UTIP (93% vs. 45%, p< 0,01). También observamos scores de Evaluación Secuencial del Daño Multiorgánico pediátrico (mediana de 8 [RIC 4-11] vs. 3 [RIC 1-5], p< 0,01) y mortalidad (36% vs. 4%, p< 0,01) mayores en ShS SEPSIS-3, con OR de morir de 17 (IC95 5-63).*

Conclusión: *Los niños ingresados en Urgencias con ShS que cumplieron con los criterios de ShS SEPSIS-3 presentaron mayor morbimortalidad. La baja proporción de pacientes que tuvieron un qSOFA positivo muestra su escasa utilidad para la detección temprana de la sepsis.*

INTRODUCTION

Sepsis and septic shock (SSh) remain significant health concerns, with greater impact in low-income settings[1-6]. Prognosis of SSH is "time-dependent" and it is therefore an emergency. It has been shown that with every hour of delay in diagnosis and treatment, mortality rates double[7]. One of the main challenges in the management of sepsis is the delay in its recognition, and pediatric emergency departments (PEDs) play an essential role in addressing this barrier[8,9]. In recent years, sufficiently sensitive, although not very specific, tools have emerged for the early detection of sepsis, facilitating immediate treatment initiation. However, these tools may also result in administering therapies to children without sepsis in some cases. Many PEDs are equipped with such resources, utilized within their triage areas[10-12]. Other tools provide prognostic information on hospital morbidity and mortality, such as the Sequential Organ Failure Assessment (SOFA) score, recently validated in the pediatric population (pediatric SOFA score [pSOFA] [Annex 1])[13-16]. Its usefulness for diagnostic purposes in the context of PEDs is currently debated[17,18].

Another challenge for the adequate management of sepsis is the ongoing lack of consensus on its definition. Recently, emphasis has been placed on using a "theoretical" concept and an "operational" definition aimed at simplifying the diagnosis of sepsis using clinical criteria[19]. In 2005, the Pediatric Sepsis Consensus Conference (PSCC) developed diagnostic criteria for the different stages of sepsis: systemic inflammatory response syndrome (SIRS), sepsis, severe sepsis, sepsis with cardiovascular dysfunction, and septic shock[20]. On the other hand, the Surviving Sepsis Campaign (SSC) and the American College of Critical Care Medicine (ACCM) define pediatric SSh clinically or operationally as a condition characterized by infection with either hypothermia or hyperthermia, tachycardia (which may be absent in hypothermia), and altered mental status in the presence of some sign of decreased tissue perfusion or hypotension (late sign)[21,22]. The latter definition is often more practical in PEDs because it allows for quick action and is not conditioned by the availability of resources.

In 2016, the Third International Consensus for Definitions of Sepsis and Septic Shock proposed a new definition for adult patients, known as SEPSIS-3. The authors defined sepsis as life-threatening organ dysfunction caused by a dysregulated host response to infection. There was agreement to simplify concepts: the terms SIRS, severe sepsis, and sepsis with multiorgan involvement were eliminated. In addition, three operational definitions were proposed. The first is a simplification of the SOFA score into a quick SOFA (qSOFA), only considering three clinical aspects: altered mental status, increased respiratory rate (> 22 breaths per minute), and/or decreased systolic blood pressure (SBP ≤100 mmHg). The qSOFA is considered positive when at least two of the three above-mentioned criteria are met. A positive qSOFA is interpreted as "suspected sepsis"; "sepsis" was also defined as a

TABLE 1. Operational definitions of sepsis and septic shock (PSCC and SEPSIS-3).

2005 - International pediatric sepsis consensus conference (PSCC)[20]		
SIRS	*The presence of at least two of the following four criteria, one of which must be abnormal temperature or leukocyte count:* • Core temperature of 38.5°C or 36°C • Tachycardia (> 2 SD above normal for age in the absence of external stimulus, pain, chronic drugs, or an otherwise unexplained persistent elevation over 30 minutes to 4 hours) • In < 1 year old, bradycardia (heart rate < 10th percentile for age) in the absence of a vagal stimulus or congenital heart disease OR otherwise unexplained • Persistent bradycardia over at least 30 minutes • Respiratory rate 2 SD above normal for age or mechanical ventilation for an acute process not related to underlying neuromuscular disease or the receipt of general anesthesia • Leukocyte count elevated or depressed for age (not secondary to chemotherapy-induced leukopenia) OR 10% immature neutrophils	
Infection	A suspected or proven (by positive culture or PCR) infection caused by any pathogen OR a clinical syndrome associated with a high probability of infection. Evidence of infection includes positive findings on clinical exam, imaging, or laboratory tests	
Sepsis	SIRS in the presence of or as a result of suspected or proven infection	
Severe sepsis	Sepsis plus one of the following: • Cardiovascular organ dysfunction • Respiratory distress • ≥ 2 organ dysfunctions	
Septic shock	Sepsis + cardiovascular organ dysfunction	
2016 - SEPSIS-3 (adults)[23]		
Suspected sepsis	Positive quick SOFA	The presence of at least 2 of the following: • Altered mental status • SBP ≤ 100 mmHg • RR ≥ 22 breaths x min + • Suspected infection
Sepsis	SOFA score ≥ 2	
Septic shock	• Vasoactive drugs to maintain MAP ≥ 65 mmHg + • Serum lactate level >2 mmol/L	

SD: standard deviation; HR: heart rate; RR: respiratory rate; PCR: polymerase chain reaction; SBP: systolic blood pressure; MAP: mean arterial pressure.

possible infection associated with a SOFA score ≥ 2 and "septic shock" as sepsis with the requirement for vasopressors to maintain a mean arterial pressure (MAP) of ≥ 65 mmHg and a serum lactate level > 2 mmol/L (Table 1)[23].

These criteria have been used in adults for the purpose of rapid diagnosis and initiation of treatment in the emergency setting. However, translating these definitions to pediatric patients is challenging due to significant physiological differences between the two age groups. In children, hypotension is considered a late sign, and its presence is associated with increased mortality[24]. Studies in pediatric intensive care units (PICUs) demonstrated that the modified SEPSIS-3 operational criteria for children could identify children with more severe SSh[14,25]; however, limited data are available regarding its applicability in lower resource settings and in PEDs.

Our aim was to analyze, in a population of children diagnosed with SSh, how many met each of the SEPSIS-3 operational criteria upon admission to the PED, and to compare the clinical course and mortality between those who met the SEPSIS-3 operational definition of SSH and those who did not.

MATERIAL AND METHODS

A secondary analysis of a prospective multicenter study conducted between October 2019 and June 2021 was performed. We included a consecutive sample of children older than 30 days and younger than 18 years admitted to the PED with a diagnosis of SSh. SSh was defined when the care coordinator, following an objective clinical evaluation and based on SSC[22] and ACCM[21] criteria, identified the condition as such and initiated specific treatment. The coordinator was a specialist in pediatric emergency and/or pediatric intensive care. Children were excluded if they had received treatment at another institution at the time of admission to the PED, patients under adjustment of therapeutic effort, and those diagnosed with an alternative condition within the first 48 hours, as well as those whose records lacked more than one item of information to calculate the pSOFA[13] score (see p< SOFA in Appendix 1) and in whom serum lactate level measurement had not been performed. Ten tertiary care centers from six Latin American countries (Argentina, Bolivia, Brazil, Colombia, Costa Rica, and Paraguay) participated in the study. Third level of care was defined as

university children's hospitals or other referral centers with 24-hour admission, laboratory and imaging services, PICU, and pediatric subspecialties accessible 24 hours a day. All participating institutions have a structured triage system and a local protocol for the management of SSh. The study was approved by the corresponding Ethics and Research Committees.

Data were collected on demographic variables, comorbidities, and risk factors, and episode data were recorded, including the presence of an evident infectious focus and clinical manifestations. "Adequate treatment during the first hour" was defined if the the following criteria were met: 1) placement of a vascular access in the first 5 minutes, 2) fluid administration in the first 30 minutes, and 3) administration of antibiotics and vasoactive drugs within 60 minutes. In addition, the pSOFA[13] score was obtained at admission. Information on clinical evolution and mortality was retrospectively collected during the first 21 days of admission. As obtaining arterial acid-base status (ABS) is not routine practice in the PED, respiratory variables (pressure and arterial oxygen saturation) from the pSOFA were not recorded and were assumed to be normal. Additionally, when information on a second item was unavailable, it was considered normal. The primary objective was to evaluate compliance with the operational criteria for SSh according to SEPSIS-3 adapted for children (SEPSIS-3 SSh+), defined as positive when patients required vasoactive drugs and had a serum lactate measurement > 2 mmol/L.

Based on the studies by Jabornisky et al.[26] and Fustiñana et al.[27] a sample size of 48 patients per group was calculated to have a power of 80% and an alpha error of 0.05 to evaluate the differences in mortality between the SEPSIS-3 SSh (+) and SEPSIS-3 SSh (-) groups.

As a secondary objective, we assessed compliance with the operational criteria of: a) sepsis according to the PSCC, defined by suspected infection and at least two of the following four criteria: temperature > 38.5 C, tachycardia, tachypnea, and/or altered leukocyte count; b) suspected sepsis according to SEPSIS-3 adapted to children, when the quick pSOFA is positive (at least two of three present: altered mental status, tachypnea, and/or arterial hypotension - the latter two were age-adjusted according to Goldstein et al.[20]; and, c) SEPSIS-3 sepsis adapted to children: pSOFA score ≥ 2[13].

Data were recorded in an ad hoc spreadsheet using RedCap software version 13.4.11. Categorical variables were summarized using frequency and percentage. Continuous variables were described using median and interquartile range (IQR) as measures of central tendency and dispersion. Univariate comparative analysis was conducted using two-tailed tests. The nonparametric Mann-Whitney U test was used for non-normally distributed variables and comparison of medians. Categorical variables were compared using the chi-squared or Fisher's exact test, as appropriate. To assess whether children meeting SEPSIS-3 SSh criteria had an increased risk of mortality, a multivariate logistic regression model was used, and odds ratios (ORs) with their 95% confidence intervals (CIs) are reported. A p-value < 0.05 was considered statistically significant. Statistical analyses were performed using SPSS version 24.

RESULTS

A total of 219 children with SSh were identified, of whom 22 were excluded because they presented an alternative diagnosis during the first 48 hours after admission. Of the remaining 197, serum lactate levels were not recorded in 40 and in seven more than one variable was missing to calculate the pSOFA. Finally, 150 patients were included, of whom 43 (29%) met the operational criteria for SSh established by SEPSIS-3 (SEPSIS-3 SSh +) (Figure 1). Fifty-five percent were male, with a median age of 3.8 years (IQR 1.2-11). Table 2 shows the patients who met the diagnostic criteria proposed by the PSCC and SEPSIS-3.

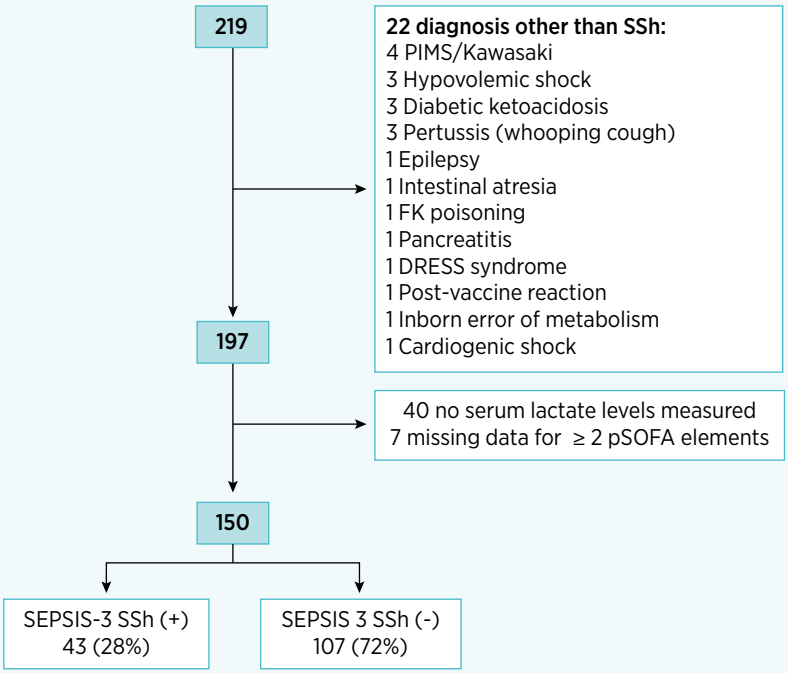
As shown in Table 3, no differences in demographic data were found between the SEPSIS-3 SSh (+) and SEPSIS-3 SSh (-) groups. However, differences were observed in clinical markers of severity, including altered mental status, a greater tendency towards tachypnea, and lower blood pressure values, as well as higher levels of lactate and CRP in the SEPSIS-3 SSh (+) group.

Table 4 shows the clinical course of the children with SSh included in the study. Treatment with vasoactive drugs was required in 93 children (62% with refractory shock to fluid infusion) within the first hour of therapy. Those who did not require vasoactive drugs at admission, did not require them in the 48 hours following admission. Among those who met the SSh SEPSIS-3 (+) criteria, there was a three-fold increase in the need for intubation in the PED (44% *vs.* 13%, p< 0.01) and mechanical ventilation (MV) support in the PICU (61% *vs.* 22%, p< 0.01) and a two-fold increase in the need for PICU admission (93% *vs.* 45%, p< 0.01). Higher pSOFA scores (median 8 [IQR 4-11] *vs.* 3 [IQR 1-5], p< 0.01) and mortality (36% *vs.* 4%, p< 0.01) were also observed in the SEPSIS-3 SSh (+) group.

A multivariate logistic regression analysis was conducted to adjust for potential confounders and evaluate the association between SEPSIS-3 SSh (+) and mortality. The odds ratio (OR) for mortality in the SEPSIS-3 SSh (+) group was 17 (95% CI: 5-63), independent of age less than 6 months, sex, presence of comorbidities (as listed in Appendix 2), and "adequate treatment during the first hour."

DISCUSSION

This study is a secondary analysis of data obtained from a multicenter study focusing on adherence to treatment recommendations for pediatric sepsis in Latin American PEDs[27]. The initial study provided valuable information on the outcome and prognosis of children with SSh who are seen in a context where scientific evidence is limited. In this new analysis, we observed that when applying the operational criteria for SSh adapted to SEPSIS-3 children (children with vasoactive drug requirement and serum lactate > 2 mmol/L), we identified a subgroup that showed a higher organ failure score (pSOFA), increased need for intubation and MV, and higher PICU admission and mortality rates (Table 4). Our findings agree with those of the authors of the adult definitions, who suggest that the SSh definition identifies patients with a 40% mortality risk[23]. Similarly, our results are consistent with pediatric studies indicating that the SEPSIS-3 operational



PIMS: pediatric inflammatory multisystem syndrome; FK: tacrolimus (also FK-506 or fujimycin), immunosuppressive drug; DRESS: drug reaction with eosinophilia and systemic symptoms.

FIGURA 1. Patients included in the study.

TABLE 2. Distribution of PSCC and SEPSIS-3 operational criteria in patients with septic shock.

Operational criteria	n= 150
PSCC sepsis (%)	131 (87)
SEPSIS-3 suspicion of sepsis (%)[1]	88 (59)
SEPSIS-3 sepsis (%)[2]	106 (71)
SEPSIS-3 septic shock (%)[3]	43 (29)

[1]Positive qSOFA; [2]pSOFA score ≥ 2; 3sepsis + vasoactive drugs + serum lactate level > 2 mmol/L. PSCC: International Pediatric Sepsis Consensus Conference (2005).

criteria are specific for identifying patients at higher risk of mortality due to sepsis[13,16,28-30]. These results are anticipated, because when a child with SSh presents with arterial hypotension (decompensated shock), the disease is at a more advanced stage where all the compensatory mechanisms of the child's physiological response have failed. These findings reaffirm, once again, that hypotension should not be considered for early identification of pediatric sepsis and that its presence is associated with higher mortality[24]. Although in our population the SEPSIS-3 SSh operational criterion has not been sensitive in identifying children with a diagnosis of SSh, its application could be useful in predicting the need for more complex resources, including admission to a PICU. These observations are not insignificant, considering that the availability of these resources in Latin America is scarce[9,31].

Timely detection of sepsis has been identified as one of the main barriers for the management of the condition[9]. Late diagnosis delays treatment and increases morbidity and mortality[7]. The SEPSIS-3 expert panel pointed out the possibility to identify adult patients with sepsis using the qSOFA, proposed as a tool for timely screening of patients at risk of unfavorable outcomes, especially valuable in the ED to prompt physicians to increase their vigilance[23]. However, our findings in a cohort of children with SSh demonstrate that this tool failed to identify a significant number of children with SSh, with the pediatric qSOFA yielding negative results in 41% of the cases. These findings are consistent with those reported by various authors regarding the limitations of SEPSIS-3 as an operational criterion for diagnosing and treating the condition in children due to its low sensitivity[16,25,29,30,32-34].

