ISSN: 2184-3333
e-ISSN: 2184-4453

Indexed in: Latindex,
Free Medical Journals, Indexrmp, Scopus, DOAJ, COPE, RCAAP

PORTUGUESE JOURNAL OF PEDIATRICS

Vol. 56 No 3 July / September 2025
https://pjp.spp.pt

SPP
SOCIEDADE
PORTUGUESA
DE PEDIATRIA

PERMANYER
www.permanyer.com

Dioralyte®

Pó para solução oral

DESIDRATAÇÃO e DIARREIA

RESTABELECE O EQUILÍBRIO ELECTROLÍTICO

CRIANÇAS

200ml
(após cada dejecção)
1 Saqueta

ADULTOS e IDOSOS

200ml a 400ml
(após cada dejecção)
1 a 2 Saquetas

LACTENTES

150ml/Kg peso

O conteúdo de cada saqueta deve ser dissolvido em 200ml de água potável

Regime sugerido para o tratamento da diarreia infantil, baseado no peso corporal em Kg.

Dia	Volume da solução de Dioralyte (ml)	Volume total em 24 h (ml)
1	150 ml x kg de peso	150 ml x kg de peso
2	120 ml x kg de peso	
3	90 ml x kg de peso	
4	60 ml x kg de peso	
5	30 ml x kg de peso	

Assegura a reposição de fluídos e electrólitos para toda a família

Korangi

Korangi - Produtos Farmacêuticos, Lda. - Rua da Vinha, Nº17. 2765-388 Estoril. NIF: 505322307. Tel.: 219 251 901. e-mail: geral@korangi.pt

INFORMAÇÕES ESSENCIAIS COMPATÍVEIS COM O RESUMO DAS CARACTERÍSTICAS DO MEDICAMENTO. DENOMINAÇÃO DO MEDICAMENTO: Dioralyte, pó para solução oral. **COMPOSIÇÃO QUALITATIVA E QUANTITATIVA: Substâncias activas** g/saqueta: Glicose 3,56; Cloreto de sódio 0,47; Cloreto de potássio 0,30; Citrato dissódico 0,53. **INDICAÇÕES TERAPÊUTICAS:** Correcção da perda de líquidos e electrólitos nos lactentes, crianças e adultos. Tratamento da diarreia aquosa de várias etiologias, incluindo as gastrenterites, em todos os grupos etários. **POSOLOGIA E MODO DE ADMINISTRAÇÃO:** Cada saqueta deve ser sempre dissolvida em 200 ml de água. O volume de Dioralyte reconstituído a tomar deve ser decidido pelo médico assistente, tendo em consideração o peso do doente e o estado e gravidade da situação. Um princípio básico no tratamento da diarreia é a substituição da perda de líquidos e a manutenção de uma ingestão de líquidos suficiente para repor a sua perda nas fezes. A ingestão diária deve ser baseada num volume de 150 ml/Kg de peso nos lactentes e 20–40 ml/Kg de peso nos adultos e crianças. Uma aproximação razoável é a seguinte: -lactentes – 1 a 1,5 vezes o volume alimentar habitual; - crianças – 1 saqueta após cada dejecção diarreica; - adultos – 1 ou 2 saquetas após cada dejecção diarreica. Inicialmente, podem ser necessárias maiores quantidades de Dioralyte para assegurar uma reposição precoce do equilíbrio hídro-electrolítico. Nos estadios iniciais do tratamento da diarreia, todos os alimentos, incluindo o leite de vaca e o leite artificial, devem ser interrompidos. Não se deve no entanto interromper o aleitamento materno. Nas crianças amamentadas sugere-se que se dê à criança o mesmo volume de Dioralyte do que o da alimentação normal, seguindo-se o aleitamento. Pode ser necessário, durante este período, a expressão do leite residual da mama. Após 24-48 horas, quando os sintomas desaparecerem, a dieta normal deve ser retomada gradualmente para evitar o agravamento da situação. O regime sugerido para o tratamento da diarreia infantil grave baseado no peso corporal em Kg é apresentado no quadro anterior. Quando a diarreia é acompanhada de vómitos, sugere-se ingestão frequente de pequenas quantidades de Dioralyte. No entanto, é importante que seja tomado o volume total necessário de Dioralyte. Quando o funcionamento dos rins é normal torna-se difícil superhidratar por via oral e quando existem dúvidas acerca da dosagem correcta, mais vale tomar a mais do que a menos. **CONTRA-INDICAÇÕES:** Não se conhecem contra-indicações ao Dioralyte. No entanto, existem algumas situações em que o tratamento com Dioralyte é inapropriado, tais como por exemplo, situações de oclusão intestinal requerendo intervenção cirúrgica, ou em caso de vómitos persistentes e desidratação grave ou diarreia infantil grave em que será necessária uma terapêutica por via intravenosa. **ADVERTÊNCIAS E PRECAUÇÕES ESPECIAIS DE UTILIZAÇÃO:** O Dioralyte só deve ser reconstituído com água. Cada saqueta deve ser sempre reconstituída em 200 ml de água. Uma solução mais fraca do que a recomendada não contém a concentração óptima de glicose e electrólitos e uma solução mais forte do que a recomendada pode provocar desequilíbrio electrolítico. Se a diarreia não melhorar rapidamente, os doentes deverão ser reavaliados. Nos idosos, a administração de soluções contendo glucose e electrólitos deve ser cuidadosa em caso de alterações renais ou hepáticas graves ou em outras situações em que o balanço electrolítico normal se encontre alterado. Nos lactentes, deve interromper-se durante 24 horas a alimentação com leite de vaca ou leite artificial, que deverão ser reintroduzidos gradualmente quando a diarreia tiver diminuído. Não se deve interromper o aleitamento materno. **EFEITOS INDESEJÁVEIS:** Podem ocorrer náuseas ou vómitos após a administração da solução, em particular quando esta é ingerida com demasiada rapidez. Estão também descritos casos isolados de desconforto abdominal e de obstipação.Data da revisão do texto: Janeiro de 2004.**TITULAR DA AUTORIZAÇÃO DE INTRODUÇÃO NO MERCADO: KORANGI - Produtos Farmacêuticos, Lda. Medicamento não sujeito a receita médica. Para mais informações contactar o Titular da Autorização de Introdução no Mercado**

DIORALYTE/MED. 01 - 02/2024

SPP
SOCIEDADE PORTUGUESA DE PEDIATRIA

25º CONGRESSO NACIONAL DE PEDIATRIA

29 • 31 OUTUBRO 2025 • ALFÂNDEGA DO PORTO

Organização:

SPP - Sociedade Portuguesa de Pediatria
E-mail: secretariado@spp.pt
Tel: +351 217 574 680 • Fax: +351 217 577 617
www.spp.pt

Secretariado:

VERANATURA
E-mail: cnpediatra25@veranatura.pt
Tel: +351 217 120 778
www.veranatura.pt

25.spp-congressos.pt

Aptamil® PROfutura®

A fórmula mais próxima do **leite materno***

50 ANOS DE investigação avançada no leite materno

Demonstrou **tolerância gastrointestinal semelhante à** de **bebés amamentados**[1]

Descubra o estudo completo aqui!

SCAN ME

Material exclusivamente destinado a Profissionais de saúde. Não se destina ao público em geral.

* Aptamil® Profutura® 1 é a fórmula mais próxima do leite materno da gama Aptamil® leites para lactentes.

1- Blesa-Baviera L et al. BMC Pediatr. 2025 Mar 25;25(1):229. doi: 10.1186/s12887-025-05446-6.

NOTA IMPORTANTE: O leite materno é a nutrição ideal para o lactente, com todos benefícios para o melhor início de vida. É importante que na gravidez e durante o aleitamento materno, o/a Profissional de Saúde recomende que a alimentação da Mãe se baseie numa dieta sã e equilibrada. A Mãe deve ser informada e aconselhada sobre o facto de a combinação do leite materno com a alimentação por biberão, durante as primeiras semanas de vida, poder reduzir a produção do leite materno e sobre a dificuldade de voltar atrás na decisão de não amamentar. As implicações financeiras e sociais de utilizar um leite para lactentes devem sempre ser consideradas. No caso da impossibilidade do aleitamento materno e no caso de serem utilizadas fórmulas para lactentes, mediante recomendação do Profissional de Saúde, devem ser seguidas as instruções de utilização dadas pelo fabricante, pois a sua incorreta utilização pode colocar em risco a saúde do lactente.