Our study has both strengths and limitations. As a secondary analysis of a prospective multicenter study, its main strength lies in the diverse settings it covers: Latin American PEDs. Applying the SEPSIS-3 SSh operational criteria to children with SSH admitted to the PED could facilitate the transfer of patients to sites that can respond to the more complex demands for the management of sepsis. This finding is particularly important for a condition where prognosis depends on timely intervention. We emphasize the urgent need for early recognition, not only for the diagnosis of sepsis, but also to promptly determine the optimal treatment location for patients already diagnosed. In this regard, the results of our research are important. Another significant aspect of our study was the coordination of the care of each patient by a specialist in pediatric emergency and/or intensive care, which facilitated standardized management of the children included.

Among the limitations, we may mention that, as this was a secondary objective of a non-intervention study, a proportion of patients did not undergo serum lactate measurements, and some other values necessary to calculate the pSOFA score were not available; however, importantly, these patients

TABLE 3. Comparison of characteristics of children who were admitted to PEDs with septic shock and met the SEPSIS-3 operational criteria for septic shock (SEPSIS-3 SSh +) *vs.* those who did not (SEPSIS-3 SSh -).

Population characteristics	SEPSIS-3 SSh (+) n 43	SEPSIS-3 SSh (-) n 107	p (*,**)
Male sex (%)	27 (63)	56 (52)	0.2*
Age (years)	3.8 (1.5-11.5)	4 (1-11)	0.9**
Focus (%)	39 (91)	87 (81)	0.16*
Comorbidities (%)	16 (37)	46 (43)	0.5*
Cold shock (%)	36 (84)	75 (70)	0.08*
Warm shock (%)	7 (16)	12 (11)	0.4*
Hypotension (%)	17 (40)	17 (16)	< 0.01*
Altered mental status (%)	35 (81)	56 (52)	< 0.01*
Delayed capillary refill (%)	34 (79)	73 (68)	0.18*
Flash capillary refill (%)	6 (14)	8 (8)	0.2*
Positive culture (%)	20 (47)	59 (55)	0.3*
HR	150 (140-170)	150 (130-170)	0.3**
RR	40 (28-50)	32 (25-43)	< 0.05**
SBP	90 (74-105)	105 (92-114)	< 0.01**
DBP	53 (40-65)	63 (50-69)	< 0.01**
Serum lactate	3.8 (3-5.9)	2 (1.3-2.9)	< 0.01**
Treatment aims the first hour of sepsis (%)	8 (19)	21 (20)	0.9*
CRP (mg/dl)	77 (25-163)	32 (11-96)	< 0.05**

**Chi-squared test. **Mann-Whitney U test. HR: heart rate; RR: respiratory rate; SBP: systolic blood pressure; DBP: diastolic blood pressure; CRP: C-reactive protein.*

TABLE 4. Outcome differences between the SEPSIS-3 SSh (+) and SEPSIS-3 SSh (-) groups.

Outcome	SEPSIS-3 SSh (+) n 43	SEPSIS-3 SSh (-) n 107	p (*,**)
Intubation in the PED (%)	19 (44)	14 (13)	< 0.01*
PICU (%)	40 (93)	48 (45)	< 0.01*
PICU days	3,5 (1-7)	4 (2,3-7)	0.3**
MV support (%)	26 (61)	23 (22)	< 0.01*
MV support days	3 (1-6.5)	4 (2-7)	0.6**
Inotropic drugs (%)	43 (100)	49 (46)	< 0.01*
Inotropic drugs days	2 (1-5)	2 (1-4)	0.7**
Days of hospital stay	9 (1-16)	8 (4-14)	0.5**
SOFA score	8 (4-11)	3 (1-5)	< 0.01**
Death (%)	15 (36)	4 (4)	< 0.001*

**Chi-squared test. **Mann–Whitney U test. PED: Pediatric Emergency Department; PICU: Pediatric Intensive Care Unit; MV: mechanical ventilation.*

who were excluded did not have higher mortality rates than those included. In addition, in some cases, in which only one item of the pSOFA score was missing, we assumed this value to be normal, although this assumption may not have been true. On the other hand, all the hospitals that participated were tertiary care centers, and our findings might not have been the same if sites lacking adequate resources – which is common in Latin America - had been included. Furthermore, 41% (62) of the included children had comorbidities, and these rates may not accurately reflect the true population of children with sepsis in our region, potentially affecting the external validity of our findings. In future research, it would be appropriate to include primary and secondary care centers with fewer resources to mitigate this bias. It is also important to note that during the study, the SARS-CoV-2 (COVID-19) pandemic broke out, leading to a significant decrease in the number of visits to the PED.

Finally, the data from our investigation support the specificity of the SEPSIS-3 SSh operational criteria in children admitted to the ED with a diagnosis of SSh, useful to determine

the need for their transfer to institutions with a PICU capable of offering more advanced sepsis management. Similarly, it cautions against relying on the qSOFA as a detection tool, which, because of its moderate sensitivity, may leave patients with a potential risk of death undiagnosed.

In conclusion, our study found that patients admitted to the PED with SSh who met the operational criteria of SEPSIS-3 presented with an increased risk of morbidity and mortality, a greater need for intubation and MV support, and admission to the PICU. Additionally, this group had higher pSOFA scores and mortality rates. These findings could be helpful in the early identification of at-risk patients and support timely decision-making. Furthermore, a significant proportion of patients had negative qSOFA results, indicating limited usefulness of this tool for early sepsis detection in PEDs.

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REFERENCES

1. Kissoon N, Carapetis J. Pediatric sepsis in the developing world. J Infect. 2015; 71(S1): S21-6.
2. Fleischmann-Struzek C, Goldfarb DM, Schlattmann P, Schlapbach LJ, Reinhart K, Kissoon N. The global burden of paediatric and neonatal sepsis: a systematic review. Lancet Respir Med. 2018; 6(3): 223-30.
3. Hartman ME, Linde-Zwirble WT, Angus DC, Watson RS. Trends in the epidemiology of pediatric severe sepsis. Pediatric Crit Care Med. 2013; 14(7): 686-93.
4. Thompson GC, Kissoon N. Sepsis in Canadian children: a national analysis using administrative data. Clin Epidemiol. 2014; 6: 461-9.
5. Wang Y, Sun B, Yue H, Lin X, Li B, Yang X, et al. An epidemiologic survey of pediatric sepsis in regional hospitals in China. Pediatr Crit Care Med. 2014; 15(9): 814-20.
6. Baelani I, Jochberger S, Laimer T, Otieno D, Kabutu J, Wilson I, et al. Availability of critical care resources to treat patients with severe sepsis or septic shock in Africa: A self-reported, continent-wide survey of anaesthesia providers. Crit Care. 2011; 15(1): R10.
7. Han YY, Carcillo JA, Dragotta MA, Bills DM, Watson RS, Westerman ME, et al. Early Reversal of Pediatric-Neonatal Septic Shock by Community Physicians Is Associated With Improved Outcome. Pediatrics. 2003; 112(4): 793-9.
8. Paul R, Melendez E, Stack A, Capraro A, Monuteaux M, Neuman MI. Improving adherence to PALS septic shock guidelines. Pediatrics. 2014; 133(5): e1358-66.
9. Kohn-Loncarica GA, Fustiñana AL, Jabornisky RM, Pavlicich SV, Prego-Pettit J, Yock-Corrales A, et al. How Are Clinicians Treating Children With Sepsis in Emergency Departments in Latin America? Pediatr Emerg Care. 2021; 37(11): e757-63.
10. Gilholm P, Gibbons K, Lister P, Harley A, Irwin A, Raman S, et al. Validation of a paediatric sepsis screening tool to identify children with sepsis in the emergency department: a statewide prospective cohort study in Queensland, Australia. BMJ Open. 2023; 13(1): e061431.
11. Gomes S, Wood D, Ayis S, Haliasos N, Roland D. Evaluation of a novel approach to recognising community-acquired paediatric sepsis at ED triage by combining an electronic screening algorithm with clinician assessment. Emerg Med J. 2021; 38(2): 132-8.
12. Lloyd JK, Ahrens EA, Clark D, Dachenhaus T, Nuss KE. Automating a manual sepsis screening tool in a pediatric emergency department. Appl Clin Inform. 2018; 9(4): 803-8.
13. Matics TJ, Sanchez-Pinto LN. Adaptation and validation of a pediatric sequential organ failure assessment score and evaluation of the Sepsis-3 definitions in critically ill children. JAMA Pediatr. 2017; 171(10): e172352.
14. Schlapbach LJ, Straney L, Bellomo R, MacLaren G, Pilcher D. Prognostic accuracy of age-adapted SOFA, SIRS, PELOD-2, and qSOFA for in-hospital mortality among children with suspected infection admitted to the intensive care unit. Intensive Care Med. 2018; 44(2): 179-88.
15. Niederwanger C, Varga T, Hell T, Stuerzel D, Prem J, Gassner M, et al. Comparison of pediatric scoring systems for mortality in septic patients and the impact of missing information on their predictive power: a retrospective analysis. Peer J. 2020; 8: e9993.
16. Camarena-Vielma L, Lona-Reyes JC, Vázquez-Bojórquez MS, Ramos-Gutiérrez RY, Jiménez-Texcalpa ME, Alatorre-Rendón F, et al. Implementation of the Pediatric Index of Mortality 3 and the pediatric Sequential Organ Failure Assessment in an intensive care unit in Mexico. Arch Argent Pediatr. 2022; 120(5): 332-5.
17. van Nassau SC, van Beek RH, Driessen GJ, Hazelzet JA, van Wering HM, Boeddha NP. Translating Sepsis-3 criteria in children: Prognostic accuracy of age-adjusted quick SOFA score in children visiting the emergency department with suspected bacterial infection. Front Pediatr. 2018; 6: 266.
18. Romaine ST, Potter J, Khanijau A, McGalliard RJ, Wright JL, Sefton G, et al. Accuracy of a Modified qSOFA Score for Predicting Critical Care Admission in Febrile Children. Pediatrics. 2020; 146(4): e20200782.
19. Fernández-Sarmiento J, De Souza DC, Martinez A, Nieto V, López-Herce J, Soares Lanziotti V, et al. Latin American Consensus on the Management of Sepsis in Children: Sociedad Latinoamericana de Cuidados Intensivos Pediátricos [Latin American Pediatric Intensive Care Society] (SLACIP) Task Force: Executive Summary. J Intensive Care Med. 2022; 37(6): 753-63.
20. Goldstein B, Giroir B, Randolph A. International pediatric sepsis consensus conference: Definitions for sepsis and organ dysfunction in pediatrics. Pediatric Crit Care Med. 2005; 6(1): 2-8.
21. Davis AL, Carcillo JA, Aneja RK, Deymann AJ, Lin JC, Nguyen TC, et al. American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock. Crit Care Med. 2017; 45(6): 1061-93.
22. Weiss SL, Peters MJ, Alhazzani W, Agus MSD, Flori HR, Inwald DP, et al. Surviving sepsis campaign international guidelines for the

management of septic shock and sepsis-associated organ dysfunction in children. Pediatr Crit Care Med. 2020; 21(2): e52-106.

23. Singer M, Deutschman CS, Seymour C, Shankar-Hari M, Annane D, Bauer M, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA. 2016; 315(8): 801-10.
24. Carcillo JA, Kuch BA, Han YY, Day S, Greenwald BM, McCloskey KA, et al. Mortality and functional morbidity after use of PALS/APLS by community physicians. Pediatrics. 2009; 124(2): 500-8.
25. Sankar J, Dhochak N, Kumar K, Singh M, Sankar MJ, Lodha R. Comparison of International Pediatric Sepsis Consensus Conference Versus Sepsis-3 Definitions for Children Presenting with Septic Shock to a Tertiary Care Center in India: A Retrospective Study. Pediatr Crit Care Med. 2019; 20(3): E122-9.
26. Jabornisky R, Sáenz S, Capocasa P, Jaen R, Moreno RP, Landry L, et al. Estudio epidemiológico de sepsis grave pediátrica en la República Argentina. Arch Argent Pediatr. 2019; 117(3): 135-56.
27. Fustiñana A, Yock-Corrales A, Casson N, Galvis L, Iramain R, Lago P, et al. Adherence to Pediatric Sepsis Treatment Recommendations at Emergency Departments: A Multicenter Study in Latin America. Pediatr Emerg Care. 2022; 38(9): E1496-502.
28. Schlapbach LJ, Straney L, Bellomo R, MacLaren G, Pilcher D. Prognostic accuracy of age-adapted SOFA, SIRS, PELOD-2, and qSOFA for in-hospital mortality among children with suspected infection admitted to the intensive care unit. Intensive Care Med. 2018; 44(2): 179-88.
29. Mohamed El-Mashad G, Said El-Mekkawy M, Helmy Zayan M. Paediatric sequential organ failure assessment (pSOFA) score: A new mortality prediction score in the paediatric intensive care unit. An Pediatr (Engl Ed). 2020; 92(5): 277-85.
30. Balamuth F, Scott HF, Weiss SL, Webb M, Chamberlain JM, Bajaj L, et al; Pediatric Emergency Care Applied Research Network (PECARN) PED Screen and PECARN Registry Study Groups. Validation of the Pediatric Sequential Organ Failure Assessment Score and Evaluation of Third International Consensus Definitions for Sepsis and Septic Shock Definitions in the Pediatric Emergency Department. JAMA Pediatr. 2022; 176(7): 672-8.
31. Cáceres L BA, Cagnasia S, Galvis L, Rino P, Yock-Corrales A, et al. Estado actual de Recursos Generales y Funcionamiento de Servicios Hospitalarios de Emergencias Pediátricas con Gestión Pública en Latinoamérica. Rev Fac Med Hum. 2022; 22(2): 232-43.
32. Schlapbach LJ, MacLaren G, Festa M, Alexander J, Erickson S, Beca J, et al. Prediction of pediatric sepsis mortality within 1 h of intensive care admission. Intensive Care Med. 2017; 43(8): 1085-96.
33. Seymour CW, Liu VX, Iwashyna TJ, Brunkhorst FM, Rea TD, Scherag A, et al. Assessment of Clinical Criteria for Sepsis: For the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA. 2016; 315(8): 762-74.
34. Machado FR, Cavalcanti AB, Monteiro MB, Sousa JL, Bossa A, Bafi AT, et al. Predictive Accuracy of the Quick Sepsis-related Organ Failure Assessment Score in Brazil. A Prospective Multicenter Study. Am J Respir Crit Care Med. 2020; 201(7): 789-98.

ANNEX 1. Pediatric Sequential Organ Failure Assessment (pSOFA) Score.

	Score[a]				
Variables	0	1	2	3	4
Respiratory					
PaO_2: FiO_2[b]	≥ 400	300-399	200-299	100-199 with respiratory support	< 100 with respiratory support
or					
SpO_2: FiO_2[c]	≥ 292	264-291	221-264	148-220 with respiratory support	< 148 with respiratory support
Coagulation					
Platelet count × 10^3/ml	≥ 150	100-149	50-99	20-49	< 20
Hepatic					
Bilirrubin, mg/dl	< 1.2	1.2-1.9	2.0-5.9	6.0-11.9	> 12.0
Cardiovascular					
MAP by age group or vasoactivo infusion, mmHg o µg/kg/min[d]					
< 1 month	≥ 46	< 46	Dopamine hydrochloride ≤ 5 or dobutamine hydrochloride (any)	Dopamine hydrochloride ≥ 5 or epinephrine ≤ 0.1 or norepinephrine bitartrate ≤ 0.1	Dopamine hydrochloride > 15 or epinephrine > 0.1 or norepinephrine bitartrate > 0.1
1-11 months	≥ 55	< 55			
12-23 months	≥ 60	< 60			
24-59 months	≥ 62	< 62			
60-143 months	≥ 65	< 65			
144-216 months	≥ 67	< 67			
> 216 months[e]	≥ 70	< 70			
Neurologic					
Glasgow Coma Scale[f]	15	13-14	10-12	6-9	< 6
Renal					
Creatinine by age group, mg/dl					
< 1 month	< 0.8	0.8-0.9	1.0-1.1	1.2-1.5	≥ 1.6
1-11 months	< 0.3	0.3-0.4	0.5-0.7	0.8-1.1	≥ 1.2
12-23 months	< 0.4	0.4-0.5	0.6-1.0	1.1-1.4	≥ 1.5
24-59 months	< 0.6	0.6-0.8	0.9-1.5	1.6-2.2	≥ 2.3
60-143 months	< 0.7	0.7-1.0	1.1-1.7	1.8-2.5	≥ 2.6
144-216 months	< 1.0	1.0-1.6	1.7-2.8	2.9-4.1	≥ 4.2
> 216 months	< 1.2	1.2-1.9	2.0-3.4	3.5-4.9	≥ 5.0

FiO_2: fraction of inspired oxygen; SpO_2: peripheral oxygen saturation; MAP: Mean arterial pressure.
SI conversion factors:
- *To convert bilirubin to micromoles per liter, multiply by 17.104.*
- *To convert creatinine to micromoles per liter, multiply by 88.4.*
- *To convert platelet count to 10^9/L, multiply by 1.*

[a]The pSOFA score was calculated for every 24-hour period. The worst value for every variable in each 24-hour period was used to calculate the subscore for each of the six organ systems. If a variable was not recorded in a given 24-hour period, it was assumed to be normal and a score of 0 was used. Daily pSOFA score was the sum of the 6 subscores (range, 0-24 points; higher scores indicate a worse outcome). [b]PaO_2 was measured in millimeters of mercury. [c]Only SpO_2 measurements of 97% or lower were used in the calculation. [d]MAP (measured in millimeters of mercury) was used for scores 0 and 1; vasoactive infusion (measured in micrograms per kiligram per minute), for scores 2 to 4. Maximum continuous vasoactive infusion was administered for at least 1 hour. [e]Cutoffs for patients older than 18 years (216 months) were identical to the original SOFA score. [f]Glasgow Coma Scale was calculated using the pediatric scale.
From: Matics T, Sanchez-Pintos N. Adaptation and Validation of pediatric sequential organ failure assessment score and evaluation of sepsis-3 definitions in critically ill children. JAMA Pediatr. 2017; 171: e172352.