APTAMIL® PROFUTURA® 1 é um leite para lactentes destinado a fins nutricionais específicos de lactentes desde nascimento até aos 6 meses, como substituto do leite materno, quando não amamentados.

ISSN: 2184-3333
e-ISSN: 2184-4453

PORTUGUESE JOURNAL OF PEDIATRICS

PORTUGUESE JOURNAL OF PEDIATRICS

former Acta Pediátrica Portuguesa

The official journal of the Portuguese Society of Pediatrics
https://pjp.spp.pt • pjp@spp.pt

EDITORIAL BOARD

SCIENTIFIC BOARD

ADVISORY AND TECHNICAL ASSISTANCE

Editorial Assistant
Sónia Gaspar

PUBLISHER

Sociedade Portuguesa de Pediatria • *Portuguese Society of Pediatrics*

REGISTRY

ISSN: 2184-3333 online • Quaterly editions

Original papers should be deposited in their electronic version through the following URL:

http://publisher.portuguesejournalofpediatrics.permanyer.com

PERMANYER
www.permanyer.com

Permanyer
Mallorca, 310 – Barcelona, Cataluña, España
permanyer@permanyer.com

www.permanyer.com

ISSN: 2184-3333
Ref.: 10807APTG253

PORTUGUESE JOURNAL OF PEDIATRICS

PERMANYER

Check for updates

EDITORIAL

Enhancing the *Portuguese Journal of Pediatrics:* focusing on what matters most

Melhorar o Portuguese Journal of Pediatrics: *focar no que mais interessa*

Luís Pereira-da-Silva

Retiring Editor-in-Chief of the Portuguese Journal of Pediatrics; Faculdade de Ciências Médicas, NOVA Medical School, Lisbon, Portugal; Unidade Local de Saúde São José, Hospital Dona Estefânia, Lisbon, Portugal

Three years ago, Professor André Graça, President of the Portuguese Society of Pediatrics, and Dr. David Lito, the newly appointed executive Editor-in-Chief of the *Portuguese Journal of Pediatrics* (PJP), invited me to collaborate with the journal as a non-executive Editor-in-Chief in an advisory role. I accepted the honorable invitation for a three-year term, as retirement was approaching. My decision was based not only on the motto "What can you do for society?", but also on the opportunity to work with a young, ambitious, and responsible executive editor.

What could I offer? It would be my advice, based on years of knowledge accumulated through my interest in scientific and editorial activities. I should note that that collaboration was not my editorial debut in the journal of the Society. For eight years (2005-2013), I was an associate editor of its predecessor, the *Acta Pediátrica Portuguesa*. I took advantage of this experience to propose the PJP restructuring, anchored in a critical analysis expressed in an editorial about the weaknesses that led to the unsuccessful attempt to index our journal in Medline[1]. What is noteworthy is that 13 years after this reflection, most of the substantial shortcomings of the journal remained. Against this backdrop, the PJP reorganization prioritized the following strategies: increasing the proportion of original research relative to descriptive case series and case reports; limiting the number of narrative reviews and opinion articles and trying to attract systematic reviews; inviting the presidents of the Portuguese Society of Pediatrics' sections and societies to use the PJP as their primary means of disseminating guidelines; and opening the doors to international authors by capitalizing on the fact that the PJP was published in English. In addition, professional English editing was implemented to ensure consistent quality and accuracy, particularly to avoid literal translations from Portuguese and gross translation errors. To avoid unacceptable delays in the editorial process, all its steps began to be monitored in a structured way. The Instructions for Authors were rewritten and substantially shortened to make them user-friendly. "What is added" in relation to the literature must now be stated in bullet points in all submitted manuscripts. Meetings of the entire editorial board, including the associate editors and technical assistant, were started to identify and solve the main problems as a team.

Many objectives have been achieved. However, there are two main concerns that deserve the most attention, especially in light of a potential new attempt to index the PJP in Medline:

– The first concern is continuing the effort to increase the number of research-based articles. Decades of not being indexed have created a pernicious cycle in which the best national pediatric research has

Correspondence:
Luís Pereira-da-Silva
E-mail: l.pereira.silva@nms.unl.pt

Received: 06-06-2025
Accepted: 09-06-2025
https://pjp.spp.pt

Available online: 25-06-2025
Port J Pediatr. 2025;56(3):129-130
DOI: 10.24875/PJP.25000039

fled to indexed journals, in search of prestige for the articles and curricular advantages for the authors. It is pointless to dream of indexing the PJP if it does not contain a sufficient amount of quality research.

– The second concern is to guarantee a minimum number of reliable reviewers. In a country the size of Portugal, it has been challenging to ensure the regular and sustained collaboration of the few Portuguese experts as reviewers in pediatric subspecialty areas. With the recent "boom" in medical and biomedical journals worldwide, the online harassment of reviewers has reached unprecedented levels. Portuguese reviewers are no exception. Therefore, a shortage of reviewers is foreseeable, which could delay the peer review process and editorial decisions further.

When times change and problems seem insurmountable, difficulty can create opportunity. As I retire, I am confident that the current PJP editorial team will support the dissemination of our authors' scientific work through their dedication, competence, and innovation, thereby reinforcing the prestige of our Society's journal.

Reference

1. Pereira-da-Silva L. Editorial: recusa de indexação na Medline – discriminação ou veredicto inevitável? Um ponto de vista [Editorial: Refusal of indexing in Medline – discrimination or inevitable verdict? A point of view]. Acta Pediatr Port. 2008;39:XXV–XXVI.

PORTUGUESE JOURNAL OF PEDIATRICS

PERMANYER

Check for updates

EDITORIAL

In gratitude and reflection: a tribute to Professor Luís Pereira-da-Silva

Com gratidão e reflexão: uma homenagem ao Professor Luís Pereira-da-Silva

André Graça[1]* *and David Lito*[2]

[1]*President, Portuguese Society of Pediatrics;* [2]*Editor-in-Chief, Portuguese Journal of Pediatrics*

The *Portuguese Journal of Pediatrics* has served as a pillar of scientific dissemination in the field of pediatrics in Portugal since its founding in 1938. Over the decades, many have contributed to making this journal a publication of high scientific and editorial standards.

It would be remiss not to acknowledge all the editors who, throughout the years, dedicated their time and effort in pursuit of a journal with ever-growing national and international scientific impact. Their commitment laid the foundation for the credibility and relevance the journal holds today.

In this edition, however, we mark the farewell of Professor Luís Pereira-da-Silva, who, over the past three years, has brought critical insight and tireless energy to the continuous improvement of the journal's quality. A testimony to his contribution is the editorial he authors in this issue—an important set of reflections that will undoubtedly serve as a valuable reference for future generations. For this reason, the Board of the Portuguese Society of Pediatrics and the journal's Co-Editor-in-Chief extend their sincere and heartfelt gratitude.

***Correspondence:**
André Graça
E-mail: amgraca@campus.ul.pt

Received: 03-06-2025
Accepted: 10-06-2025
https://pjp.spp.pt

Available online: 25-06-2025
Port J Pediatr. 2025;56(3):131
DOI: 10.24875/PJP.M25000461

PORTUGUESE JOURNAL OF PEDIATRICS

PERMANYER

Check for updates

ORIGINAL ARTICLE

Do post-pandemic bronchiolitis require more ventilatory support? Perspective from a level II hospital

Gonçalo Passos Croca, Catarina Mendonça, Teresa Magalhães, Mariana Viegas, and Catarina Gomes*

Department of Pediatrics, Centro Hospitalar do Oeste, Unidade das Caldas da Rainha, Caldas da Rainha, Portugal

Abstract

Introduction and Objectives: After the COVID-19 pandemic, the epidemiology and severity of bronchiolitis cases were affected. The aim of our study is to compare pre and postpandemic respiratory support and intensive care transfers in a level two hospital. **Methods:** A retrospective study of hospitalized patients with bronchiolitis in 2019 (prepandemic period) and 2022 (postpandemic period) in a level two hospital. **Results:** In 2019, 81 children were admitted for bronchiolitis compared to 101 in 2022. Of these, 56% were boys, with a median age of three months. In 2022, there was a higher need for CPAP (8.9% vs. 1.2%, p = 0.02), mechanical ventilation (2.0% vs. 1.2%, p = 0.65), supplemental oxygen (73.3% vs. 39.5%, p < 0.01) and admission to intensive care (8.9% vs. 2.5%). **Discussion:** In our postpandemic sample, there was a significantly higher need for oxygen and noninvasive ventilation in hospitalized patients. Our results are similar to those from previous studies in other European countries.