ANNEX 2. Distribution of comorbidities in the SEPSIS 3 SSh (+) and SEPSIS 3 SSh (-) groups.

Comorbidity	SEPSIS-3 SSh (+) n 43 (%)	SEPSIS-3 SSh (-) n 107 (%)	Total
Endocrine	0 (0)	1 (1)	1
Gastrointestinal (non hepatic)	2 (5)	3 (3)	5
Genetic	1 (2)	0 (0)	1
Hepatic	0 (0)	1 (1)	1
Hematological	1 (2)	8 (7)	9
Immunodeficiency (primary or secondary)	1 (2)	2 (2)	3
Metabolic	0 (0)	1 (1)	1
Neurosurgical	1 (2)	1 (1)	2
Neurologic	3 (7)	7 (7)	10
Oncological	3 (7)	8 (7)	11
Respiratory	1 (2)	1 (1)	2
Transplant	1 (2)	3 (3)	4
Urological/renal	0 (0)	2 (2)	2
Others	2 (5)	8 (7)	10
Total	**16 (37)**	**46 (43)**	**62**

SEUP
SOCIEDAD ESPAÑOLA DE URGENCIAS DE PEDIATRÍA

EMERGENCIASPediátricas
Vol. 3. No. 1. January - April 2024

Emerg Pediatr. 2024; 3(1): 19-23

REVIEW

Inhaled corticosteroids in the management of bronchospasms in Pediatric Emergency Departments

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INTRODUCTION

Bronchospasms or asthma exacerbations are episodes characterized by inflammation, hyperresponsiveness and reversible airway obstruction, leading to shortness of breath, wheezing, coughing, and a feeling of tightness or chest pain, associated with decreased lung function.

Bronchospasms or asthma exacerbations are among the most frequent medical emergencies in pediatric practice and are a leading cause for consultation in Pediatric Emergency Departments. They are estimated to account for approximately 5% of pediatric emergency visits, increasing to nearly 15% during autumn and winter months due to their seasonal presentation pattern. A combination of infectious, allergic, environmental factors, emotional stress, and meteorological stimuli seem to underlie this seasonal pattern. These incidence peaks create significant pressure on Pediatric Emergency Departments and lead to an increased demand for specialized resources. Moreover, approximately 15% of patients require hospital admission, disrupting family dynamics and impacting the quality of life of affected children[1].

ASSESSMENT OF BRONCHOSPASM SEVERITY

In the initial evaluation of a patient with bronchospasms, accurately assessing the severity of the exacerbation is crucial to establish an appropriate treatment and care strategy. To this end, several clinical assessment scales have been developed in recent years to stratify the severity of airway obstruction and response to treatment. One of these is the Pulmonary Score (PS) scale, a simple, widely used, and validated tool (Tables 1 and 2)[1,2].

Received on March 14, 2024
Accepted on April 16, 2024

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CURRENT MANAGEMENT OF BRONCHOSPASM IN PEDIATRIC EMERGENCY DEPARTMENTS

The current Clinical Practice Guidelines for treating bronchospasm in pediatric patients in the Emergency Department recommend as first-line treatment the use of short-acting β2-adrenergic agonists (salbutamol) in combination with anticholinergic drugs (ipratropium bromide), administered via nebulization or inhalation. In addition, systemic corticosteroids are recommended via oral or intravenous administration[1-4].

β2-adrenergic agonists

Short-acting inhaled β2-adrenergic agonists (the most widely used of which is salbutamol) are the first-line treatment. Their bronchodilating effect starts within a few seconds, peaks at 30 minutes, and has a half-life between 2 and 4 hours. They should preferably be administered with a pressurized inhaler and spacer, as this is as effective as the nebulized route, with fewer side effects and greater cost-effectiveness. Nebulized salbutamol is indicated in severe episodes with hypoxemia or in moderate episodes with significant respiratory distress. The doses used are usually well tolerated. The most common side effects include tremors, hyperactivity, vomiting, and tachycardia, which are generally mild. Repeated high doses may lead to hypokalemia and hyperglycemia, usually without clinical or electrocardiographic consequences.

Ipratropium bromide

Ipratropium bromide is an anticholinergic agent with a slower onset of bronchodilation compared to β2-adrenergic agonists, but with a longer duration of action. Co-administration of salbutamol and ipratropium bromide in moderate-to-severe bronchospasms results in a more rapid im-

TABLE 1. Pulmonary Score for the clinical assessment of acute asthma episodes in children.

Score*	Respiratory rate		Wheezing	Accessory muscle use-Sternocleidomastoid***
	< 6 years	≥ 6 years		
0	< 30	< 20	No	No
1	31-45	21-35	Terminal expiration (stethoscope)	Mild increase
2	46-60	36-50	Entire expiration (stethoscope)	Increase
3	> 60	> 50	Inspiration and expiration, without stethoscope**	Maximal activity

**Score from 0 to 3 in each item (minimum 0, maximum 9). **If there is no wheezing and the activity of the sternocleidomastoid is increased, assign the wheezing item a score of 3. ***The use of accessory muscles refers only to the sternocleidomastoid, which is the only muscle that has been well correlated with the degree of obstruction.*
Mild episode: 0-3 points; moderate episode: 4-6 points; severe episode: 7-9 points.

TABLE 2. Global assessment of the severity of asthma attacks in children by integrating the Pulmonary Score and oxygen saturation by pulse oximetry.

	Pulmonary score	Oxygen saturation by pulse oximetry
Mild	0-3	> 94%
Moderate	4-6	91-94%
Severe	7-9	< 91%

In case of discordance between the clinical score and the oxygen saturation, the one with the higher severity will be used.

provement of symptoms and respiratory function, leading to a decreased hospitalization rate. However, it has not been demonstrated that continued administration of ipratropium bromide beyond the initial three doses in the emergency department provides any additional benefit. Therefore, it is not recommended to maintain this treatment in hospitalized patients.

Systemic corticosteroids

Systemic corticosteroids are recommended early as an essential component of the treatment for bronchospasms, as they reduce inflammation and enhance the effects of bronchodilators. They have been demonstrated to prevent reconsultations, hospital admissions, and to decrease the total number of doses of β2-adrenergic agonists. As short cycles have been employed, no significant side effects have been observed. The effects typically start within 2-4 hours, with full action seen at 12-24 hours. They should be administered in moderate-to-severe episodes and considered in mild episodes with an inadequate response to bronchodilators or if the patient has a history of severe bronchospasms. The oral route is preferred because it is equally effective, rapid, less invasive, and more cost-effective than the intravenous route. Prednisone or prednisolone is the drug of choice and most commonly used. Dexamethasone has proven to be an effective and safe alternative, with a prolonged half-life allowing for a regimen of one or two doses. It does not show differences in admission rate, reconsultation, or persistence of symptoms after discharge. The intravenous route is reserved for more severe cases or in cases of oral intolerance, with methylprednisolone being the preferred drug.

CURRENT USE OF INHALED OR NEBULIZED CORTICOSTEROIDS IN ASTHMA PATIENTS

Inhaled corticosteroids for maintenance therapy in children with asthma

Inhaled glucocorticoids are the first-line maintenance therapy for children experiencing recurrent wheezing episodes or asthma. The effectiveness of daily inhaled glucocorticoids has been well established in improving clinical, functional, and bronchial inflammation parameters, enhancing quality of life, and reducing the risk of exacerbations and hospitalizations. In addition, inhaled glucocorticoids, at the usual doses, are safe drugs for the treatment of asthma in children[5]. Although inhaled corticosteroids are frequently used as maintenance therapy in children with persistent asthma, their use is not widespread in the Pediatric Emergency Department as their efficacy and clinical relevance in this setting where the clinical profile is acute has not yet been clarified.

Inhaled corticosteroids for asthma exacerbations in adults

It should be noted that the GEMA 5.3 guideline (Spanish Guide for the Management of Asthma; 2023)[5] recommends the early administration of inhaled glucocorticoids within the first hour of care for adult patients experiencing moderate-to-severe asthma attacks, as they reduce the need for hospital admission. Additionally, the guideline suggest that combining inhaled glucocorticoids with systemic glucocorticoids results in an even greater decrease in the number of hospital admissions. The inhaled glucocorticoids used in adult patients include budesonide and fluticasone propionate. Budesonide can be administered via inhalation using a pressurized device and spacer at a dose of 800 µg (4 inhalations of 200 µg each puff) every 10-15 minutes, or via nebulization at a dose of 0.5 mg every 20 minutes during the first hour. Fluticasone propionate is administered via inhalation with a pressurized device and spacer at a dose of 500 µg (2 inhalations of 250 µg each puff) every 10-15 minutes. However, the same GEMA 5.3 guideline concludes that, in pediatric patients, there is insufficient evidence to recommend the use of inhaled or nebulized corticosteroids as an alternative or additional treatment to systemic corticosteroids for asthma attacks. Larger studies with improved

methodological quality, cost-effectiveness analysis, and safety assessments are needed.

POSSIBLE USE OF INHALED OR NEBULIZED CORTICOSTEROIDS FOR BRONCHOSPASMS IN THE PEDIATRIC EMERGENCY SETTING

Justification

Although the effectiveness of systemic corticosteroids in managing bronchospasm is well established, and their use represents the standard treatment for moderate-to-severe asthma exacerbations in Pediatric Emergency Departments, the slow onset of their action and the fact that many children still require hospital admission despite their administration remain concerns. Consequently, in recent years, research has focused on exploring new treatments, such as inhaled or nebulized corticosteroids, to optimize the management of these patients. Moreover, it should be taken into account that in the emergency department setting, most children with mild-to-moderate bronchospasms respond well to standard treatment. Therefore, it is the patients with severe bronchospasm who are most likely to benefit from a novel treatment approach.

What we know so far about the use of inhaled or nebulized corticosteroids for the management of bronchospasm

Previous studies support the use of nebulized corticosteroids in the acute setting based on the potential advantages they may provide: good tolerance to their use, fewer systemic side effects, rapid onset of action (1 to 2 hours after administration), and direct administration to the airways with local anti-inflammatory and vasoconstrictor effect contributing to the reduction of airway reactivity and edema. In addition, it is possible to administer corticosteroids and β2-adrenergic agonists simultaneously in the same nebulization. However, we should be aware that the literature provides different and contradictory results on the use of nebulized corticosteroids for the management of bronchospasms. Several studies have demonstrated a beneficial effect of adding nebulized corticosteroids to standard short-acting β2-adrenergic agonist therapy compared to placebo in reducing hospital admission rates[6-10]. However, few studies have investigated the potential additional benefits of nebulized corticosteroids in combination with systemic corticosteroids[11,12]. It should be noted that there is insufficient evidence to support the replacement of systemic corticosteroids with nebulized corticosteroids. Therefore, systemic corticosteroids should not be discontinued in patients with bronchospasm presenting to the Pediatric Emergency Department[13]. For these reasons, nebulized corticosteroids should be viewed as an adjunctive treatment rather than a substitute for systemic corticosteroids.

International Clinical Practice Guidelines

The GINA (Global Initiative for Asthma) Clinical Practice Guideline[14], updated in 2023, indicates that the incorporation of inhaled corticosteroids into standard bronchospasm treatment (including the use of systemic corticosteroids) does not appear to decrease the risk of hospitalization. However, it does reduce the length of stay in the Emergency Department and the scores on clinical asthma rating scales in pediatric patients. Nonetheless, the guideline concludes that the specific drug, dosage, and treatment duration remain unclear.

Similarly, in 2021, a consensus paper was published by experts in pediatric allergy and respiratory diseases in Thailand regarding the use of nebulized corticosteroids in children with asthma exacerbations[15]. Recommendations were made based on the review of published studies and clinical opinions. In accordance with the *Thai Pediatric Asthma Guideline,* they recommend the use of nebulized corticosteroids for treating all asthma exacerbations in children from 1 year of age. In addition to the standard treatment with short-acting β2-adrenergic agonists and ipratropium bromide for mild-to-moderate asthma exacerbations, they recommend systemic corticosteroids or, alternatively, high doses of nebulized corticosteroids. They also suggest that nebulized corticosteroids may be more appropriate than systemic corticosteroids for this type of mild-to-moderate exacerbations. On the other hand, for severe asthma exacerbations, they recommend the combined use of systemic corticosteroids and high doses of nebulized corticosteroids, considering nebulized corticosteroids as a fast-acting adjunct to systemic corticosteroids.

Drug and dosage recommendations

In the literature, budesonide is proposed as the primary drug of choice, with nebulized fluticasone considered as an alternative. This choice is primarily based on the pharmacological properties of budesonide, which offer advantages over those of fluticasone. Budesonide exhibits faster absorption, greater water solubility, and longer deposition in the airways and lung tissues compared to fluticasone. In addition, budesonide is associated with a lower risk of pneumonia, which remains relatively consistent across all doses, whereas other corticosteroids such as fluticasone increase the risk of pneumonia in a dose-dependent manner. Finally, budesonide is associated with fewer systemic side effects than fluticasone[15].

Regarding the dose and duration of nebulized corticosteroid treatment, studies indicate that a single dose is inadequate for managing asthma exacerbations. Repeated doses are necessary (i.e., administered in conjunction with the three standard treatment courses of nebulized short-acting β2-adrenergic agonist bronchodilators) to be effective as add-on therapy to systemic corticosteroids in the setting of acute exacerbation[16].

In the Thai consensus statement published by Direkwattanachai C et al[15], recommendations are provided regarding the dosage of treatment. The authors recommend an appropriate dose of 0.5-1 mg of budesonide or fluticasone in each nebulization, emphasizing that the total daily dose of these corticosteroids should not exceed 2 mg. Concerning the nebulization regimen, they suggest administering the nebulized corticosteroid within the first hour of patient care in the hospital. It can be administered simultaneously in a mixture or sequentially after the short-acting bronchodilator dose. Each nebulized solution dose may be repeated every

20 minutes until completing three doses within the first hour of care.

Review of the current literature

Reviewing the literature of the last 4 years (2020- 2023), there are several articles on the use of inhaled or nebulized corticosteroids in the treatment of bronchospasm or asthma exacerbations in the pediatric emergency setting. Some of these publications are presented below.

In a meta-analysis, Sawanyawisuth K et al[17] conclude that using inhaled corticosteroids as monotherapy in mild-to-moderate asthma exacerbations, and in combination with systemic corticosteroids in moderate-to-severe asthma exacerbations, could be beneficial in reducing the risk of hospitalization in pediatric patients.

Murphy et al[18] conducted a systematic review that demonstrated that nebulized corticosteroids are at least as effective (non-inferior) as systemic corticosteroids in managing mild-to-moderate asthma exacerbations in patients under 5 years of age.

In another systematic review published by Ahmadi Afshar A et al[19], several studies were analyzed to evaluate the impact of inhaled budesonide on hospitalization rate, changes in asthma clinical rating scale scores, and vital signs in children with asthma exacerbations. The results showed that, compared to placebo and systemic corticosteroids, the administration of inhaled budesonide decreased the risk of hospital admission, although the results were not statistically significant. On the other hand, compared to placebo and oral corticosteroids, no significant differences were found in terms of vital signs (heart rate, respiratory rate and oxygen saturation) after administration of inhaled budesonide.

In a systematic review, Castro-Rodriguez et al[20], reviewed different studies to evaluate the efficacy of inhaled corticosteroids added to systemic corticosteroids compared to systemic corticosteroids alone in children with asthma exacerbation. It was concluded that, compared to single administration of systemic corticosteroids, the addition of nebulized budesonide does not affect the admission rate, but does decrease hospital stay and significantly improves the score on clinical asthma rating scales in an emergency department setting.

Li CY et al[21] published a meta-analysis that included various clinical trials aimed at evaluating hospital admission rates, the need for systemic corticosteroid use, length of hospital stay, and adverse events when adding inhaled budesonide to the standard treatment of moderate-to-severe bronchospasm in pediatric patients in the Emergency Department. The results indicated that children who received nebulized budesonide had a reduced risk of hospital admission and of requiring systemic corticosteroids compared to those who received a placebo. No differences were found in the length of hospital stay or in the risk of adverse events between the two groups.