Keywords: Bronchiolitis. Intensive care unit. CPAP ventilation.

A bronquiolite pós-pandémica exige mais suporte ventilatório? Perspectiva de um hospital de nível II

Resumo

Introdução e Objetivos: A pandemia COVID-19 levou a uma modificação epidemiológica e da gravidade da bronquiolite. O objetivo do estudo é comparar o suporte respiratório e transferências para cuidados intensivos por bronquiolite aguda pré e pós-pandemia. **Métodos:** Estudo retrospetivo dos doentes internados com bronquiolite aguda em 2019 (pré-pandemia) e 2022 (pós-pandemia) num hospital nível II. **Resultados:** Em 2019 foram internadas 81 crianças com bronquiolite vs. 101 em 2022. 56,0% do sexo masculino com mediana de idade de três meses. Pós-pandemia houve maior necessidade de CPAP (8,9% vs 1,2%, p = 0,02), ventilação mecânica (2,0% vs 1,2%, p = 0,65), oxigenoterapia (73,3% vs 39,5%, p < 0,01) e admissão em cuidados intensivos (8,9% vs 2,5%). **Discussão:** Os doentes hospitalizados no período pós-pandémico apresentaram significativamente maior necessidade de oxigénio e de ventilação não invasiva. Os nossos resultados são semelhantes a estudos de outros países europeus.

Palavras-chave: Bronquiolite. Unidade de terapia intensiva. Ventilação CPAP.

***Correspondence:**
Gonçalo Passos Croca
E-mail: passoscroca@gmail.com

Received: 26-11-2023
Accepted: 07-11-2024
https://pjp.spp.pt

Available online: 25-06-2025
Port J Pediatr. 2025;56(3):132-136
DOI: 10.24875/PJP.23000053

Keypoints

What is known

- Postpandemic bronchiolitis cases have required more respiratory support.
- It reinforces the theory of immunity debt after the COVID-19 pandemic.

What is added

- It shows that there is an increase in intensive care admissions due to bronchiolitis, as reported in other European studies.

Introduction

Bronchiolitis is one of the most common viral lower respiratory tract infections in infants and is the main cause of hospitalization in children under two years of age[1-10]. Bronchiolitis is a self-limited infection, with symptoms lasting, on average, five to seven days. However, preterm infants, children with preexisting conditions such as bronchopulmonary dysplasia, congenital heart disease or immunodeficiency have a higher risk of severe infection[1,2]. Most viruses can cause acute bronchiolitis, however respiratory syncytial virus (RSV) is the most common etiology[1,2,4,5,8-11]. These viruses are spread through droplets expelled via the airway, so close contact is needed to transmit this disease[1].

In March 2020, the World Health Organization (WHO) declared a worldwide pandemic due to the spread of SARS-CoV-2. Social distancing, hand hygiene and masks were adopted globally to reduce the spread of this disease, leading to a reduction in viral infections compared to previous seasons[3,6,12]. Furthermore, the restrictions shifted the outbreak of infection from the winter months to spring[3,4,6,7,12]. Despite the severity of COVID-19 in adults, children remained largely asymptomatic. Therefore, SARS-CoV-2 does not appear to trigger severe bronchiolitis and caused a shift in pathogens with the reduction of RSV infection[3,4,11].

The pandemic-associated restrictions led to a postpandemic increase in co-infections, greater severity of disease, longer hospital stays and intensive care admissions, as well as ventilatory support[2-4,6,7,12-15]. This leads to the hypothesis that the reduction in viral and bacterial diseases in children during the pandemic led to an immunity debt, resulting in a postpandemic increased severity of infection[6].

The aim of our study is to assess if there was a postpandemic increase in the need for hospitalization, oxygen therapy or respiratory support in a level two hospital.

Methods

A retrospective observational study of hospitalized children in a level two hospital with bronchiolitis, comparing a prepandemic (January to December 2019) and postpandemic period (January to December 2022).

The study sample was obtained through systematic sampling and selecting children under two years of age who were hospitalized with the diagnosis of acute bronchiolitis. We excluded older children, immunodeficiency and chronic heart, neurological or pulmonary disease. Demographic, clinical and microbiological data were collected by consulting each patient's electronic file. In our hospital, the etiological agent was obtained using a PCR test which tested for RSV, SARS-CoV-2 and influenza A and B.

Data collected from level three intensive care units consisted of the type of respiratory support used.

For statistical analysis, Microsoft Office Excel and IBM SPSS® were used.

Results

Out of a population of 427 children hospitalized in 2019, 90 were diagnosed with acute bronchiolitis (21.1%). Ten were excluded, giving us a final sample of 80 patients. In 2022, there were 377 children hospitalized, 112 with bronchiolitis (29.7%). Ten children were excluded, leaving a final sample of 102 patients (Fig. 1).

Our final sample of 182 children consisted of 56% boys, with a median age of three months (eight days to two years), which was similar in both periods. In both the prepandemic and postpandemic groups, bronchiolitis admissions comprised 0.3% of all emergency department visits.

The median length of stay was four days (one to 18 days) and RSV was the main agent involved in 2022 with 57 patients (N = 102, 55.9%), followed by SARS-CoV-2 in four (N = 102, 3.9%). In 2019, there was no systematic testing of respiratory pathogens for epidemiological purposes. In those tested, RSV accounted for 90% (27 out of 30) of the bronchiolitis cases (Table 1).

In 2022, 74 children (73.3%) admitted for acute bronchiolitis required supplemental oxygen compared to 32 patients in 2019 (39.5%), a statistically significant difference ($p < 0.001$). There was also a statistically significant increase in noninvasive ventilation

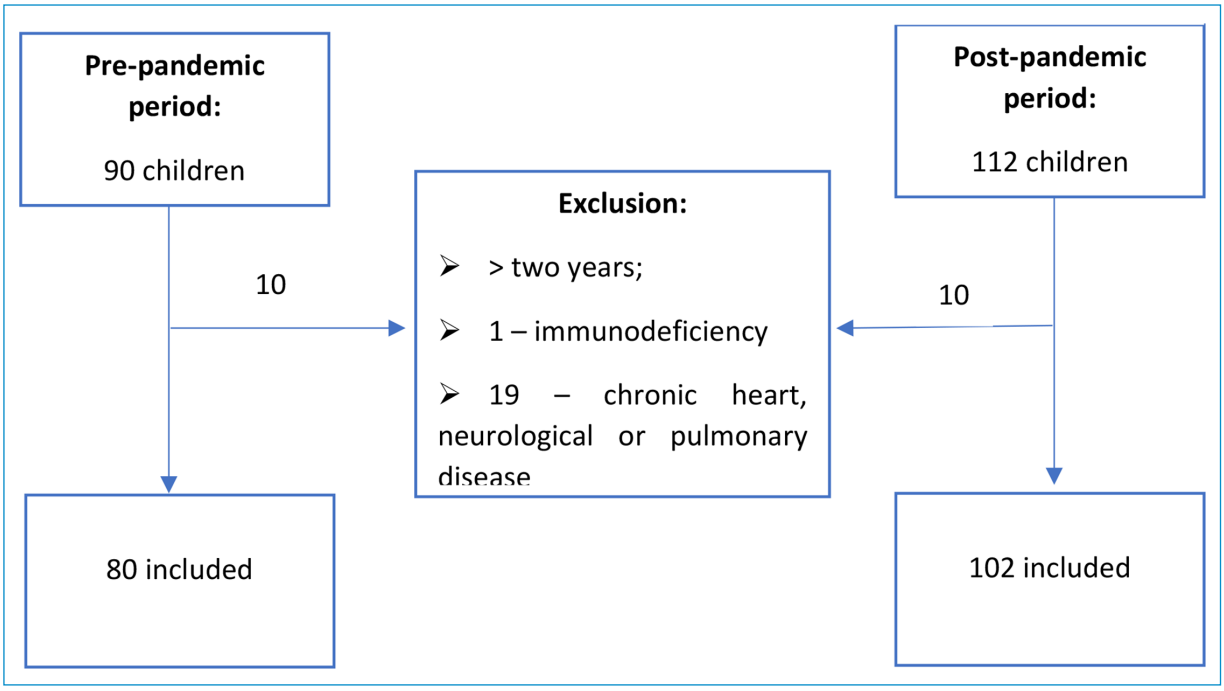

Figure 1. Exclusion criteria.

Table 1. Clinical data of the study population

	2019 (prepandemic period) n = 102	2022 (postpandemic period) n = 102
Demographic data		
Age	Three months	Three months
Median (min-max)	(Eight days-19 months)	(16 days-two years)
Gender	46 boys (56.8%)	56 boys (55.4%)
Hospitalization (days)	4	4
Median (min-max)	(1-13)	(1-18)
Etiological agent (PCR)		
RSV, n (%)	27/30 (90%)	57/102 (55.9%)
SARS-CoV-2, n (%)	-	4/102 (3.9%)
Influenza A, n (%)	-	2/102 (2.0%)

in 2022 (nine vs. one, p = 0.023) but not in high-flow oxygen therapy (one vs. one, p = 0.150). In 2022, most infants requiring non-invasive ventilation were three months old or younger (88.9%). Two patients needed mechanical ventilation in 2022 (2.0%) and one in 2019 (1.2%, p = 0.645). Accordingly, there was an increased admission to intensive care in 2022, with nine patients compared to two in 2019 (8.9% vs. vs. 2.5%, p = 0.070). Most of the patients who required intensive care were one month old or younger (63.6%) (Table 2).

There were no cases of SARS-CoV-2 bronchiolitis requiring ventilatory support or intensive care admission.

Discussion

This study revealed that there was a postpandemic increased need for respiratory support, particularly noninvasive ventilation. In 2022, there were more children admitted for bronchiolitis and there was an increased need for oxygen therapy, noninvasive

Table 2. Ventilatory support and oxygen therapy in pre- and post- pandemic bronchiolitis

	2019 (prepandemic period)	2022 (postpandemic period)	p
Oxygen therapy	32 (39.5%)	74 (73.3%)	< 0.001
Noninvasive ventilation	1 (1.2%)	9 (8.9%)	0.023
High-flow oxygen	1 (1.2%)	1 (1.0%)	0.150
Mechanical ventilation	1 (1.2%)	2 (2.0%)	0.645
Intensive care admission	2 (2.5%)	9 (8.9%)	0.070

ventilation and intensive care admission, which suggests more severe disease. Caballero et al. also reported a postpandemic increased severity of infection with more children needing ventilation and intensive care unit admission, with 34.3% of infections requiring intensive care admission after the pandemic compared to 22.4% prior to the pandemic. Ghirardo S et al. also reported more children needing ventilation (23% vs 12%), intensive care unit admission (29% vs 16%) and oxygen therapy (77% vs 55%)[14]. The lack of a significant increase in mechanical ventilation could be due to the small sample size, but it is also reported by Cardenas, J. et al.[6].

Our low rates of high-flow oxygen therapy are probably explained by the lack of experience at our center, as most literature reports a higher use, especially after the pandemic.

Children requiring ventilation support or intensive care were primarily small infants, as already well documented by several studies, such as Zurita-Cruz, J. N. et al. and Nguyen, S. et al.[2].

As reported by several studies, such as Caballero et al. and Guitart, C. et al., SARS-CoV-2 infection does not appear to be a major factor for respiratory support in bronchiolitis[3].

In line with previous studies, our study suggests that the pandemic led to an immunity debt, resulting in an increased need for ventilatory support. However, ventilatory support was an individualized decision based on clinical and gasometrical parameters, not a standardized approach.

The study results and analysis are limited due to its retrospective design, small sample size and lack of systematic testing of etiological agents in the prepandemic period. It also lacks data from intensive care admissions, especially regarding respiratory and infectious complications.

Acknowledgements

The Pediatric Department of Centro Hospitalar do Oeste.

Author contributions

All authors: Conception and design of the study, report, review or other type of work or paper; Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work.

Funding

There were no external funding sources for the drafting of this paper.

Conflicts of interest

The authors declare that there were no conflicts of interest in conducting this research.

Ethical considerations

Protection of humans and animals. The authors declare that no experiments involving humans or animals were conducted for this research.

Confidentiality, informed consent, and ethical approval. The study does not involve patient personal data nor requires ethical approval. The SAGER guidelines do not apply.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

References

1. Meissner HC. Viral bronchiolitis in children. N Engl J Med. 2016;374(1):62-72.
2. Zurita-Cruz JN, Gutierrez-Gonzalez A, Manuel-Apolinar L, Fernández-Gárate JE, Arellano-Flores ML, Correa Gonzalez RA, et al. Hospitalizations for viral respiratory infections in children under 2 years of age: epidemiology and in-hospital complications. BMC Pediatr. 2020;20(1).
3. Guitart C, Bobillo-Perez S, Alejandre C, Armero G, Launes C, Cambra FJ, et al. Bronchiolitis, epidemiological changes during the SARS-cov-2 pandemic. BMC Infect Dis. 2022;22(1):84.
4. Márquez Caballero J, Cordero Matía ME. Epidemiology of acute bronchiolitis in a third-level hospital during the COVID-19 pandemic. Arch Bronconeumol. 2023;59(4):264-6.

5. Ralston SL, Lieberthal AS, Meissner HC, Alverson BK, Baley JE, Gadomski AM, et al. Clinical practice guideline: the diagnosis, management, and prevention of bronchiolitis. Pediatrics. 2014;134(5):e1474-502.
6. Cardenas J, Pringle C, Filipp SL, Gurka MJ, Ryan KA, Avery KL. Changes in critical bronchiolitis after COVID-19 lockdown. Cureus. 2022;14(5):e25064.
7. Guerrero-Del-Cueto F, Ramos-Fernandez JM, Leiva-Gea I, Reina-Moreno E, Ortiz-Ortigosa A, Carazo-Gallego B, et al. Bronchiolitis before and after the SARS-cov-2 pandemic: twelve years of experience in a spanish paediatric hospital. Pediatr Pulmonol. 2023;58(4):1201-9.
8. Dalziel SR, Haskell L, O'Brien S, Borland ML, Plint AC, Babl FE, et al. Bronchiolitis. Lancet. 2022;400(10349):392-406.
9. Silver AH, Nazif JM. Practice Gaps. Available from: http://pedsinreview.aappublications.org
10. Jartti T, Smits HH, Bønnelykke K, Bircan O, Elenius V, Konradsen JR, et al. Bronchiolitis needs a revisit: distinguishing between virus entities and their treatments. Allergy. 2019;74(1):40-52.
11. Milani GP, Bollati V, Ruggiero L, Bosis S, Pinzani RM, Lunghi G, et al. Bronchiolitis and SARS-cov-2. Arch Dis Child. 2021;106(10):999-1001.
12. Berdah L, Romain AS, Rivière S, Schnuriger A, Perrier M, Carbajal R, et al. Retrospective observational study of the influence of the COVID-19 outbreak on infants' hospitalisation for acute bronchiolitis. BMJ Open. 2022;12(10):e059626.
13. Brisca G, Mariani M, Buratti S, Ferretti M, Pirlo D, Buffoni I, et al. How has the SARS-cov-2 pandemic changed the epidemiology and management of acute bronchiolitis? Pediatr Pulmonol. 2023;58(4):1169-77.
14. Ghirardo S, Cozzi G, Tonin G, Risso FM, Dotta L, Zago A, et al. Increased use of high-flow nasal cannulas after the pandemic in bronchiolitis: a more severe disease or a changed physician's attitude? Eur J Pediatr. 2022;181(11):3931-6.
15. Nguyen SN, Nguyen TNT, Vu LT, Nguyen TD. Clinical epidemiological characteristics and risk factors for severe bronchiolitis caused by respiratory syncytial virus in vietnamese children. Int J Pediatr. 2021;2021:9704666.