To assess the impact of adding nebulized budesonide to salbutamol for the treatment of mild-to-moderate asthma exacerbations in pediatric patients compared to using nebulized salbutamol alone, Amir Najim Abood HA et al[22] conducted a clinical trial. The methodology involved determining the Pulmonary Score (PS) clinical rating scale score upon arrival at the Emergency Department and then randomly assigning patients to two groups: group A (salbutamol group) or group B (budesonide plus salbutamol group). Subsequently, the PS score was calculated every 30 minutes. The results showed that, after 30 minutes, patients treated with the combination of nebulized budesonide and salbutamol had a significantly lower PS score than those treated with salbutamol alone. In addition, the mean length of stay in the emergency department was significantly shorter in patients treated with the combination of nebulized budesonide and salbutamol compared to the use of nebulized salbutamol monotherapy.

REFERENCES

1. Paniagua Calzón N, Benito Fernández J. Diagnóstico y tratamiento de la crisis asmática en Urgencias. Protoc diagn ter pediatr. 2020; 1: 49-61.
2. Claret Teruel G, Fernández de Sevilla Estrach M, Cols Roig M. Crisis asmática. En: Luaces Cubells C, editor. Urgencias en pediatría. Protocolos diagnósticos-terapéuticos. Hospital Sant Joan de Déu Barcelona. 6ª ed. Madrid: Ergon; 2022. p. 121-8.
3. Moral Gil L. Asma infantil. En: Cruz M. Manual de Pediatría. 4ª ed. Madrid: Ergon; 2020. p. 1009-14.
4. Leung JS. Paediatrics: how to manage acute asthma exacerbations. Drugs Context. 2021; 10: 2020-12-7.
5. Guía Española para al Manejo del Asma (GEMA) 5.3. SEMG; 2023. Disponible en: https://www.gemasma.com.
6. Su XM, Yu N, Kong LF, Kang J. Effectiveness of inhaled corticosteroids in the treatment of acute asthma in children in the emergency department: a meta-analysis. Ann Med. 2014; 46(1): 24-30.
7. Ochoa Sangrador C, Gimeno Díaz de Atauri Á, Martínez Rubio MV. ¿Son eficaces los corticoides inhalados en las exacerbaciones asmáticas? Evidentia praxis. An Pediatr (Engl Ed). 2021; 94(1): 54.e1-6.
8. Razi CH, Cörüt N, Andıran N. Budesonide reduces hospital admission rates in preschool children with acute wheezing. Pediatr Pulmonol. 2017; 52(6): 720-8.
9. Alangari AA, Malhis N, Mubasher M, Al-Ghamedi N, Al-Tannir M, Riaz M, et al. Budesonide nebulization added to systemic prednisolone in the treatment of acute asthma in children: a double-blind, randomized, controlled trial. Chest. 2014; 145(4): 772-8.
10. Chen AH, Zeng GQ, Chen RC, Zhan JY, Sun LH, Huang SK, et al. Effects of nebulized high-dose budesonide on moderate-to-severe acute exacerbation of asthma in children: a randomized, double-blind, placebo-controlled study. Respirology. 2013; 18 Suppl 3: 47-52.
11. Marghli S, Bouhamed C, Sghaier A, Chebbi N, Dlala I, Bettout S, et al. Nebulized budesonide combined with systemic corticosteroid vs systemic corticosteroid alone in acute severe asthma managed in the emergency department: a randomized controlled trial. BMC Emerg Med. 2022; 22(1): 134.
12. Beckhaus AA, Riutor MC, Castro Rodriguez JA. Inhaled versus systemic corticosteroids for acute asthma in children. A systematic review. Pediatr Pulmonol. 2014; 49(4): 326-34.
13. Edmonds ML, Milan SJ, Camargo CA Jr, Pollack CV, Rowe BH. Early use of inhaled corticosteroids in the emergency department treatment of acute asthma. Cochrane Database Syst Rev. 2012; 12(12): CD002308.

14. Global Initiative por Asthma (GINA). Global Strategy por Asthma Management and Prevention. 2023. Disponible en: https://ginasthma.org.
15. Direkwattanachai C, Aksilp C, Chatchatee P, Jirapongsananuruk O, Kamalaporn H, Kamchaisatian W, et al. Practical considerations of nebulized corticosteroid in children with acute asthmatic exacerbation: A consensus. Asian Pac J Allergy Immunol. 2021; 39(3): 168-76.
16. Upham BD, Mollen CJ, Scarfone RJ, Seiden J, Chew A, Zorc JJ. Nebulized budesonide added to standard pediatric emergency department treatment of acute asthma: a randomized, double-blind trial. Acad Emerg Med. 2011; 18(7): 665-73.
17. Sawanyawisuth K, Chattakul P, Khamsai S, Boonsawat W, Ladla A, Chotmongkol V, et al. Role of Inhaled Corticosteroids for Asthma Exacerbation in Children: An Updated Meta-Analysis. J Emerg Trauma Shock. 2020; 13(2): 161-6.
18. Murphy KR, Hong JG, Wandalsen G, Larenas-Linnemann D, El Beleidy A, Zaytseva OV, et al. Nebulized Inhaled Corticosteroids in Asthma Treatment in Children 5 Years or Younger: A Systematic Review and Global Expert Analysis. J Allergy Clin Immunol Pract. 2020; 8(6): 1815-27.
19. Ahmadi Afshar A, Rahmati M, Maleki A, Kamali K. The Effectiveness of Budesonide in the Treatment of Asthma Attacks in Children: A Systematic Review and Meta-Analysis. PCNM. 2023; 13(3): 9-18.
20. Castro-Rodriguez JA, Pincheira MA, Escobar-Serna DP, Sossa-Briceño MP, Rodriguez-Martinez CE. Adding nebulized corticosteroids to systemic corticosteroids for acute asthma in children: A systematic review with meta-analysis. Pediatr Pulmonol. 2020; 55(10): 2508-17.
21. Li CY, Liu Z. Effect of budesonide on hospitalization rates among children with acute asthma attending paediatric emergency department: a systematic review and meta-analysis. World J Pediatr. 2021; 17(2): 152-63.
22. Amir Najim Abood HA, Al-Musawi ZM, Hussein AM, Hameed RM. Effects of nebulized budesonide plus salbutamol and nebulized salbutamol monotherapy on mild to moderate acute exacerbation of asthma in children: A comparative study. J Pak Med Assoc. 2021; 71(Suppl 9)(12): S29-34.

SEUP
SOCIEDAD ESPAÑOLA DE URGENCIAS DE PEDIATRÍA

EMERGENCIASPediátricas
Vol. 3. No. 1. January - April 2024

Emerg Pediatr. 2024; 3(1): 37-39

CASE REPORT

Pediatric epidural spinal abscess due to *Staphylococcus aureus*

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Received on April 12, 2023
Accepted on May 24, 2023

Key words:

Epidural abscess
Staphylococcus aureus
Pediatrics

Palabras clave:

Absceso epidural espinal
Staphylococcus aureus
Pediatría

Abstract

Spinal epidural abscess is a rare invasive infection in children, representing a medical-surgical emergency due to the risk of irreversible paralysis. The clinical triad of thoracolumbar pain, fever, and neurological involvement is not always evident, leading to potential delays in diagnosis. Staphylococcus aureus is the most common causative agent, and secondary septic foci should be ruled out when associated bacteremia is present.

We present the case of an 11-year-old patient with an unremarkable personal history, who consulted because of paresthesia and weakness in the lower limbs that developed over a few hours, as well as a 4-day history of fever and low back pain. Physical examination revealed hypoesthesia from D10 down, weakness of both lower limbs (strength 1/5), and absence of patellar and ankle reflexes. Magnetic resonance imaging confirmed a posterior dorsal spinal abscess causing spinal cord compression. Intravenous antibiotic treatment was started and urgent surgery involving laminectomy and drainage was performed. Methicillin-sensitive S. aureus was isolated from the abscess culture, but there was no associated bacteremia. The patient completed a 3-week course of intravenous cloxacillin, showing a favorable clinical outcome without neurological sequelae.

ABSCESO EPIDURAL ESPINAL PEDIÁTRICO POR *STAPHYLOCOCCUS AUREUS*

Resumen

El absceso epidural espinal es una infección invasiva infrecuente en pediatría que constituye una urgencia médico-quirúrgica por el riesgo de parálisis irreversible. La tríada clínica de dolor dorsolumbar, fiebre y afectación neurológica no siempre está presente, lo que puede demorar el diagnóstico. *Staphylococcus aureus* (*S. aureus*) es el agente causal más frecuente, debiendo descartarse focos sépticos secundarios cuando hay bacteriemia asociada.

Presentamos el caso de una paciente de 11 años, sin antecedentes personales de interés, que consultó por parestesias y debilidad en miembros inferiores de horas de evolución, junto con fiebre y dolor lumbar desde hacía 4 días. En la exploración física presentaba hipoestesia desde D10, debilidad de ambos miembros inferiores (fuerza 1/5) y abolición de reflejos rotulianos y aquíleos. Se diagnosticó por resonancia magnética de absceso espinal dorsal posterior con compresión medular, se inició tratamiento antibiótico intravenoso y cirugía urgente con laminectomía y drenaje. Se aisló en cultivo del absceso *S. aureus* meticilín sensible, sin bacteriemia asociada, completando 3 semanas de tratamiento intravenoso con cloxacilina, con evolución clínica favorable sin secuelas neurológicas.

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INTRODUCTION

We present a rare case of an invasive infection due to Staphylococcus aureus (*S. aureus*), which is relevant because of the potential complications arising from delayed diagnosis, as this may lead to irreversible motor paralysis.

Spinal epidural abscess is a rare condition that occurs in approximately 1 in 100,000 individuals[1]. It typically affects adults aged 50-60 years[2], and is infrequent in children. The most common etiologic agent is *S. aureus spp*, which may reach the spinal area through direct extension or hematogenous dissemination from a secondary infectious focus[1].

CASE REPORT

An 11-year-old female patient with an unremarkable personal history presented to the Emergency Department because of paresthesia and acute loss of strength in the lower limbs, evolving over a few hours. In addition, she had high fever and lumbar pain radiating to the rib cage, persisting without response to oral analgesia for the past 4 days. Furthermore, bowel movements were absent, indicating a habitual constipation pattern. The PET scan was normal. The body temperature was 38.2°C, heart rate 111 bpm, and blood pressure 119-78 mmHg. Physical examination was normal. Neurological examination revealed no focal abnormalities, and normal cranial nerves. Upper-limb strength was 5/5, while lower-limb strength was 1/5. Tactile and painful hypoesthesia was observed at the level of D10. The patient could not walk or stand, and sitting was painful even with support. Achilles and patellar reflexes were absent. Lumbar flexion was impossible due to pain, and the Lasegue sign was positive in both lower limbs. Blood analysis showed 9370 × 10^3/µl leukocytes and 7300 × 10^3/µl neutrophils, CRP 208 mg/L, with normal biochemistry and coagulation (except fibrinogen 862 mg/dl). Urgent spinal magnetic resonance imaging (MRI) showed a posterior epidural collection from D7 to D10, restricting diffusion and producing significant spinal cord compression of approximately 50% (Figure 1). During the diagnostic tests, there was a rapid progression of neurological symptoms, with a loss of strength and sensation in both lower limbs developing within the following 2 hours. Urgent surgical intervention was performed, consisting of laminectomy at the level of D8-D9 and drainage of the abscess, without complications. Empirical antibiotic therapy with intravenous (i.v.) cefotaxime was started. In the culture of the abscess, oxacillin-sensitive *S. aureus spp* was isolated; therefore, antibiotic therapy was switched to iv cloxacillin, given for 3 weeks. Blood culture on admission was negative. The postoperative dorsal CT scan showed a lesion in the base of the right lung suggestive of a necrotic infectious focus (Figure 2), and additional studies were performed to rule out other infectious foci (echocardiography, abdominal ultrasound, PET-CT). The outcome was highly favorable, with complete recovery of motor and sensory functions, allowing independent sitting and walking, with no surgical or neurological complications. The patient was discharged with an oral course of linezolid until completing 6 weeks of treatment and with satisfactory clinical and radiological improvement after hospital discharge.

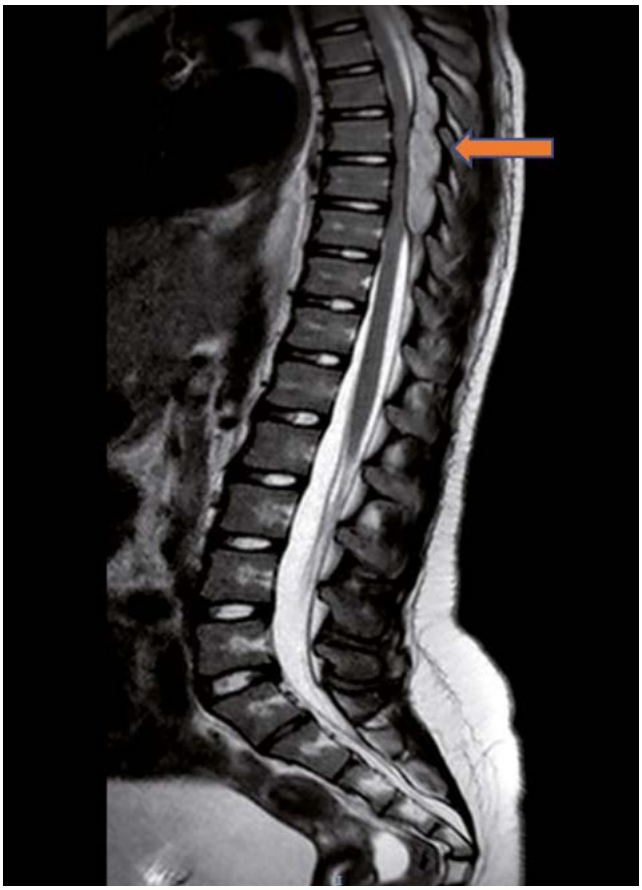

FIGURE 1. MRI with contrast of the dorsal lumbar spine showing a posterior epidural collection extending from D7 to D10 (arrow), characterized by well-defined boundaries, elongated morphology, and heterogeneous signal intensity. No lesions are observed in the vertebral bodies.

DISCUSSION

A spinal epidural abscess is a rare invasive bacterial infection in children, resulting from the accumulation of purulent material between the dura mater and the spinal canal[3]. It is a medical-surgical emergency due to the risk of irreversible paralysis.

The most common etiology is S. Aureus observed in 60-70% of the cases[3-5], followed by Gram-negative bacilli[1]. Less common pathogens include coagulase-negative staphylococcus and Gram-negative bacteria, specifically *Escherichia coli* and *Pseudomonas.*

The pathogenic mechanisms include hematogenous seeding of a bacteremic process, dissemination from an adjacent infectious focus, or direct inoculation due to trauma, spinal surgery, or an epidural catheter[3-5].

Different risk factors have been described, including diabetes, obesity, intravenous drugs, history of local trauma, spinal surgery, and recent placement of catheter or epidural injection, although in children these are described in only one third of the cases[4,6].

The classic clinical triad (dorsolumbar pain, fever and neurological signs) manifests only in a minority of patients (9-33%)[3,6,7], leading to potential delays in diagnosis. In our case, the patient presented with the classic triad, raising early suspicion of spinal cord compression due to a spinal

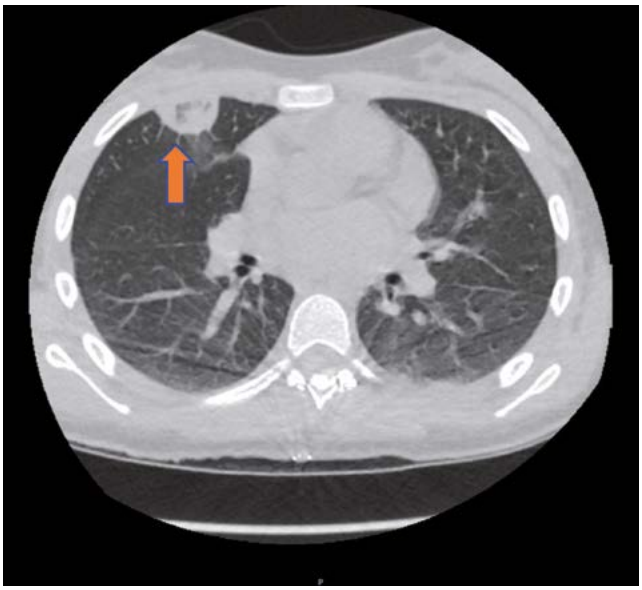

FIGURE 2. Postoperative dorsal CT scan showing increased density in the anterior pulmonary segment of the right upper lobe (arrow), with areas of lower density within, suggestive of a lesion in cavitation pathways (focus of necrosis/infarction or abscess). The remaining lung parenchyma is normal.

mass. None of the risk factors outlined in the literature were present in her case.