PORTUGUESE JOURNAL OF PEDIATRICS

PERMANYER

Check for updates

ORIGINAL ARTICLE

Impact of the "Creche com Sabor e Saúde" (C2S) project on the food provided by Portuguese daycare centers

Olívia Pita[1], *Beatriz Teixeira*[1,2]*, *Lúcia Nova*[1], *Beatriz Cidade Coelho*[1], *Inês Dias*[3], *Mariana Conceição*[3], *Liliana Ferreira*[2,4], *Ana Jorge*[4], *Maria do Céu Monteiro*[1,5], *Maria Cristina Teixeira Santos*[1,6,7], *Sara Rodrigues*[1,2], *Ada Rocha*[1,8], *Ana Gonçalves*[3], and *Cláudia Afonso*[1]

[1]*Faculdade de Ciências da Nutrição e Alimentação, Faculty of Nutrition and Food Sciences, University of Porto, Porto;* [2]*EPIUnit ITR, Institute of Public Health, University of Porto, Porto;* [3]*Associação Cultural e Recreativa de Cabreiros, Braga;* [4]*Cáritas Diocesana de Coimbra, Coimbra;* [5]*TOXRUN – Toxicology Research Unit, Instituto Universitário de Ciências da Saúde-CESPU, Porto;* [6]*ProNutri Group – CINTESIS@RISE – Centro de Investigação em Tecnologias e Serviços de Saúde da Universidade do Porto, Porto;* [7]*Laboratório Associado RISE – Rede de Investigação em Saúde, Porto;* [8]*GreenUPorto - Sustainable Agrifood Production Research Centre/Inov4Agro, Porto. Portugal*

Abstract

Introduction and Objectives: To assess the impact of implementing a community intervention project on the food offered at lunch in Portuguese daycare centers. **Methods:** A study was conducted in a nonprobabilistic, convenience sample of 18 Portuguese daycare centers that welcome children from six to 36 months old. The characterization of the institutions was developed using a self-administered online questionnaire. To evaluate the menu, a qualitative analysis tool was created. After an initial assessment of 12 weeks of menus in each institution, the intervention lasted for nine months. This entailed the preparation of individualized technical reports and the close monitoring of the daycare centers. A further application of the menu analysis tool was subsequently conducted for the final 12 weeks of the project. The impact of the intervention was estimated by the difference between the results obtained before and after the intervention. **Results:** Following the intervention, there was an improvement in the description of meal components and the overall quality of the menus, which was improved by 16%. Throughout the study, the number of facilities with a lunch menu for the six to eight months age group increased from 13 to 16, while the number of times cooked fruit was offered decreased by a median of 100% in the institutions. In the nine to 11 months age group, there was a median of 100% of institutions beginning to offer only one type of pureed fruit. In the 12 to 36 months age group, the number of times that oily fish was offered, as well as vegetables, in addition to the carbohydrate source increased in a median of 8.3% of the institutions. **Discussion:** Despite the simplicity and duration of this intervention, there was an improvement with compliance with recommendations, including a decrease in the number of times cooked fruit was offered in the six to eight months age group and an increase in the number of times oily fish was offered in the 12 to 36 months age group.

Keywords: Child daycare center. Lunch. Menu planning. Children.

***Correspondence:**
Beatriz Teixeira
E-mail: beatrizteixeira.nutricao@gmail.com

Received: 22-02-2024
Accepted: 28-10-2024
https://pjp.spp.pt

Available online: 27-03-2025
Port J Pediatr. 2025;56(3):137-146
DOI: 10.24875/PJP.24000024

Impacto da intervenção do projeto "Creche com Sabor e Saúde" (C2S) na oferta alimentar de creches portuguesas

Resumo

Introdução e Objetivo: Avaliar o impacto da implementação de um projeto de intervenção comunitária na oferta alimentar de creches portuguesas. **Métodos:** Estudo realizado numa amostra de seleção não probabilística e de conveniência em 18 creches portuguesas com crianças dos 6 aos 36 meses. Para caracterização das instituições, desenvolveu-se um questionário online de autoaplicação. Para avaliação das ementas, desenvolveu-se uma ferramenta de análise qualitativa. Após uma avaliação inicial de 12 semanas de ementas a cada instituição, a intervenção teve a duração de 9 meses e consistiu na redação de relatórios técnicos individualizados e num acompanhamento próximo das creches. O impacto foi estimado pela diferença entre os resultados obtidos na pré-intervenção e numa nova aplicação da ferramenta de análise de ementas nas últimas 12 semanas do projeto. **Resultados:** Após a intervenção, verificou-se uma melhoria na descrição dos componentes das refeições e na qualidade global das ementas, que melhorou 16%. Ao longo do estudo, o número de estabelecimentos com ementa de almoço entre os seis e os oito meses aumentou de 13 para 16, e o número de vezes que foi oferecida fruta cozinhada diminuiu numa mediana de 100% nas instituições. Dos nove aos 11 meses, houve uma mediana de 100% de instituições que passaram a oferecer apenas um tipo de puré de fruta. Dos 12 aos 36 meses, a oferta de peixe gordo e de hortícolas adicionais à fonte de hidratos de carbono aumentou numa mediana de 8,3% das instituições. **Discussão:** Apesar da simplicidade e da duração desta intervenção, registou-se uma melhoria na adesão às recomendações, incluindo uma diminuição do número de vezes que foi oferecida fruta cozinhada dos seis aos oito meses e um aumento do número de vezes que foi oferecido peixe gordo dos 12 aos 36 meses.

Palavras-chave: Creches. Almoço. Ementas. Crianças.

Keypoints

What is known?
- Adequate nutrition is essential for optimal growth and development in children.
- Daycare centers are valuable environments for fostering healthy eating behaviors.

What is added?
- This pioneering study in Portuguese daycare centers aims to enhance lunchtime food quality.
- There was a 16% improvement in the results of the qualitative assessment of the lunch menus at the end of the project.
- These results highlight the urgent need to develop intervention projects in the food environment of daycare centers.

Introduction

According to recent literature, Portuguese children have inadequate dietary habits. The 2012 Study on Dietary Patterns and Child Growth (EPACI) showed that children aged 12 to 36 months consumed insufficient quantities of vegetables and an excess of dairy products, soft drinks, sweets, and snacks[1]. According to the National Survey on Nutrition and Physical Activity (IAN-AF 2015/16), children aged three to nine years have a lower intake of fruits and vegetables and an excessive consumption of soft drinks and red and processed meats compared to the World Health Organization (WHO) recommendations[2]. Based on these findings, there is an urgent need to improve the dietary habits of Portuguese children.

There is strong scientific evidence that exposure to environmental factors during critical periods of growth and development has lasting effects on an individual's health[3-6], in particular the early postnatal period, when nutrition plays a very important role regarding the risk of developing noncommunicable diseases, such as obesity, type 2 diabetes, and cardiovascular disease through metabolic programming effects[7,8].

Daycare centers are among the key factors that must be taken into account in shaping dietary preferences during childhood. Daycare is understood as a social response aimed at accommodating children between the ages of three and 36 months during the daytime period corresponding to their parents' working hours[9]. In recent decades, there has been an increase in the number of children enrolled in these facilities due to the greater participation of women in the workforce[10], making the nutritional quality of the menus offered in these settings a key factor in promoting healthy eating during childhood[11]. The WHO highlights daycare centers as a unique setting for implementing health-promoting interventions[12].

Daycare centers have become increasingly important as excellent settings for intervening to promote child health, with a particular focus on encouraging healthy dietary habits, in countries such as Poland, Brazil, Australia, and China[13-16]. The "Healthy Start" intervention project, conducted in the United States in 2002, successfully reduced the total and saturated fat content consumed by children aged two to five by modifying the food provision in these settings[17,18]. In Australia, the "Romp & Chomp" project in 2010 achieved a reduction in the prevalence of obesity in children aged nine to five by increasing the consumption of fruits and vegetables and decreasing the intake of energy-dense, nutrient-poor foods and beverages[19].

In Portugal, the "Creche com Sabor e Saúde" (C2S) project (2022-2023) involved 18 Portuguese daycare centers, with more than 800 children aged six to 36 months[20]. This project made it possible to characterize lunch offerings in this country for the first time, which revealed inadequacies. Notable findings from this analysis include an excessive provision of prepared fruit for the six to eight months age group, the simultaneous serving of a protein-based dish and soup for the 9-11 months age group, and the absence of oily fish and eggs for children aged 12-36 months. Therefore, aiming to enhance the nutritional quality of the food supply in these educational settings, where many children embark on and undergo dietary diversification, establishing their preferences and eating habits, we proposed researching the impact of a nine-month intervention strategy for children aged six to 36 months in the daycare social response stemming from the C2S project.

Materials and methods

This study was conducted using a nonprobabilistic, convenience sample consisting of 18 social institutions with daycare services, located in the northern and central regions of Portugal. These institutions were part of the C2S project. All the institutions attend children aged 12 to 36 months, but only 17 (out of 18) had children aged six to 11 months. The study took place between February 2022 and February 2023.

1st phase (initial phase) – data collection

An initial, self-administered online questionnaire was developed for the purpose of gathering information on the characteristics of the social institutions. This included the type of food service unit (preparation or collection), the type of management (direct or concession), the number of children enrolled in daycare, the number of education professionals (teachers and educational assistants) and food handlers, collaboration with a nutritionist in the institution, and the existence of food donations.

In the initial phase, lunch menus from the 12 weeks prior to the start of the project were collected. A qualitative evaluation tool, developed within the context of the C2S project, was applied based on recommendations from the Directorate-General of Health (DGS), the European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN), and the WHO[21-23]. The tool is designed to assess compliance with specific parameters for three distinct age groups (six to eight months, nine to 11 months, and 12 to 36 months), investigating a total of 23, 47, and 48 items, respectively. Compliance is established as "Compliant," "NonCompliant," and "Not Applicable/Not Auditable." The percentage (%) of compliance over the 12 weeks was calculated for each item. Finally, the mean value of the menu quality for each institution was calculated by averaging the total percentage of compliance across all evaluated parameters[20].

2nd phase – intervention strategy

Following the evaluation of lunch menus provided in daycare centers (phase 1), the research team drafted individualized technical reports for each institution. These reports detailed which evaluated items complied the most with the recommendations and, conversely, which items did not adequately comply with the recommendations and therefore should be prioritized. Each report included suggestions for improvement for the items that were not properly addressed so as to enhance the quality of the menus offered. These reports were presented and discussed individually in a meeting with the daycare nutritionist at each institution or, in the absence of a nutritionist, with the person in charge of the institution. Additionally, the research team provided ongoing support to the institutions throughout the 12-month project period for the purpose of clarifying any doubts related to the suggested improvements.

3rd phase (final phase) – evaluation of the intervention strategy

In the final phase, the lunch menu plans from the previous 12 weeks of the project were collected and evaluated using the same tool employed in the initial phase[20]. In addition to calculating the percentage of compliance for each parameter and the average menu quality percentage, the percentage of variation in compliance and the percentage of improvement were determined.

The variation percentage represents the difference between the average menu quality values in the initial and final periods. The improvement percentage corresponds to the proportion of positive change, calculated as (100 – [final % × 100 / initial %]).

The data were analyzed using the Software Package for Social Sciences (SPSS®) for Windows V.27.0 and results were considered statistically significant when $p < 0.05$. The descriptive analysis of the variables was conducted by presenting measures of central tendency and dispersion. Specifically, relative and absolute frequencies were employed for nominal variables, while mean (± standard deviation) or median (25^{th}-75^{th} percentile) were utilized for continuous variables. This approach was based on the normality of the variable, which was assessed by the Shapiro-Wilk test. The Wilcoxon signed-rank test was employed to ascertain whether there were discernible discrepancies in the quality of the menus in question prior to and subsequent to the intervention, as well as for each item under consideration in this study. The association between institutional characteristics and the enhancement in menu quality (in general and for each item) was evaluated utilizing the Pearson correlation coefficient and the t-student test for independent samples.

This study was approved by the Ethics Committee of the Faculty of Nutrition and Food Sciences at the University of Porto (report No. 77/2022/CEFCNAUP/2022).

Results

Twelve weekly menu plans from 18 private social solidarity institutions were analyzed at two assessment periods (the 1^{st} and 3^{rd} phases), totaling 432 weeks of menu plans (216 in each phase) and 5,040 meals analyzed (1^{st} phase: 780 from the six to eight months age bracket, 780 from the nine to 11 months age bracket and 1,080 from the 12 to 36 months age bracket; 3^{rd} phase: 960 from the six to eight months age bracket, 960 from the nine to 11 months age bracket and 1,080 from the 12 to 36 months age bracket).

Out of the institutions surveyed, 15 (83.3%) were preparation units while three (16.7%) were collection units. Additionally, 17 (94.4%) institutions had an in-house management service while one institution (5.6%) had a leased management service. Approximately 60% (n = 11) of the establishments received food donations and only 10 (55.6%) had a nutritionist working daily in these spaces. The average number of enrolled children in the institutions was 45, with a min of 25 and a max of 90, and the number of human resources dedicated to meal preparation and cooking varied between two and 11 individuals (Table 1).

Table 1. Characterization of institutions involved in the "Creche com Sabor e Saúde" (C2S) project

Characteristic	n = 18
Type of food service unit, n (%)	
Preparation	15 (83.3)
Collection	3 (16.7)
Type of management, n (%)	
Direct	17 (94.4)
Concession	1 (5.6)
Total number of children, mean (SD)	45 (18)
Total number of education professionals, mean (SD)	10 (3)
Total number of food handlers, mean (SD)	5 (3)
Total number of employees, mean (SD)	14 (4)
Collaboration of a nutritionist in the institution, n (%)	
Yes	12 (66.7)
No	6 (33.3)
Receipt of food donations, n (%)	
Yes	11 (61.1)
No	7 (38.9)

SD: standard deviation.

In terms of the qualitative assessment of menus, a comparison of the postintervention evaluation with the preintervention evaluation revealed that all institutions exhibited an improvement in the quality of their lunch menus. Indeed, the difference observed in the quality of the menus before and after the intervention was statistically significant ($p < 0.001$; result shown only in the text). The median value of improvement in the percentage of compliance with menu plan evaluations was 16%, with the median percentage of compliance in the final evaluation being 80.7% and in the initial evaluation being 70.3%. Specifically, an improvement of greater than 30% was observed in two institutions, between 15.0 and 30.0% in nine institutions, and between 0.0 and 15.0% in nine institutions (Table 2).

In the initial phase of the study, 18 institutions were taken into consideration for the 12-36 months age group and 13 (73%) for the 6-11 months age group. Four of the latter, despite providing meals, did not have a defined menu plan. In the final phase, there was a notable increase in the number of institutions with menu plans for the 6-11 months age group, from 13 (76.5%) to 16 (94.1%), along with an increase in the number of assessable items. In these cases, the

Table 2. Evaluation of the effect of the intervention strategy on the lunch menu plans under the "Creche com Sabor e Saúde" (C2S) project

Daycare center	Average % of compliance (initial phase)	Average % of compliance (final phase)	% compliance variation*	% of improvement†
A	71.9	93.0	+21.1	29.3
B	61.7	66.4	+4.7	7.7
C	72.3	75.8	+3.5	4.8
D	73.8	79.5	+5.7	7.7
E	63.7	91.6	+27.9	43.7
F	78.6	97.4	+18.8	23.9
G	66.8	81.8	+15.0	22.5
H	71.4	87.7	+16.3	22.9
I	81.3	87.9	+6.6	8.2
J	74.0	83.5	+9.5	12.9
K	66.9	77.5	+10.6	15.9
L	66.9	77.5	+10.6	15.9
M	66.9	77.5	+10.6	15.9
N	66.9	77.5	+10.6	15.9
O	71.1	76.0	+4.9	6.8
P	69.7	76.2	+6.6	9.4
Q	66.2	89.5	+23.2	35.1
R	70.8	87.1	+16.2	22.9
Total	70.3	80.7	+10.6	16

*Compliance % variation = final phase % - initial phase %.
†Improvement % = 100 - (final phase % x 100 / initial phase %).

qualitative assessment of menus was more comprehensive, as a more detailed description of soup and dessert components was observed. A notable increase was observed in the number of institutions specifying the drink (water) on their lunch menus. This increase was particularly evident in the six to eight months age group, with a 27% increase, followed by the 9-11 months age group, with a 34.6% increase, and finally the 12-36 months age group, with a 22.2% increase (results shown only in the text).