Four clinical stages were described by Heusner in 1948:3 stage 1: back pain at the level of the affected vertebrae; stage 2: radicular pain from the affected area; stage 3: motor and sensory impairment and/or bladder and bowel dysfunction; stage 4: paralysis. Once the patient enters stages 2 and 3, the spinal cord is involved and urgent spinal cord decompression is required, as was the case in our patient with rapid neurological progression.

MRI is the diagnostic test of choice due to its high sensitivity and multiplanar capacity, which helps to define the location and anatomical extension, assisting in surgical planning. CT with contrast is an option when MRI is not immediately available or is contraindicated[8]. Acute phase reactants are usually elevated and there is typically leukocytosis with a left shift. Blood culture may be positive in up to 50% of cases[3].

S. aureus bacteremia is associated with secondary septic foci[5,9]. In adults with S. Aureus bacteremia, epidural abscesses are reported in up to 8%[9]. Although our patient had a negative blood culture, a lesion suggestive of pulmonary infection was found. Consequently, additional studies were performed to investigate other potential infectious foci, with negative results.

Treatment is based on iv antibiotic therapy and surgical drainage, including decompressive laminectomy and urgent debridement in indicated cases. As *S. aureus* is the most frequent pathogen, it is recommended to start early empirical therapy according to the local resistance pattern (vancomycin/cloxacillin). The duration of treatment is 3-4 weeks, extending to 6 weeks if vertebral osteomyelitis is present[3].

Irreversible paralysis is the most severe complication, resulting from spinal cord ischemia due to direct compression, abscess expansion, or ischemia secondary to vascular involvement[3,10]. The abscess can evolve rapidly and unpredictably, as occurred in our patient. The time of progression from one stage to another is highly variable and may develop from a mild neurological deficit to paraplegia within hours or days[11]. Prognosis is related to the clinical stage at the time of diagnosis and depends on early diagnosis and treatment[7].

REFERENCES

1. Pons M, Pérez L, Juárez F. Absceso epidural espinal: caso clínico pediátrico. Arch Argent Pediatr. 2017; 115(3): e146-9.
2. Reihsaus E, Waldbaur H, Seeling W. Spinal epidural abscess: a meta-analysis of 915 patients. Neurosurg Rev. 2000; 23(4): 175-204.
3. Lepetic S, Martignetti C, Dalzotto A, Díaz F, Bickham D, Mariñasnky A, et al. Absceso epidural espinal por Staphylococcus aureus en pediatría. Caso clínico y revisión bibliográfica. Rev Hosp Niños (B Aires). 2017; 59(266): 166-70.
4. Vergori A, Cerase A, Migliorini L, Pluchino MG, Oliveri G, Arrigucci U, et al. Pediatric spinal abscess in an immunocompetent host without risk factors: Case report and review of the literature. IDCases. 2015; 2(4): 109-15.
5. Tong SYC, Davis J, Eichenberger E, Holland TL, Fowler Jr VG. Staphylococcus aureus infections: epidemiology, pathophysiology, clinical manifestations, and management. Clin Microbiol Rev. 2015; 28(3): 603-61.
6. Mantadakis E, Birbilis T, Michailidis L, Souftas V, Chatzimichael A. Spinal epidural abscess in a young girl without risk factors. Eur J Pediatr. 2011; 170(7): 945-8.
7. Davis DP, Wold RM, Patel RJ, Tran AJ, Tokhi RN, Chan TC, et al. The clinical presentation and impact of diagnostic delays on emergency department patients with spinal epidural abscess. J Emerg Med. 2004; 26(3): 285-91.
8. Sexton DJ, Sampson JH. Spinal epidural abscess. En: Stephen B, editor. UpToDate. Waltham, Mass: UpToDate; 2023.
9. Fowler Jr VG, Olsen MK, Ralph Corey G, Woods CW, Cabell CH, Barth Reller L, et al. Clinical identifiers of complicated Staphylococcus aureus bacteriemia. Arch Intern Med. 2003; 163(17): 2066-72.
10. Darouiche RO. Spinal epidural abscess. N Engl J Med. 2006; 355(19): 2012-20.
11. Reisaus E, Waldbaur H, Seeling W. Spinal Epidural abscess: a meta-analysis of 915 patients. Neurosurg Rev. 2000; 23(4): 175-204.

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SOCIEDAD ESPAÑOLA DE URGENCIAS DE PEDIATRÍA

EMERGENCIASPediátricas
Vol. 3. No. 1. January - April 2024

Emerg Pediatr. 2024; 3(1): 40-43

CASE REPORT

Subacute subdural hematomas associated with macrocephaly: Should we suspect non-accidental trauma?

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Received on June 17, 2023
Accepted on September 14, 2023

Key words:

Benign enlargement of the subarachnoid spaces
Subdural hematoma
History of trauma
Macrocephaly
Spontaneous

Palabras clave:

Aumento benigno de los espacios subaracnoideos
Hematoma subdural
Historia de trauma
Macrocefalia
Aparición espontánea

Abstract

Introduction: The etiological diagnosis of subacute subdural hematomas can be challenging for the pediatric emergency physician. In children, subacute subdural hematomas may be the result of non-accidental trauma. However, the presence of subdural collections has been associated with the benign enlargement of subarachnoid spaces that some infants with macrocephaly may experience. This association is infrequent and poorly reported in the literature.

Case reports: We present two patients with macrocephaly who were referred to the emergency department because of a progressive and rapid increase in head circumference. They had a normal neurological examination and neuroimaging studies were compatible with multiple subacute subdural hematomas.

Conclusion: In pediatric patients with subdural hematomas, non-accidental trauma should be ruled out as the cause before considering other diagnoses. Nevertheless, there are other etiologies associated with the presence of these hematomas, such as accidental trauma or spontaneous occurrence. Expanding the etiological investigation and understanding these potential associations is important, as it enables appropriate and timely diagnosis, which may significantly impact the child's future.

HEMATOMAS SUBDURALES SUBAGUDOS ASOCIADOS A MACROCEFALIA. ¿ESTAMOS ANTE UN TRAUMA NO ACCIDENTAL?

Resumen

Introducción: *El diagnóstico etiológico de los hematomas subdurales subagudos puede suponer, en ciertos escenarios, un reto para el médico de Urgencias. En niños, en ocasiones es el resultado de una lesión craneal no accidental. Sin embargo, la presencia de colecciones subdurales se ha relacionado con el aumento de espacios subaracnoideos que pueden presentar algunos lactantes con macrocefalia. Esta asociación es poco conocida y poco reportada en la literatura.*

Casos clínicos: *Exponemos los casos clínicos de dos pacientes con macrocefalia que fueron derivados a Urgencias por un aumento progresivo y rápido del perímetro cefálico. Presentaban exploración neurológica normal y estudios de neuroimagen compatibles con hematomas subdurales subagudos múltiples.*

Conclusión: *Es necesario excluir la causa de traumatismo no accidental antes de plantear otros diagnósticos en pacientes pediátricos ante el hallazgo de hematomas subdurales. Aun así, existen otras etiologías relacionadas con la presencia de estos hematomas, como traumatismos accidentales o aparición espontánea. Es importante ampliar el estudio etiológico y conocer estas posibles asociaciones, así como realizar un diagnóstico adecuado y precoz dado que puede condicionar el futuro del niño.*

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INTRODUCTION

Children with subdural hematomas (SDH) often present to the emergency department with nonspecific signs or symptoms, which makes diagnosis challenging. These may include lethargy, feeding difficulties, altered levels of consciousness, or progressive macrocephaly without other associated symptoms. Diagnosis is usually made based on neuroimaging, including transfontanellar ultrasound, brain computed tomography (CT), or magnetic resonance imaging (MRI)[1-3].

These findings should always raise suspicion of possible non-accidental trauma (NAT), indicating potential child abuse or maltreatment. In addition, investigations should be conducted to explore accidental trauma and other potential causes of SDH[4].

We describe two asymptomatic patients who consulted for macrocephaly, and who were diagnosed with spontaneous subacute SDH with different treatments and outcome.

CASE REPORTS

Case 1. A 13-month-old boy was referred to the emergency department due to a sudden increase in head circumference (HC) from -1 standard deviation (SD) to +1 SD over the last 6 months. The neurological examination was normal, psychomotor development was according to age, and there was no history of previous trauma. Transfontanellar ultrasound did not reveal any alterations and it was decided to admit the patient to complete the investigations. The MRI showed subacute SDHs, one in the right frontoparietal region, with a maximum thickness of 8 mm and another in the left parietooccipital region with a maximum thickness of 5 mm, and enlargement of the subarachnoid spaces (Figure 1). After evaluation by social services and considering that the skeletal X-rays and fundoscopy were normal, it was concluded that there was no evidence of NAT. Based on the patient's asymptomatic condition, the neurosurgery team opted for watchful waiting. Follow-up neuroimaging studies conducted 3 months later revealed complete resolution of the hematomas.

Case 2. A 5-month-old male infant with a 2-month history of progressive macrocephaly (46 cm, > 2 SD) was referred to the emergency department for evaluation. The infant had sustained head trauma from a fall off the sofa when he was pushed by his older brother, which occurred one month earlier. The patient was asymptomatic and his neurological development was normal. Transfontanellar ultrasound and fundoscopy showed no abnormalities. However, the MRI revealed bilateral cerebral hemispheric subdural collections of varying density, measuring up to 2 cm in size, with a mass effect on the adjacent parenchyma and enlargement of the subarachnoid spaces (Figure 2). He underwent neurosurgical intervention for drainage of the hematomas. Skeletal x-rays yielded normal results, and evaluation by social services did not reveal any signs of NAT. Nevertheless, two months after the initial procedure, urgent surgical drainage was necessary due to an 8-mm, right-sided displacement of the midline, secondary to a left frontotemporo-parietal hematoma with both subdural and epidural components, measuring 113 x 40 x 61 mm in diameter, resulting in the mass effect.

Both patients underwent coagulation tests and metabolic studies with normal results.

DISCUSSION

The incidence of SDH, regardless of the etiology, is estimated at 12 cases per 100,000 children under 2 years of

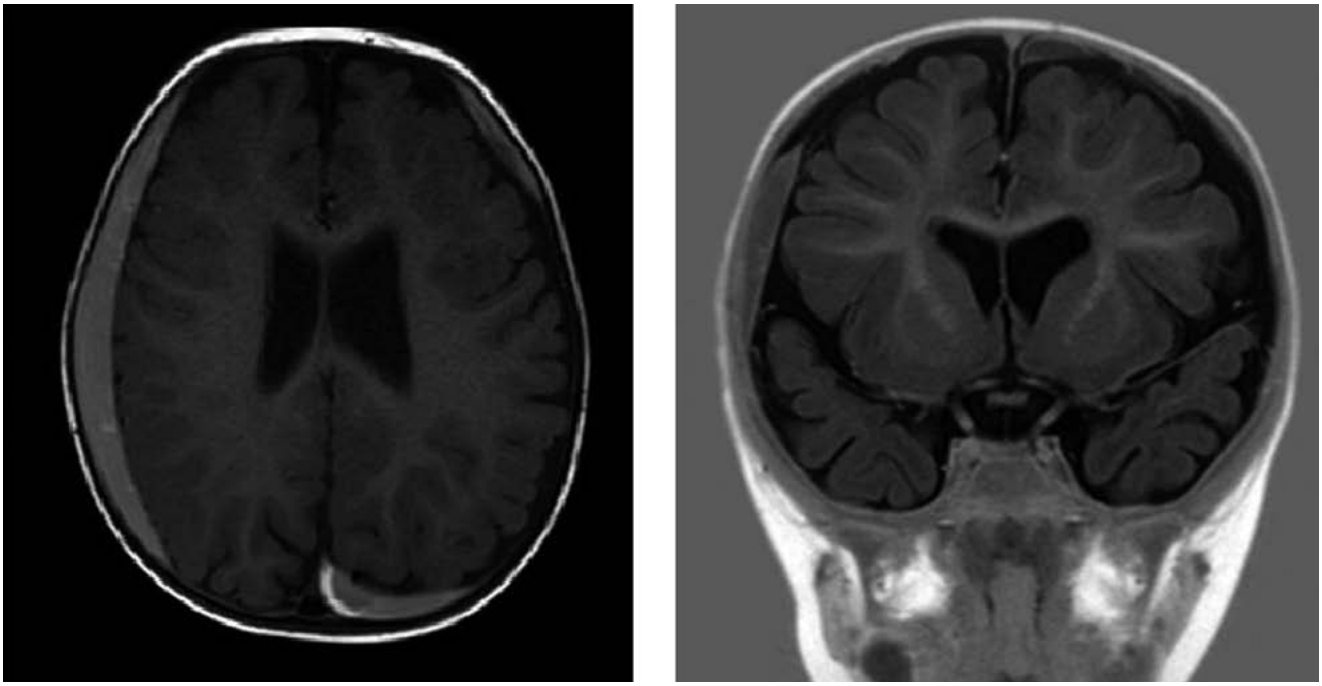

FIGURE 1. Brain MRI of case 1, axial and coronal T1-slices. Right frontoparietal and left parietooccipital subdural hematoma.

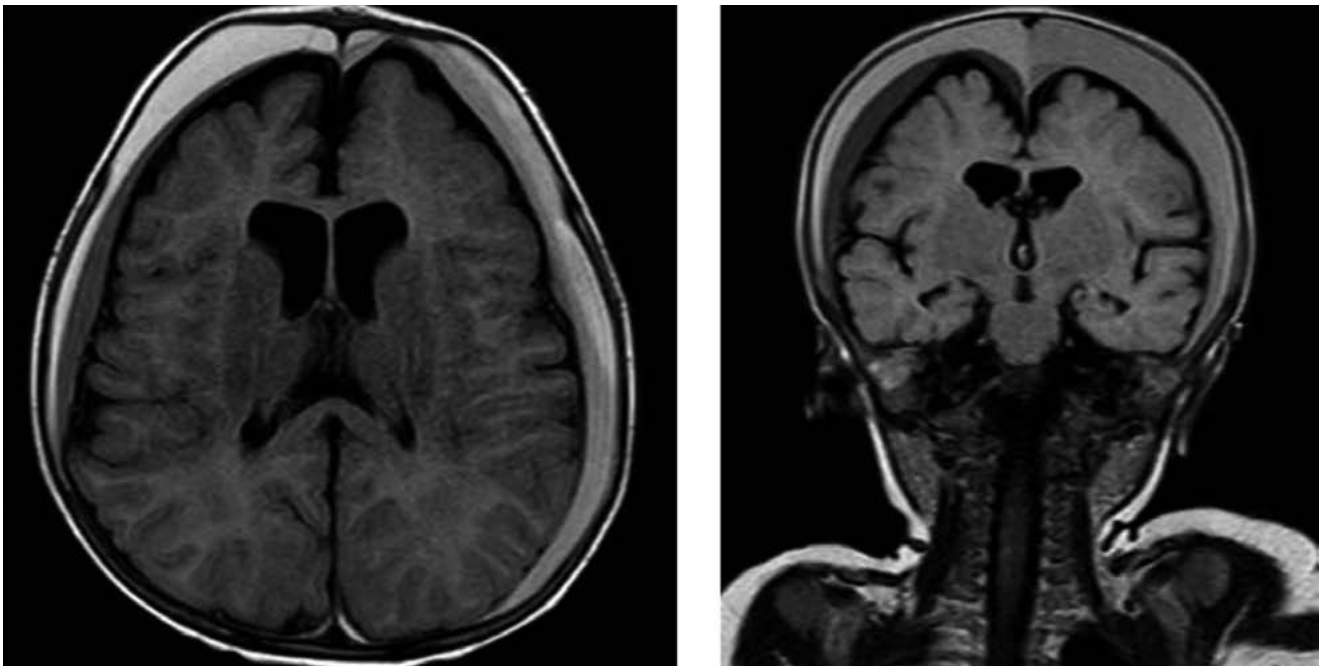

FIGURE 2. Brain MRI of Case 2, axial and coronal FLAIR sections depicting bilateral subdural hematomas.

age. The clinical presentation is often nonspecific, posing a challenge for pediatric emergency physicians in both diagnosing SDH and determining their underlying cause. While the cases described here represent an uncommon form of presentation, it remains crucial to consider the possibility of SDH in an infant with asymptomatic progressive macrocephaly due to the clinical and social implications associated with early detection[3,5,6].

The diagnosis is made based on neuroimaging. The use of MRI as the first option in the case of suspected NAT is controversial, as it is less sensitive than CT scan in the detection of acute hemorrhage. However, in an asymptomatic patient, MRI is preferable to CT scan because of its greater sensitivity in revealing parenchymal involvement and lesions in different stages of evolution[7].

The differential diagnosis of an infant with SDH mainly includes accidental traumatic brain injury (TBI), NAT, and non-traumatic causes.

Minor head trauma is a common reason for emergency department visits. In most cases it is mild and patients can be discharged after a period of observation. Nevertheless, in children under 2 years of age, the risk of NAT is higher and may lead to death or severe neurological sequelae, often associated with the presence of SDH. Given the strong association with NAT, the pediatric emergency physician should be alert and consider this diagnosis as the first option upon consultation in the emergency department. The mechanism underlying SDH in these patients typically involves tearing of the bridging veins, resulting from the acceleration-deceleration forces caused by shaking the infant while being held by the trunk. In addition, these infants commonly exhibit other associated injuries such as retinal hemorrhages and rib or long-bone fractures[3,8].

Spontaneous causes should also be investigated in the evaluation of children with SDH. Perinatal or birth-related trauma, congenital (e.g. enlarged subarachnoid spaces), genetic (e.g. Ehlers Danlos syndrome), or metabolic (e.g. glutaric aciduria type I) diseases, infections, coagulopathies, congenital vascular malformations, dehydration, or excessive drainage of ventricular volume (overshunting) should be considered[9,10].

To establish an etiologic diagnosis of SDH, the evaluation conducted by the pediatric emergency physicians should include a detailed history of possible accidental causes, ruling out underlying medical conditions that may cause spontaneous SDH, and a thorough assessment of the injuries. Physical examination of the skin and mouth, skeletal x-rays and fundoscopy are important to rule out NAT. In cases of suspected spontaneous SDH, studies to evaluate coagulation and metabolic disorders, as well as comprehensive neuroimaging assessment are essential.

The finding of benign enlarged subarachnoid spaces (BESS) is common in infants with macrocephaly. The incidence of SDH in patients with BESS has been estimated to range between 4-18% and they may manifest with minimal or no trauma. The association between BESS and SDH remains poorly understood, but several hypotheses have been proposed. The prevailing theory suggests that BESS may lead to easier displacement of the brain, resulting in more frequent stretching and injury to the bridging veins. Even so, individuals with BESS may remain asymptomatic, as the brain is protected by the enlarged spaces in which BESS develops[9,11,12]. Nevertheless, it has also been suggested that the occurrence of macrocephaly with the enlargement of the subarachnoid space might be the result of a previous hemorrhage that would cause an alteration in the arachnoid granulations and impedes the normal absorption of CSF. Therefore, Raissaki et al. have proposed a guideline for patients presenting with BESS and subdural collections, recommending that the investigations should be completed with skeletal x-rays, even when the fundoscopy, evaluation by social services, and clinical examination are inconclusive[4,5,13].

CONCLUSIONS

The finding of SDH in the emergency department necessitates the exclusion of NAT in all cases. In the presence of an asymptomatic infant with macrocephaly and SDH, even if the infant presents an image compatible with BESS, the diagnosis of child abuse cannot be ruled out without performing other complementary studies.

REFERENCES

1. Girard N, Brunel H, Dory-Lautrec P, Chabrol B. Neuroimaging differential diagnoses to abusive head trauma. Pediatr Radiol. 2016; 46(5): 603-14.
2. Caré MM. Macrocephaly and subdural collections. Pediatr Radiol. 2021; 51(6): 891-7.
3. Snelling PJ, Aruljoe Thanasingam A, Jones P, Connors J. Comparison of abusive head trauma versus non-inflicted subdural haematoma in infants: A retrospective cohort study. Emerg Med Australas. 2022;34(6):968-75. doi:10.1111/1742-6723.14028.
4. Raissaki M, Adamsbaum C, Argyropoulou MI, Choudhary AK, Jeanes A, Mankad K, et al. Benign enlargement of the subarachnoid spaces and subdural collections-when to evaluate for abuse. Pediatr Radiol. 2023; 53(4): 752-67.
5. Hansen JB, Frazier T, Moffatt M, Zinkus T, Anderst JD. Evaluations for abuse in young children with subdural hemorrhages: findings based on symptom severity and benign enlargement of the subarachnoid spaces. J Neurosurg Pediatr. 2018; 21(1): 31-7.
6. Laurent-Vannier A, Rambaud C, Levin HS. Letter to the Editor. Subdural collections in infants: trauma or not trauma?. J Neurosurg Pediatr. 2017; 20(3): 302-3.
7. Delgado Álvarez I, de la Torre IB, Vázquez Méndez É. The radiologist's role in child abuse: imaging protocol and differential diagnosis. El papel del radiólogo ante el niño maltratado. Protocolo de imagen y diagnóstico diferencial. Radiologia. 2016; 58 Suppl 2: 119-28.
8. Porto L, Bartels MB, Zwaschka J, You SJ, Polkowski C, Luetkens J, et al. Abusive head trauma: experience improves diagnosis. Neuroradiology. 2021; 63(3): 417-30.
9. Lee HC, Chong S, Lee JY, Cheon JE, Phi JH, Kim SK, et al. Benign extracerebral fluid collection complicated by subdural hematoma and fluid collection: clinical characteristics and management. Childs Nerv Syst. 2018; 34(2): 235-45.
10. Greiner MV, Richards TJ, Care MM, Leach JL. Prevalence of subdural collections in children with macrocrania. AJNR Am J Neuroradiol. 2013; 34(12): 2373-8.
11. Alshareef M, Tyler M, Litts C, Pearce J, Yazdani M, Eskandari R. Prevalence of Visible Subdural Spaces in Benign Enlargement of Subarachnoid Spaces in Infancy: A Retrospective Analysis Utilizing Magnetic Resonance Imaging. World Neurosurg. 2022; 164: e973-9.
12. Tucker J, Choudhary AK, Piatt J. Macrocephaly in infancy: benign enlargement of the subarachnoid spaces and subdural collections. J Neurosurg Pediatr. 2016; 18(1): 16-20.
13. Zouros A, Bhargava R, Hoskinson M, Aronyk KE. Further characterization of traumatic subdural collections of infancy. Report of five cases. J Neurosurg. 2004; 100(5 Suppl Pediatrics): 512-8.

SEUP
SOCIEDAD ESPAÑOLA DE URGENCIAS DE PEDIATRÍA

EMERGENCIASPediátricas
Vol. 3. No. 1. January - April 2024

Emerg Pediatr. 2024; 3(1): 44-48

NURSING

Development of a training program in ultrasound-guided peripheral venous catheter placement: experience in a tertiary pediatric hospital

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INTRODUCTION

Placement of a peripheral venous catheter (PVC) in pediatric patients always poses a challenge. In emergency situations, in 15% of children difficulties in securing a PVC are encountered[(1)].

The DIVA2 (Difficult Intravenous Access) prediction score identifies patients with difficulties in detecting suitable veins for the intravenous administration of medication or sampling due to poorly visible, collapsed, or damaged veins (Table 1).

When a patient is classified as DIVA, it is advisable to use technologies such as infrared imaging and/or ultrasound to optimize the chances of successful venous access.

Ultrasound (US) guidance for PVC placement has proven to be effective, reducing the use of central venous catheters, increasing staff autonomy, and improving patient satisfaction[(3)]. However, the success of the procedure will depend on the proficiency of the operator, highlighting the importance of prioritizing training in these skills[(4)].

In 2008, at the Hospital de Pediatría Prof. Dr. "Juan P. Garrahan" in Argentina, the "catheter patrol" was established—a team of specialized nurses dedicated to infusion therapy. Since 2019, this team has incorporated the use of US for the placement of PVCs in DIVA patients.

Currently, at the emergency department, there is a need to integrate this resource as an effective strategy to address the challenge. For this purpose, a theoretical-practical training program for the healthcare team was developed with the aim of taking a significant step towards a better quality of care.

The aim of this article was to describe our experience with the design and implementation of a training program in the use of ultrasound-guided PVC placement in the emergency department of a tertiary hospital. The analysis of the impact and results of the implementation of this technology for the placement of venous access will be the subject of a future study.

Received on November 25, 2023
Accepted on March 26, 2024

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DEVELOPMENT

Setting

The "Prof. Dr. Juan P. Garrahan" Pediatric Hospital in Argentina is a tertiary care center that receives more than 600,000 outpatient visits per year. It has 587 beds, 132 of which are for intensive care. Each year, the Center for the Comprehensive Care of Hematology-Oncology Patients (CAIPHO) receives around 520 new patients. In addition, approximately 120 transplants (bone marrow, heart, kidney, liver, and cochlea) are performed annually. The Emergency Department receives 120,000 visits per year.

Teaching team

The catheter patrol team consists of five nurses specialized in infusion therapy with graduate training and experience ranging from 3 to 13 years. The nurses have been formally trained by participating in various theoretical, practical, and simulation courses at recognized national and international institutions.

Initially, they incorporated infrared light for percutaneous catheter placement into their routine practice, and in 2019,

TABLE 1. DIVA prediction score.

Variable	Point value		Score
Vision	Visible	0	
	Not visible	2	
Palpability	Palpable	0	
	Not palpable	2	
Age	> 3 years	0	
	1-2 years	1	
	< 1 year	3	
History of prematurity	Full-term	0	
	Premature	3	
		Total	

Modified from: Whitney R, Langhan M. Vascular Access in Pediatric Patients in the Emergency Department[6].

they added US guidance for catheter placement. The implementation of this tool required the mentoring of a pediatric surgeon until the team became proficient and autonomous. Over the years, the number of US-guided catheter placements increased (Figure 1).

The catheter patrol operates from monday to friday from 07:00 am to 9:00 pm and any area of the hospital can request a consultation with this team. Initially, the patrol will evaluate the patient's therapeutic needs and perform a clinical and US assessment to define the type of catheter, approach route, and technology to be used. Secondly, the placement of the catheter will be scheduled with the treating team.

With the aim to improve and expand continuing education the patrol has created its own practice and simulation

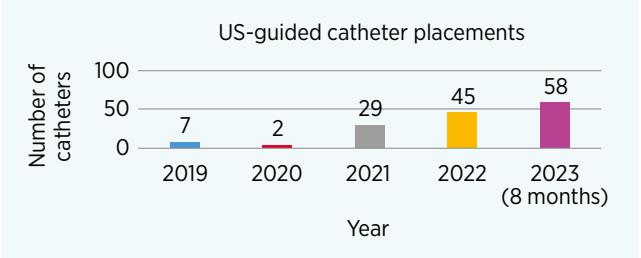


FIGURE 1. Ultrasound-guided procedures in DIVA patients performed by the catheter patrol.

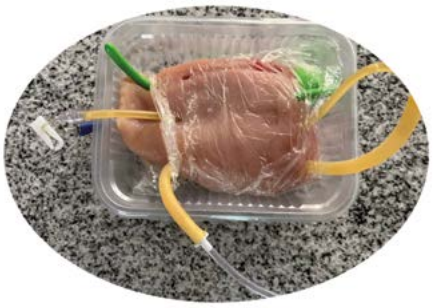
materials for vascular access placement using gel-based devices and biological models (Figure 2).

For over a decade, the patrol has been systematically providing theoretical and practical training to practitioners working in different areas of the hospital. The team conducts educational activities for medical and nursing residents with curricula that include training in these skills.

Intervention

Between March and August 2023, within the framework of the continuing education program of the Emergency Department of the Garrahan Hospital, training in the use of US for PVC placement was implemented for physicians and nurses of the permanent staff. The training was conducted by catheter patrol nurses and emergency department staff and consisted of two 60-minute theoretical-practical modules. Aspects related to basic US handling, recognition of vascular structures, evaluation of the venous system using the RaPeVA (Rapid Peripheral Venous Assessment)5 protocol, and finally, placement of a PVC in gel-based and biological models (Figure 2).

GEL-BASED SIMULATOR
Materials:
- Unflavored gelatin powder
- Water
- Glycerin
- Food coloring (optional, to color the gelatin)
- Containers or molds with holes for inlet and outlet
- Latex tubes 5 x 8 (Inner diameter: 5 mm/Outer diameter: 8 mm).
- Use of Macro Drip (attach a macro dripper with serum to one end of the latex tube. Prime the latex tubing to ensure that no air bubbles are present)



BIOLOGICAL MODEL SIMULATOR
Materials:
- Biological model with inlet and outlet holes
- Latex tubes 5 x 8 (inner diameter: 5 mm/Outer diameter: 8 mm)
- Use of Macro Drip. (Attach a macro dripper with serum to one end of the latex tube. Prime the latex tubing to ensure that no air bubbles are present)

FIGURE 2. Material for the simulation.

FIGURE 3. The emergency team is practicing with US guidance using self-made and low-cost resources.

Trained staff

Thus, a total of 11 physicians and 15 nurses from the emergency department were trained in the basic use of US, evaluation of the venous system, and ultrasound-guided catheter placement (Figure 3).

After completing the theoretical and practical training, emergency department practitioners conducted a series of intravenous line placements under the supervision of the catheter patrol nurses.

Incorporation of US into an algorithm for intravenous line placement

Finally, an algorithm was developed for PVC placement in the emergency department, incorporating the novel use of US.

Adequate management of a patient's venous access should be considered at every stage of care. Upon admission to the emergency department, priority will be given to intravenous line placement, based on the urgency of the clinical situation. Certain circumstances may necessitate evaluation of other variables contributing to the rational management of vascular access, especially in patients undergoing prolonged treatment and frequent hospitalization.

The DIVA prediction score is used to evaluate possible peripheral venous access in patients in need of infusions and/or blood sampling. It evaluates the visibility and palpability of the vessel, along with the patient's age and history of prematurity (Table 1). The cumulative score obtained for each variable represents the DIVA score, ranging from 0 to 10 points[6]. If > 4, the utilization of infrared light technology or US should be contemplated before inserting a PVC.

When admitting a patient, we will first evaluate whether it is an emergency or an urgency and, therefore, how fast we should start specific therapy. Other factors to consider in the choice of vascular access are the estimated treatment time and difficulty according to the DIVA scale (Table 1) as well as the availability of suitable vessels. At this stage, it is also relevant to define the number of suitable vessels in order to select the most experienced operator and consider the use of US (Table 2).

We propose the following algorithm for decision-making regarding venous access in the emergency department (Figure 4). The algorithm introduces the use of US in different clinical scenarios. If the patient presents with respiratory arrest or decompensated shock, intraosseous access is recommended. If the patient requires emergency intervention but does not need intraosseous access, the choice of placement modality is determined based on the DIVA prediction score and the availability of adequate vessels. Venous access via direct puncture (using direct vision, palpation, or anatomical references) is preferred for patients with visible and palpable vessels. However, if direct puncture is unsuccessful after four attempts or if the DIVA score exceeds 4 points, US guidance should be used.

If the patient is not in an emergency situation, we can include an additional consideration related to estimating the duration of required infusion therapy, particularly for patients who are frequently hospitalized or undergo prolonged treatments. For treatments anticipated to last less than 5 days, a short peripheral venous access may be selected, considering the DIVA score and the availability of suitable veins. For treatments lasting between 6-30 days, US-guided midline catheters are recommended.

TABLE 2. Assessment of the degree of difficulty according to the number of suitable veins according to operator skills[7].

Grade	Number of suitable veins	Insertion management
1	3-5 veins	Insertion by trained competent healthcare practitioner
2	2-3 veins	Insertion by trained competent healthcare practitioner
3	1-2 veins	Insertion by trained competent healthcare practitioner
4	No palpable visible veins	Ultrasound-guided insertion by trained competent healthcare practitioner
5	No suitable veins with ultrasound	Refer to specialist

Source: Fuente: Hallam C, Denton A, Weston V, et al. Marco de Salud y Preservación de venas (VHP) del Reino Unido[7].

DISCUSSION

In the pediatric emergency care setting, the search for approaches that reduce the need for repeated punctures represents a challenge. In daily practice, there are several situations that complicate the placement of PVCs in children,

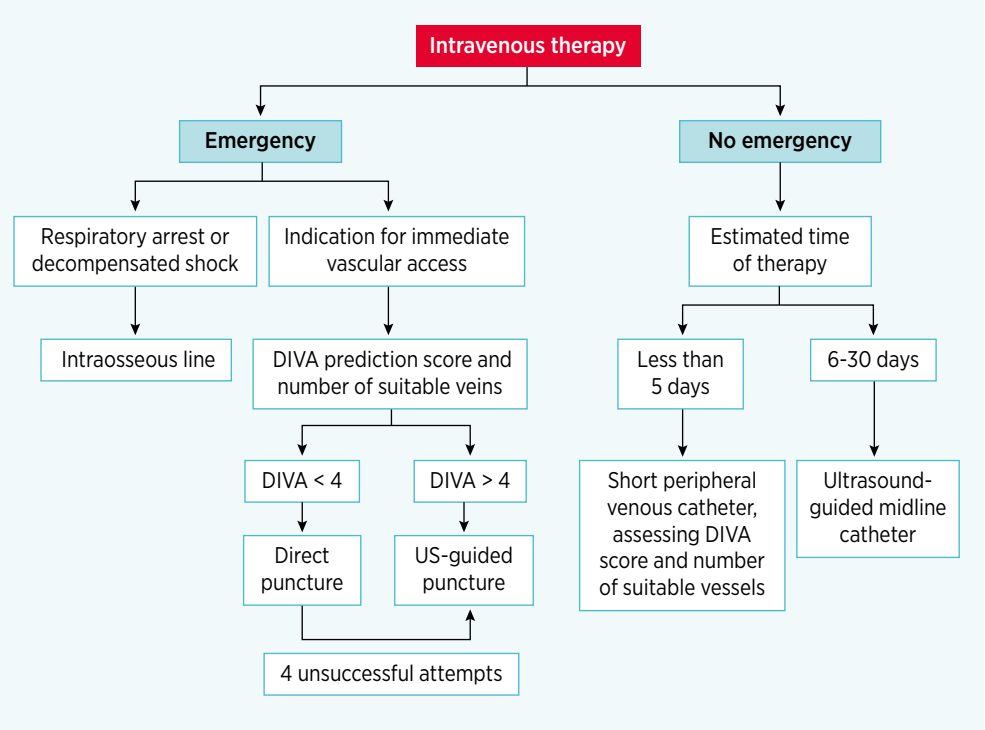


FIGURE 4. Algorithm for the placement of a peripheral venous catheter.

some related to pre-existing conditions (prematurity, young age, obesity, chronic diseases, etc.) and others related to the acute condition (fever, dehydration, acidosis, etc.). According to current recommendations, it is suggested that up to four attempts be made to place a PVC[8].