The parameters of the qualitative menu evaluation tool are detailed in table 3, demonstrating the greatest variation in the compliance percentage between the initial and final phases across the different age groups. Notably, in the six to eight months age group, there was an increase in compliance by offering soup with a min of three different vegetables (+ 100%, p = 0.007) and providing prepared fruit a max of twice a week (+ 100%, p = 0.014). In the 9-11 months age group, there was a 100% increase in compliance concerning offering pureed fruit of only one variety, although this was not statistically significant (p = 0.317). There was also a 100% increase in the inclusion of at least three different vegetables in each soup (p = 0.007). Among the 12-36 months age group, for instance, there was a higher provision of oily fish (8.3%, p = 0.025) and a decrease in animal protein in soup (4.2%, p = 0.006). In this age group, two parameters exhibited a negative variation: the offering of meat as the main protein source two to three times a week (–8.3%, p = 0.007) and the absence of dishes with components of a similar texture (–4.2%, p = 0.007).

In examining the relationship between menu quality improvement and institutional management characteristics, no statistically significant differences were observed.

Table 3. Effect of the intervention strategy on the degree of compliance with the parameters of the menu evaluation tool within the scope of the "Creche com Sabor e Saúde" (C2S) project

Variable	Average % of compliance (initial phase)		Average % of compliance (final phase)		p*	Compliance % variation†
	n	Median (p25, p75)	n	Median (p25, p75)		Median (p25, p75)
Parameters						
6-8 months						
A minimum of three different vegetables in the soup, daily	11	0 (0, 95.8)	14	100 (100,100)	0.007	+100 (31.3,100)
Fish in soup two to three times a week	12	91.7 (0.0, 93.8)	16	100.0 (87.5, 100.0)	0.010	+8.3 (0.0, 79.2)
Provision of prepared fruit, with no added sugar, no more than twice a week	10	0.0 (0.0, 0.0)	15	100.0 (50.0,100.0)	0.014	+100.0 (0.0, 100.0)
9-11 months						
Wide range of cooking techniques	8	33.3 (33.3, 50.0)	13	83.3 (33.3, 83.3)	0.180	+50.0 (0.0, 83.3)
Absence of repeated dishes in a month	8	0.0 (0.0, 0.0)	13	66.7 (33.3, 100.0)	0.024	+41.7 (33.3, 66.7)
A minimum of three different vegetables in the soup, daily	11	0.0 (0.0, 95.8)	13	100.0 (100.0, 100.0)	0.007	+100.0 (31.3, 100.0)
Fish as the main source of protein two to three times a week	11	100.0 (95.8, 100.0)	16	100.0 (91.7, 100.0)	0.102	+4.2 (0.0, 85.4)
Max presence of the same CH supplied twice a week	8	70.8 (50.0, 100.0)	13	91.7 (83.3, 100.0)	0.034	+33.3 (8.3, 83.3)
Provision of prepared fruit, with no added sugar, no more than once a week	4	0.0 (0.0, 25.0)	15	100.0 (50.0,100.0)	0.317	+100.0 (0.0, 100.0)
Fruit puree of only one variety of fruit	2	-	15	100.0 (100.0, 100.0)	0.317	+100.0 (100.0, 100.0)
12-36 months						
Absence of prefried and deep-fried foods	18	70.8 (52.1, 81.3)	18	83.3 (66.7, 83.3)	0.043	+4.2 (0.0, 9.6)
Absence of animal protein food (meat/fish/egg) in soup	18	91.7 (72.9, 100.0)	18	100.0 (100.0, 100.0)	0.006	+4.2 (0.0, 8.3)
Meat as the main source of protein two to three times a week	18	100.0 (91.7, 100.0)	18	91.7 (83.3, 100.0)	0.007	–8.3 (–8.3, 0)
Oily fish at least once a week	18	16.7 (0, 31.3)	18	41.7 (20.8, 56.3)	0.025	+8,3 (0.0, 45.8)
Max provision of the same CH supplied twice a week	18	83.3 (41.7, 89.6)	18	83.3 (83.3, 100.0)	0.022	+8.3 (0.0, 41.7)
Adding vegetables to CH supplied twice a week	18	45.8 (25.0, 66.7)	18	50.0 (43.8, 72.9)	0.093	+8.3 (0.0, 16.7)
Provision of legumes on the plate once a week	18	70.8 (50.0, 83.3)	18	83.3 (58.3, 97.9)	0.046	+4.2 (0.0, 14.6)

(*Continues*)

Table 3. Effect of the intervention strategy on the degree of compliance with the parameters of the menu evaluation tool within the scope of the "Creche com Sabor e Saúde" (C2S) project (*continued*)

Variable	Average % of compliance (initial phase)		Average % of compliance (final phase)		p*	Compliance % variation†
	n	Median (p25, p75)	n	Median (p25, p75)		Median (p25, p75)
Varied offer between raw and cooked vegetables	18	70.8 (43.8, 91.7)	18	91.7 (77.1, 91.7)	0.008	+4.2 (0.0, 39.6)
Absence of dishes with all components of a similar texture	18	100.0 (100.0, 100.0)	18	95.8 (77.1, 100.0)	0.007	–4.2 (–23.0, 0.0)
Absence of sweet desserts	18	91.7 (60.4, 97.9)	18	100.0 (100.0,100.0)	0.087	+4.2 (0.0, 8.3)

*Wilcoxon signed-rank test.
†Compliance % variation = final phase % - initial phase %.
CH: carbohydrates; P25 – 25th percentile; P75 – 75th percentile.

This indicates that there is no association between the percentage of improvement and the total number of children (p = 0.493), education professionals (p = 0.801), food handlers (p = 0.563), and collaborators (p = 0.492). Furthermore, there was no correlation between menu quality improvement and the receipt of food donations (mean with donations = 16.9%, mean without donations = 19.4%, p = 0.551) or collaboration with a nutritionist in the institution (mean with nutritionists = 20.2%, mean without nutritionists = 13.1%, p = 0.590).

The absence of animal protein sources (meat, fish, and eggs) in the soup was found to be statistically significantly different according to the total number of education professionals (correlation coefficient = 0.487, p = 0.040). Similarly, oily fish consumption at least once a week was also found to be statistically significantly different according to the total number of food handlers (correlation coefficient = 0.484, p = 0.042).

Discussion

The main results of this study are an increase in the availability of meal plans for the 6-11 months age group, a more detailed description of the ingredients in the meals, and a 16% improvement in the qualitative rating of these meal plans. Although there was no statistically significant association between the improvement in the quality of the menus and the collaboration of a nutritionist in the institution, it is important to note that the average quality of the menus was higher in the institutions with nutritionists than in those without (20.2% and 13.1%, respectively). Moreover, it was evident that the technical and scientific support provided by the project's nutritionists in the evaluation of the menu plans and the writing of the reports had a positive impact on the final result.