Currently, there is clear evidence supporting the advantages of incorporating US in the placement of a PVC for both adults and children. Utilizing US facilitates success on the first attempt and overall success[9], thereby avoiding unnecessary punctures and reducing patient pain and anxiety. Moreover, it allows a more precise placement of the catheter minimizing the risk of complications such as arterial punctures, hematomas, infiltration, and extravasation. In addition, by reducing unsuccessful puncture attempts, US guidance saves time and resources, while also preventing the need for more invasive techniques, thus offering significant benefits to the safety and experience of the patient and their families.

Finally, there are numerous studies on the implementation of this type of educational training programs in emergency and critical care departments, which suggest beneficial results in terms of placement time, efficacy, and the need for central access[10,11]. On the other hand, regarding the number of ultrasound-guided PVC placements required to achieve proficiency, literature primarily focused on emergency department nurses and physicians suggests that four attempts are necessary to achieve a success rate of 70%, and between 15 and 26 attempts to achieve a success rate of 88%[4].

In view of the above, the implementation of a theoretical-practical training program in US-guided PVC placement is considered a promising strategy for the acquisition of these skills by emergency practitioners. Such training will serve as an additional resource for managing difficult intravenous access (DIVA) patients.

CONCLUSIONS

The successful implementation of this training program provided benefits in several aspects.

From the perspective of the healthcare team, it has promoted shared training opportunities for both physicians and nurses, reinforcing the concept of teamwork and facilitating the acquisition of skills essential for the daily operation within the emergency department. Similarly, the collaboration with the catheter patrol has proven to be a mutually enriching and exemplary experience of interdepartmental cooperation within the hospital, all aimed at achieving a common goal.

From the standpoint of patient care, the dissemination and training of personnel in this technique significantly contributed to enhancing the quality of care provided to children in the emergency department.

ACKNOWLEDGEMENTS

We would like to thank Dr. Horacio Questa for or his invaluable support and guidance throughout our learning process and Dr. Guillermo Kohn Loncarica for his review and valuable contributions to our manuscript.

REFERENCES

1. Emergencias/Urgencias. Gavecelt.it. Disponible en: http://davexpertesp.gavecelt.it/?q=node/108. [Consulta 8 de septiembre de 2023].
2. Biasucci D. Special Problems of Venous Access in Intensive Care and Emergency. En: Biasucci D, Disma N, Pittiruti M, editores. Vascular Access in Neonates and Children. Springer Nature Switzerland AG; 2022. p. 376.

3. Egan G, Healy D, O'Neill H, Clarke-Moloney M, Grace PA, Walsh SR. Ultrasound guidance for difficult peripheral venous access: systematic review and meta-analysis. Emerg Med J. 2013; 30(7): 521-6.
4. Stolz LA, Cappa AR, Minckler MR, Stolz U, Wyatt RG, Binger CW. Prospective evaluation of the learning curve for ultrasound-guided peripheral intravenous catheter placement. J Vasc Access. 2016; 17(4): 366–70.
5. Brescia F, Pittiruti M, Spencer TR, Dawson RB. The SIP protocol update: Eight strategies, incorporating Rapid Peripheral Vein Assessment (RaPeVA), to minimize complications associated with peripherally inserted central catheter insertion. J Vasc Access. 2022; 25(1): 5-13.
6. Whitney R, Langhan M. Vascular access in pediatric patients in the emergency department: Types of access, indications, and complications. Pediatr Emerg Med Pract. 2017; 14(6): 1-20.
7. Hallam C, Denton A, Weston V, Dunn H, Jackson T, Keeling S, et al. UK Vessel Health and Preservation (VHP) Framework: a commentary on the updated VHP 2020. J Infect Prev. 2021; 22(4): 147-55.
8. Boletín Oficial de la República Argentina. Procedimiento de inserción y cuidado del catéter venoso periférico corto (cvpc) 2022. Disponible en: https://www.boletinoficial.gob.ar/detalleAviso/primera/274332/20221025. [Consulta 20 de agosto de 2023].
9. Mitchell EO, Jones P, Snelling PJ. Ultrasound for Pediatric Peripheral Intravenous Catheter Insertion: A Systematic Review. Pediatrics. 2022; 149(5): e2021055523.
10. Jørgensen R, Laursen CB, Konge L, Pietersen PI. Education in the placement of ultrasound-guided peripheral venous catheters: a systematic review. Scand J Trauma Resusc Emerg Med. 2021; 29(1): 83.
11. Bhargava V, Su E, Haileselassie B, Davis D, Steffen KM. Ultrasound education improves safety for peripheral intravenous catheter insertion in critically ill children. Pediatr Res. 2022; 91(5): 1057-63.

SEUP
SOCIEDAD ESPAÑOLA DE URGENCIAS DE PEDIATRÍA

EMERGENCIASPediátricas
Vol. 3. No. 1. January - April 2024

Emerg Pediatr. 2024; 3(1): 49-51

WORKING GROUPS

Activity of the Critical Patient Working Group of the Spanish Society of Pediatric Emergency Medicine

María Teresa Leonardo Cabello[1], Yolanda Ballestero Díez[2] and Critical Patient Working Group of the Spanish Society of Pediatric Emergency Medicine

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The Critical Patient Working Group (WG) of the Spanish Society of Pediatric Emergency Medicine (SEUP) was created in 2018 following a survey aimed at describing the organization of critical patient care in pediatric emergency departments (PEDs) across Spain. The survey revealed significant variability in organization, infrastructure, material and personal resources among these departments. Additionally, it highlighted the need to improve training in procedures in the critically ill patient. This realization prompted a profound reflection and became our point of departure.

Since its creation, the goal of the WG has been to provide quality care to critically ill patients treated at the national PEDs based on 2 pillars: research and education. Our objective is to ensure that this care is consistently delivered according to quality standards.

Our first project was focused on creating an observatory in order to collect data regarding critically ill patients upon arrival at the PED, the care they received both at the prehospital level and in the different PEDs, and patient outcomes. We aimed to identify areas for improvement, to early identify critically ill patients or those at risk of deterioration, and to adapt and optimize treatment protocols at both the prehospital and hospital stages.

Thus, in February 2020, the research project entitled "Multicenter registry of pediatric critical patients in Spanish pediatric emergency departments" was initiated. Currently, 21 national PEDs are participating, and 350 episodes have been collected. The data have been analyzed and were presented at different SEUP meetings, awaiting publication.

In parallel to the creation of the WG, in 2018 the SEUP Quality WG updated the document on quality indicators that would be essential to comply with in PEDs[1]. This document comprises 93 indicators, with 13 specifically pertaining to critical patient care. Our WG selected the following two indicators, which are monitored by means of biannual surveys:

Protocols for life-threatening emergencies, including treatment of TBI, initial care of polytrauma, basic and advanced CPR, and treatment of shock, coma, respiratory failure.

Review of the material and equipment in the resuscitation room and crash cart.

The WG collaborated in the development of do-not-do recommendations, together with the other SEUP WGs[2]. Specifically, the five most important actions not recommended in the critically ill patient can be consulted at the following link: https://seup.org/pdf_public/gt/Acciones/GT_Pac_critico.pdf.

However, during the development of these recommendations following the Delphi methodology, consensus was achieved within the group on seven recommendations, and we subsequently published them in the previous issue of this journal describing the selection process[3].

The final list of the "7 do-not-do recommendations" is shown in Figure 1.

In addition to this collaboration, since 2020 we have been working with different societies, including the Spanish Society of Pediatric Intensive Care (SECIP), the Spanish Society of Neonatology (SeNeo), and the Spanish Society of Emergency Medicine (SEMES) to improve the care provided to critically ill pediatric patients across the care system.

The physiology of children differs from that of adults, and they present distinct pathologies that often require a specialized approach. Together with the regionalization of pediatric care into primary, secondary, and tertiary care cen-

Received on April 1, 2024
Accepted on April 1, 2024

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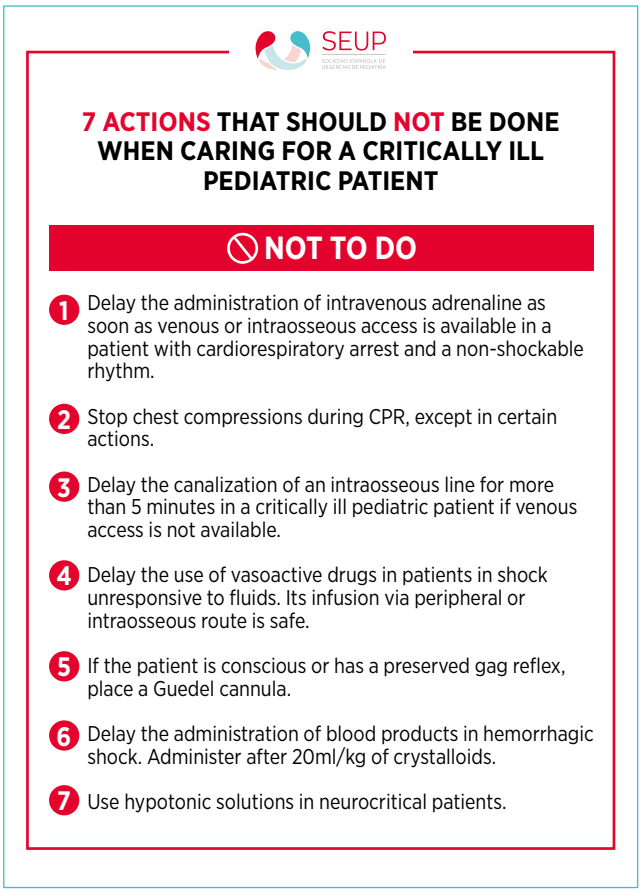

FIGURE 1. 7 actions NOT TO DO in the critically ill pediatric patient.

ters, hospitals at lower levels of care may lack the necessary material and personnel resources for managing critically ill children. Consequently, there arises a need to transfer these patients to hospitals with a higher level of complexity. Pediatric and Neonatal Transport (PNT) mobilizes the human and material resources of critical care units to hospitals lacking such resources due to the level of care required, with the objective of sustaining the early, specialized, and continuous comprehensive care essential for these patients. Numerous studies have demonstrated that specialized transport teams achieve superior outcomes with fewer complications compared to teams lacking specific training[4-7].

Thus, in 2021, we prepared a position paper on the need for the implementation of pediatric and neonatal transport units specialized in interhospital transport[8].

Similarly, we contributed to the drafting of the article entitled "Importance of specialized paediatric and neonatal transport. Current situation in Spain: Towards a more equitable and universal future"[9]. This study analyzes the situation across autonomous communities, describing the current state of pediatric transport, which lacks standardization at the national level.

The same article also emphasizes the importance of continuous training and periodic refreshers for professionals to effectively meet the quality standards in transportation. Here, the WG is supporting the training of different professionals involved in the care and transportation of pediatric and neonatal critically ill patients by offering basic and advanced courses in PNT.

Continuing with training and collaboration with other WGs, the Critical Patient WG, together with the Simulation WG, is involved in organizing the national phase of the Pediatric Simulation Games (PSG).

The PSGs are an activity in which different teams composed of MIR/EIR residents compete, with each team typically consisting of 6 to 7 residents and a "coach." As described by Abel Martinez in the previous issue of this journal, these games are more than a competition; they serve as a training activity that stimulates the development of residents and reinforces the necessity to maintain a high level of training in our PEDs[10].

The aim is for residents to demonstrate their knowledge and skills in managing critically ill children through simulation. They evaluate their individual competencies, consolidate communication and teamwork skills, and simultaneously learn about different educational contexts through exchanging experiences with colleagues from various regions. All of this occurs within a friendly and healthy competitive environment, while maintaining a high level of scientific rigor. The fourth edition, held in Guadarrama (Madrid) in March 2024, was a great success.

Another crucial aspect we are prioritizing is the development of documents and resources to assist various professionals in the care for critically ill pediatric patients. To this end, the WG has initiated the creation of medication dosage sheets calculated based on weight and age. A team of pediatricians and nurses who are members of the WG has undertaken this task. It has involved extensive efforts in creation, consensus-building, elaboration, and formatting, and the finalized sheets will be published on the SEUP website, making this tool accessible to all professionals.

Among our future projects, we plan to establish a multicenter registry for cardiorespiratory arrest and polytrauma patients. This registry will provide insights into the actual management practices, identify potential variations among different Spanish PEDs, and assess the level of compliance with quality indicators associated with these conditions.

We take this opportunity to encourage interested colleagues to join our WG.

REFERENCES

1. González Hermosa A, Benito Fernández FJ, Fernández Elías M, González Peris S, Luaces Cubells C, Velasco Zúñiga R; Grupo de Trabajo de Seguridad y Calidad. Indicadores de calidad SEUP (Revisión 2018). Madrid: Ergon; 2018. Disponible: https://seup.org/pdf_public/gt/mejora_indicadores.pdf
2. Recomendaciones NO hacer SEUP. https://seup.org/wp-content/uploads/2022/06/PosterSeup.pdf
3. May Llanas ME, Leonardo Cabello MT, Ballestero Diez Y. Recomendaciones de no hacer en la atención al paciente crítico pediátrico en los servicios de Urgencias. Emerg Pediatr. 2023; 2(3): 142-7.
4. Orr RA, Felmet KA, Han Y, McCloskey KA, Dragotta MA, Brills DM, et al. Pediatric specialized transport teams are associated with improved outcomes. Pediatrics. 2009; 124(1): 40-8.
5. Ramnarayan P, Thiru K, Parslow RC, Harrison DA, Draper ES, Rowan KM. Effect of specialist retrieval teams on outcomes in children admitted to paediatric intensive care units in En-

gland and Wales: a retrospective cohort study. Lancet. 2010; 376(9742): 698-704.

6. Vos GD, Nissen AC, H M Nieman F. Comparison of interhospital pediatric intensive care transport accompanied by a referring specialist or a specialist retrieval team. Intensive Care Med. 2004; 30(2): 302-8.
7. Calhoun A, Keller M, Shi J. Do Pediatric Teams Affect Outcomes of Injured Children Requiring Inter-hospital Transport? Prehosp Emerg Care. 2017; 21(2): 192-200.
8. Posicionamiento de las sociedades españolas de cuidados intensivos pediátricos (SECIP), neonatología (SENEO), urgencias de pediatría (SEUP) y de medicina de urgencias y emergencias (SEMES) respecto a la necesidad de implantación de unidades de transporte pediátrico y neonatal especializadas en el transporte interhospitalario. Disponible en: https://www.aeped.es/sites/default/files/posicionamiento_def_dic2020_semes_2_1.pdf
9. Millán García Del Real N, Sánchez García L, Ballesteros Diez Y, Rodríguez Merlo R, Salas Ballestín A, Jordán Lucas R, et al. Importancia del transporte pediátrico y neonatal especializado. Situación actual en España: Hacia un futuro más equitativo y universal. An Pediatr (Engl Ed). 2021; 95(6):485.e1-10.
10. Martínez Mejías A. Los juegos de simulación, un camino para la educación en Urgencias de Pediatría. Emerg Pediatr. 2023; 2(2): 135-7.

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SOCIEDAD ESPAÑOLA DE URGENCIAS DE PEDIATRÍA

EMERGENCIASPediátricas
Vol. 3. No. 1. January - April 2024

Emerg Pediatr. 2024; 3(1): 52-54

SCIENTIFIC LETTER

Assessment of simulation as a training tool in Pediatric Emergency Medicine

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Early detection and treatment of children at risk of cardiac arrest is one of the priorities in pediatrics, both in primary care and hospital settings. However, the low incidence of such events in children often leaves healthcare personnel feeling unprepared to handle situations for which they are trained but rarely encounter in daily practice. Simulation enables these professionals to train in clinical procedures analogous to real-life situations, allowing for continuous improvement that will have an impact on the safety and satisfaction of the professionals and the team, as well as on patient care and survival.

We present our experience in simulation of scenarios involving critically ill children as a tool for continuing training in pediatrics, and its assessment by the professionals who participated in the simulations.

The aim of our study was to describe the experience in clinical simulation in critically ill children conducted at our center during the 2021-22 academic year and to present the evaluation of this experience by the students.

Between October 2021 and May 2022, the Department of Pediatrics of the Hospital Universitari Mútua Terrassa carried out a training in clinical simulation in critically ill children, following the model of the Centre Internacional de Simulació i Alt Rendiment Clínic of the Fundació Universitària del Bages, Campus Manresa of the UVic-UCC[(1)]. This model consists of a preliminary phase that includes a needs analysis, setting objectives and expected outcomes, designing the activity and scenario, followed by the simulation itself. The simulation process involves pre-briefing, the simulation experience, and debriefing, which should transition from reflective observation to the application of skills in a real-world setting. At the end of the training, participants were asked to evaluate the experience using an online form. The survey adapted from that of Astudillo et al.[(2)], with slight modifications (the question regarding video recording was excluded, and questions about whether they would change anything and whether they would repeat the experience were added). Responses to the questions were rated on a scale from 1 (strongly disagree) to 5 (strongly agree). All participants provided consent for the use of their responses.

The previous online training consisted of four videos created by the instructors themselves ('Pediatric CPR Guidelines 2021 of the European Resuscitation Council' and 'Care of the Critically Ill Child, TAP and the ABCDE System,' and 'Approach to the Most Common Severe Pediatric Pathology I and II'). In addition, six clinical simulation sessions were conducted, addressing common severe conditions in pediatrics. In each session, the case of an infant and of an older child were presented (Table 1). The main aim of the training was to review the approach to critically ill patients using the Pediatric Assessment Triangle and the ABCDE triage system. The Laerdal® Megacode Junior® and Megacode Baby® manikins and the SimStart® constant simulation monitor were used. Participants were divided into 4 groups, each consisting of 2 nurses, 2 anesthesia residents, and 4 pediatricians, including residents and attending physicians from both primary care and hospital settings. The sessions were held outside working hours in a classroom in the teaching building of the institution, with a frequency of one session every 4 weeks. Of the 32 participants, 30 responded the online survey. According to professional groups, 23.3% were nurses, 20% were pediatric residents, 16.7% were primary care pediatricians, 20% were hospital pediatricians, and 20% were anesthesia residents. The mean scores of the responses are shown in Table 2. A total of 96.7% of the participants

Received on June 23, 2023
Accepted on September 26, 2023

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TABLE 1. Clinical simulation cases.

Session 1. Respiratory failure Child: asthma Infant: bronchiolitis
Session 2. Circulatory failure Child: anaphylaxis Infant: dehydration
Session 3. Neurological disorders Child: intracranial hypertension secondary to hemorrhage Infant: seizure
Session 4. Others Child: polytrauma Infant: intoxication
Session 5. Cardiac arrest with a shockable rhythm Child: sudden death in sports Infant: congenital heart disease
Session 6. Cardiac arrest with a non-shockable rhythm Child: sepsis Infant: sudden death

would take the course again, and 63.3% would not make any changes to the course organization. Among the suggested modifications, 10% of the respondents requested a change of schedule, so that it would take place within working hours.

Clinical simulation enables the recreation of rare clinical scenarios in a safe environment where errors have no consequences for the patient, improving clinical care and safety both for the patient and the professional. We chose to conduct repeated sessions over time because we believe that this improves performance more than single sessions[3]. We designed multidisciplinary teams, although not natural ones, in which each professional performed their usual role based on their expertise. The sessions were held outside the usual timetable and environment, which may be considered a limitation, but this prevented cancellation of the sessions due to healthcare duties. The feedback from the professionals who participated regarding organization, learning, and application of knowledge was highly positive.

There are different levels of assessment of training activities[4]. Our study only evaluated professional satisfaction (Kirkpatrick level 1) and not the knowledge acquired (levels 2 and 3) or the impact on routine practice (level 4)[5], for which different tools are available in the literature, especially for resident training, such as the Clinical Performance Tool[6], the Tool for Resuscitation Assessment Using Computerized Simulation[7], the Resuscitation Team Leader Evaluation[8], or the Simulation Team Assessment Tool (STAT)[9]. Our aim for the near future is to prospectively evaluate the improvement of knowledge and attitudes throughout the course.

Clinical simulation of critically ill children carried out by multidisciplinary teams is a good tool for the continuing education of professionals caring for these patients in centers with a low incidence of such cases. It enables maintaining or improving knowledge and skills while increasing the confidence and safety of the professionals who care for these children. Assessment of the training activities, including the student's perception, evaluation of the acquired knowledge, and its application in daily practice, allows for continuous improvement in these activities.

FUNDING

The authors declare no financial support for this article.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

TABLE 2. Results of the assessment survey.

Question	Mean score (range)
Simulation is a useful learning tool	4.96 (4-5)
The simulation scenarios are realistic	3.96 (2-5)
The simulation experience has improved my clinical skills	4.86 (4-5)
Simulation is useful to develop critical thinking and decision-making skills	4.9 (4-5)
The simulation cases are tailored to my theoretical knowledge	4.53 (2-5)
The experience with the simulator has enhanced my safety and confidence	4.29 (4-5)
The simulation has helped me to combine theory and practice	4.86 (4-5)
The workshops with the simulator have motivated me to learn	4.83 (3-5)
Case duration is adequate	4.86 (4-5)
Knowledge of the faculty is adequate	4.96 (4-5)
Simulation fosters communication among team members	4.93 (4-5)
Clinical simulation helps to prioritize actions	4.93 (4-5)
Interaction with the simulation has improved my clinical competency	4.86 (4-5)
Overall, the experience with the simulation has been satisfactory	4.93 (4-5)

REFERENCES

1. Camps A, Dalmau O. Disseny i planificació d'experiències de simulació. Disponible en: https://ucf.cat/sites/default/files/docs/2023/ucf_8_disseny_i_planificacio_experiencies_simulacio.pdf. Consultado en septiembre de 2023.
2. Astudillo A, López M, Cádiz V, Fierro J, Figueroa A, Vilches N. Validación de la encuesta de calidad y satisfacción de simulación clínica en estudiantes de enfermería. Cienc Enferm. 2017; XXIII(2): 133-45.
3. Ghazali DA, Fournier E, Breque C, Stéph Ragot SP, Oriot D. El efecto de las simulaciones inmersivas repetidas cada 6 semanas en la evolución del rendimiento de un equipo multidisciplinar durante un año: un ensayo controlado aleatorizado en situaciones pediátricas de riesgo vital. Emergencias. 2019; 31(6): 391-8.
4. Qué es el modelo Kirkpatrick. Disponible en: https://www.escueladidactica.com/que-es-el-modelo-kirkpatrick/. Consultado en septiembre de 2023.
5. Thim S, Henriksen TB, Laursen H, Schram AL, Paltved C Sondergaard Lindhard M. Simulation-Based Emergency TeamTraining in Pediatrics: A Systematic Review. Pediatrics. 2022; 149(4): e2021054305.
6. Donoghue A, Ventre K, Boulet J, Brett-Fleegler M, Nishisaki A, Overly F, et al. Design, Implementation, and Psychometric Analysis of a Scoring Instrument for Simulated Pediatric Resuscitation: A Report from the EXPRESS Pediatric Investigators. Simul Healthc. 2011; 6(2): 71-7.
7. Brett-Fleegler MB, Vinci RJ, Weiner DL, Harris SK, Shih MC, Kleinman ME. A Simulator-Based Tool That Assesses Pediatric Resident Resuscitation Competency. Pediatrics. 2008; 121(3): e597-603.
8. Grant EC, Grant VJ, Bhanji F, Duff JP, Cheng A, Lockyer JM. The development and assessment of an evaluation tool for pediatric resident competence in leading simulated pediatric resuscitations. Resuscitation. 2012; 83(7): 887-93.
9. Reid J, Stone K, Brown J, Caglar D, Kobayashi A, Lewis-Newby M, et al. The Simulation Team Assessment Tool (STAT): Development, reliability and validation. Resuscitation. 2012; 83(7): 879-86.

SEUP
SOCIEDAD ESPAÑOLA DE URGENCIAS DE PEDIATRÍA

EMERGENCIASPediátricas
Vol. 3. No. 1. January - April 2024

Emerg Pediatr. 2024; 3(1): 55-56

SCIENTIFIC LETTER

Hospital at home in pediatrics. An emerging model for the treatment of patients with acute diseases

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Hospital at Home (HaH) is a healthcare service that allows patients to receive hospital-level medical and nursing care at home. According to the definition proposed by the Scientific Committee of the World Hospital at Home Congress 2023[1], it is a clinical service for acute patient care that uses the personnel, equipment, technologies, medication, and techniques usually provided in hospitals and offers hospital care in the homes of selected patients. It is, therefore, a resource that replaces conventional hospitalization.

Its goal is to improve the lives of patients who need hospitalization by shifting the culture of hospitals to deliver hospital-level care in the comfort of patients' homes[1].

In Spain, HaH began in 1981, with the inauguration of the first unit of its kind at the Gregorio Marañón Hospital, formerly known as the Provincial Hospital of Madrid. Since then, over 100 units dedicated to the care for adult patients have been created[2]. Nevertheless, the development of pediatric units has been much slower, initially emerging as units for the care of specific conditions, such as the early discharge of premature newborns or the care of children with chronic and complex disorders[3], palliative care or intravenous antibiotic therapy. It was not until 5 years ago that HaH units began to operate with the aim of caring for children with all types of acute conditions or exacerbation of chronic diseases[4].

Implementation of HaH requires careful planning to ensure year-round care, prioritizing patient safety similar to conventional hospitalization practices. Factors to consider include which conditions will be managed and how, admission criteria (both general and disease-specific), allocation of human and material resources (transport, oxygen therapy, portable equipment, infusion pumps, telemonitoring), systematization of the pharmaceutical process (supply, preparation and administration of intravenous medication), documentation procedures (including informed consent, welcome guide, medical records), care plans and circuits (for admission, referral, discharge, and both scheduled and urgent care), integration into the hospital's electronic medical records, organization and training of staff and caregivers, care plans, costs, and quality control, among others. Furthermore, it is essential to establish agreements with other clinical departments, central services (radiology, laboratory), and pharmacy and out-of-hospital emergency services.

HaH provides numerous advantages for the child and their family, improving comfort, facilitating the maintenance of daily routines (play, meals, sleep, hygiene), favoring the compatibility of family and work, and encouraging greater involvement of parents in the care of their children, which leads to a high degree of satisfaction for the families[4-6].

In November 2018, the first HaH Unit in Spain dedicated to the care of children with acute diseases was inaugurated at the Niño Jesús University Children's Hospital in Madrid, operating as a transversal department of the hospital, providing coverage for all medical and surgical services.

In the initial 4 years of operation, there were a total of 1711 admissions corresponding to 1489 patients. A total of 55.9% were male. The median age was 5 (IQR, 2-10) years. When excluding patients admitted for overnight polysomnography, the median length of stay in the unit was 4 (IQR, 3-6) days. Before admission to the HaH unit, the median hospital stay was 2 (IQR, 1-5) days. In total, 6982 hospital stays were avoided.

Overall, 57% of the patients were referred to HaH from the hospital ward, 34% from the outpatient clinics (mainly for sleep studies), and 7% directly from the Emergency Department (ED).

Inpatients were referred primarily from the general pediatric ward (n= 657; 67.6%), general surgery (n= 120; 12.3%), and the hematology-oncology ward (n= 71; 7.3%).

Received on February 29, 2024
Accepted on March 6, 2024

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The most frequent diseases treated were: sleep disorder for overnight polysomnography (568; 33.2%), bronchitis/asthma requiring oxygen therapy (216; 12.6%), skin and soft-tissue infection (139; 8. 1%); ENT infection (124; 7.2%), intra-abdominal infection (119; 7%), osteoarticular infections (99; 5.8%), severe bacterial infection (87; 5.1%), pneumonia (82; 4.8%), urinary tract infection (74; 4.3%), and acute bronchiolitis (54; 3.2%).

Thirty-two percent of the patients had an underlying disease, predominantly consisting of severe neurological disorders (201; 11.7%), congenital syndromes (159; 9.3%), or cancer (94; 5.5%).

The three most frequently performed procedures were administration of intravenous antibiotic therapy (n= 729; 42.6%), polysomnography for the diagnosis of sleep-disordered breathing (n= 520; 30.4%), and oxygen therapy for acute respiratory distress (n= 306; 17.9%).

Six percent (n= 67) of the patients required hospital readmission, with 5% being unscheduled and 1% scheduled. The primary cause for unscheduled hospital readmission was clinical deterioration, accounting for 43 cases (75%).

Regarding family satisfaction, in the survey conducted during 2021 and 2022 upon discharge from the unit, 98% responded that they were very satisfied and 2% were satisfied (response rate 45%, 238/530).

Based on the activity data from these initial years, HaH has demonstrated to reduce or, at times, avoid hospital stay in children with acute conditions that are usually managed in the hospital. Although the number of patients directly benefiting from admission to HaH from the ED is still low, it is conceivable that the implementation of disease-specific diagnostic and therapeutic protocols aiding in the selection of home admission candidates, along with a cultural shift regarding the necessity of traditional hospitalization in favor of HaH, among both healthcare professionals and the general population, will lead to a change in the future.

The procedures most commonly performed during conventional pediatric hospitalization (oxygen therapy and intravenous drug administration) can be performed at home with adequate parental training and support from healthcare staff and telemonitoring[7-12]. This requires accurate identification of eligible patients, provision of sufficient resources, and collaboration and coordination with all hospital departments. Each center must tailor its approach to its specific needs. Patient safety should always be a priority, establishing a functional organization that ensures 24-hour care and rapid and adequate response mechanisms in the event of clinical deterioration or emergency.

Our experience shows that HaH represents a viable alternative to traditional hospitalization for specific pediatric patients with acute conditions. It effectively reduces hospital stays and can even prevent hospital admissions from the ED. Furthermore, it demonstrates a good safety profile, as evidenced by a low rate of readmissions, and a high level of family satisfaction.

To enhance its future development, technological integration and interdepartmental and even interhospital collaboration should be promoted. This would enable more children to receive hospital-level medical care at home, undoubtedly improving the humanization of health care.

REFERENCES

1. What is Hospital at Home? A consensus definition on Hospital at Home. World Hospital at Home Congress 2023: https://www.hospitalathome.org.uk/whatis?r_done=1
2. González-Ramallo VJ, Segado-Soriano A. Veinticinco años de hospitalización a domicilio en España. Med Clin (Barc). 2006; 126(9): 332-3.
3. Prado Atlagic F, Valdebenito Parra C, Babaic Müller N, Salinas Flores P, Muñoz Berríos F, Jáuregui Abraham M, et al. Hospitalización domiciliaria en niños y adolescentes con necesidades especiales de atención en salud (NANEAS): perspectivas financieras en hospital de alta complejidad, Chile. Rev Fac Med Hum. 2021; 21(4): 722-31.
4. Cabrera López IM, Agúndez Reigosa B, Adrados García S, Villalobos Pinto E, Cano Fernández J, Jiménez García R. Home-hospital care for children with acute illnesses: A 2-year follow-up study. J Paediatr Child Health. 2022; 58(6): 969-77.
5. Carter B, Fisher-Smith D, Porter D, Lane S, Peak M, Taylor-Robinson D, et al. Being 'at-home' on outpatient parenteral antimicrobial therapy (OPAT): a qualitative study of parents' experiences of paediatric OPAT. Arch Dis Child. 2020; 105(3): 276-81.
6. Çamur Z, Sarõkaya Karabudak S. The effect of parental participation in the care of hospitalized children on parent satisfaction and parent and child anxiety: randomized controlled trial. Int J Nurs Pract. 2021; 27(5): e12910.
7. Tie SW, Hall GL, Peter S, vine J, Verheggen M, Pascoe EM, et al. Home oxygen for children with acute bronchiolitis. Arch Dis Child. 2009; 94(8): 641-3.
8. Flett KB, Breslin K, Braun PA, Hambidge SJ. Outpatient course and complications associated with home oxygen therapy for mild bronchiolitis. Pediatrics. 2014; 133: 769-75.
9. Kingshott RN, Gahleitner F, Elphick HE, Gringras P, Farquhar M, Pickering RM, et al. Sleep studies at home: Experience in research and clinical cohorts. Arch Dis Child. 2019; 104(5): 476-81.
10. Agúndez Reigosa B, Cabrera López IM, Sánchez Marcos E, Galán-Olleros M, Sánchez Olivier M, Calleja Gero L, et al. Hospital at Home Program for the Treatment of Pediatric Osteoarticular Infections. Hosp Pediatr. 2024; 14(2): 75-83.
11. Mirón-Rubio M, González-Ramallo V, Estrada-Cuxart O, Sanroma-Mendizábal P, Segado-Soriano A, Mujal-Martínez A, et al. Intravenous antimicrobial therapy in the hospital-at-home setting: data from the Spanish Outpatient Parenteral Antimicrobial Therapy Registry. Future Microbiol. 2016; 11(3): 375-90.
12. Hodgson KA, Huynh J, Ibrahim LF, Sacks B, Golschevsky D, Layley M, et al. The use, appropriateness and outcomes of outpatient parenteral antimicrobial therapy. Arch Dis Child. 2016; 101(10): 886-93.