In the 12 month follow-up period of this study, there was a notable improvement in the quality of menus across all participating institutions, with an average increase of 10.6% and a max of 43.7%. This is a significant finding, particularly considering the fact that children spend a substantial portion of their day in a childcare setting, where they consume a considerable number of meals that can have a profound impact on their early eating habits[24]. In this study, two of these institutions showed an improvement of more than 30% in the quality of their lunch menus. However, it was not possible to identify a plausible justification for this significant improvement concerning the other institutions, nor for such a large disparity in the improvement percentage found (4.8% to 43.7%). It was not possible to ascertain whether this improvement was associated with any of the covariates analyzed, such as the presence or absence of a nutritionist or the receipt or non-receipt of food donations. The small sample size may reduce the power of this analysis, so further studies are needed to understand the factors related to the improvement in menu quality.

A multidisciplinary intervention conducted in Australia was efficacious in enhancing the food provision and nutritional practices of the 50 daycare centers included in the study[25]. In the same country and in the context of childcare, a randomized clinical trial lasting six months intervened in a group with on-the-job training for staff, the provision of checklists for planning menus, recipes, and budget fact sheets. The results indicated an increase in compliance with national dietary guidelines for children aged two to five years[26]. In this same group, it was found that improving the quality of the food offered led to an increase in the intake of healthier foods[26]. Although this study did not directly assess the food intake of children in the institutions, it is

anticipated that the findings had a positive impact on their dietary consumption, due to the increased ease of influencing behaviors in these age groups[27].

The provision of prepared fruit up to twice a week from the six to 11 months age group, as well as the provision of a fruit puree with only one variety of fruit, were identified as one of the criteria that exhibited the greatest improvement among the institutions. These items are extremely important as the first years of life are a window of opportunity for training in different tastes and textures[23]. These months are essential for the child's sensory development and from the sixth month onwards, neuromotor control and physiological and metabolic maturity allow for a progressive increase in textures[23]. A notable increase in the addition of vegetables to the carbohydrate provision was observed between the ages of 12 and 36 months. This finding suggests that a more consistent and frequent provision of these foods may be achieved by following this approach. Compliance with this item becomes even more relevant in the knowledge that the repeated offer of a particular vegetable to a child is one of the main determinants for an increase in its consumption[28].

All of the items mentioned above and those discussed support the need to increase food literacy in this context with a view to changing behaviors[29]. This is the inaugural study to assess the efficacy of a brief, simple intervention in the food provision of 18 daycare centers. In this study, the intervention strategy was based on close monitoring of these institutions for a year by a team of nutritionists, who provided early-stage recommendations for enhancing the lunch menus. Additionally, the team provided personalized monitoring with each institution to assist in overcoming the primary challenges encountered as they attempted to improve the menus. Nevertheless, the significance of these initiatives and the necessity of robust and sustainable public health policies at the national level to enhance the nutritional quality of food served in daycare centers and to enhance the training of professionals working in these institutions were readily apparent.

No statistically significant associations were observed between the general improvement of menus and the total number of children and staff. Notwithstanding these considerations, the results of this study indicate that the presence of meat, fish, or eggs in the soup (even when a dish was already provided) and the offer of oily fish at least twice a week were positively correlated with the number of professionals dealing with children and the number of food handlers, respectively. When analyzing this data, it is important to consider the influence of chance, as compliance with these items is largely due to the level of food literacy in this age group and is not directly related to the number of employees.

Despite the observed improvement in numerous parameters of the qualitative assessment tool, it was not possible to achieve 100% compliance in all the parameters considered. These data are consistent with the difficulties reported in the literature regarding the improvement of the food provision in institutions. Some studies have identified the difficulty in verifying the nutritional adequacy of the menus as the main barrier to improvement. This difficulty is inherent to the lack of knowledge, training, and resources for their drafting, which prevents institutions from complying with national and international guidelines. Additionally, the lack of support from families to promote the necessary changes at home, monitoring the eating habits of the institution, further complicates the situation[30,31]. Another study considers obstacles to improving the food provision, including the perceived increase in costs related to healthy eating, the lack of time to prepare healthy meals, the limited storage space, and the perception that children will not adhere as well to a diet that better meets the recommendations in force, resulting in increased food waste[32].

According to data from the WHO, in 2019, approximately 38.2 million children under the age of five years had preobesity and obesity[33]. In adulthood, this pathology is ranked as the fifth leading cause of death globally, accounting for the development of 44% of diabetes mellitus cases, 23% of cardiovascular diseases, and 7-41% of some types of cancer[33,34]. Although intervention projects with an impact on the early age of life (up to 36 months) are still scarce, it has been demonstrated that changing the degree of exposure to risk factors at this stage can lead to a reduction in the risk of developing diseases such as obesity and other non-communicable diseases later in life[7]. Intervention projects in this age group have demonstrated that the qualitative improvement in the food supply of daycare centers is associated with a decrease in body mass index (BMI) and a general improvement in children's eating habits. This is in line with the findings presented by Natale et al.[35].

The main limitations of this study are the small sample size (n = 18), which may have reduced the power to find statistically significant associations as well as the fact that this was a convenience sample and that it is therefore imperative to exercise caution when extrapolating these results, as the sample is not representative of the Portuguese population. In addition, the results of this study may have been biased due to the

possible inaccuracy of the data provided by the self-administered questionnaires. Also, it is crucial to acknowledge the simplicity and brief duration of the intervention strategy, despite its efficacy in yielding promising outcomes. Regarding the lunch menus, it is important to take into consideration that the menus may differ in terms of details and description between institutions, which may have under- or over-estimated the results. Besides, the analysis of the quality of the lunch menus was carried out by three different individuals, although previously trained for this purpose, in order to reduce this possible bias. Finally, although the study assessed the quality of the lunch menus, it did not directly assess children's food consumption, which is a crucial measure to understand the real impact on child nutrition.

This study, despite the aforementioned limitations, reinforces the role and importance of a nutritionist in the context of daycare centers and the need to provide guidelines aimed at improving the quality of the food provision. The intervention strategy used stands out as a practical and an effective approach. Notably, this strategy could be replicated across the country. Furthermore, it is notable that the analysis encompassed 12 week menu plans at each stage of the study, which afforded the research team results that were more closely aligned with the realities of each location and a more precise identification of the changes implemented and sustained over time.

The findings of this study revealed an average improvement of 16% (with a min of 4.8% and a max of 43.7%) in the qualitative assessment of menu plans in the institutions involved. It is noteworthy that there was a notable improvement in the menus drawn up for children aged 6-11 months and that a more precise description of meal components was provided. These findings underscore the pressing need to develop community intervention projects in the dietary environment of daycare centers. Furthermore, they highlight the untapped potential of these strategic settings to establish and positively influence children's eating habits.

Author contributions

M. do Céu Monteiro, M.C. Teixeira Santos, S.S.P. Rodrigues, A. Rocha, C. Afonso: Conception and design of the study, report, review or other type of work or paper; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. A. Gonçalves, I. Dias, M. Conceição: Conception and design of the study, report, review or other type of work or paper; Acquisition of data either from patients, research studies, or literature; Critical review of the article for important intellectual content; Agreement to be accountable for the accuracy or integrity of the work. B. Teixeira: Conception and design of the study, report, review or other type of work or paper; Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. O. Pita: Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. L. Nova: Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. B. Cidade Coelho: Acquisition of data either from patients, research studies, or literature; Drafting the article; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work.

Funding

The C2S project was co-financed by the *Associação Cultural e Recreativa de Cabreiros* and by the *Direção-Geral da Saúde.*

Conflicts of interest

None.

Ethical considerations

Protection of humans and animals. The authors declare that no experiments involving humans or animals were conducted for this research.

Confidentiality, informed consent, and ethical approval. The study does not involve patient personal data nor requires ethical approval. The SAGER guidelines do not apply.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

References

1. Moreira T, Severo M, Pinto E, Nazareth M, Graça P, Rêgo C, et al. Consumo alimentar em crianças de 1-3 anos de idade: EPACI portugal 2012. Nutr. 2014(21):43. DOI: http://hdl.handle.net/10400.14/17670.
2. Lopes C, Torres D, Oliveira A, Severo M, Alarcão V, Guiomar S, et al. Inquérito alimentar nacional e de atividade Física, IAN-AF 2015-2016: relatório de resultados. Univ do Porto. 2017;ISBN. Available from: http://www.ian-af.up.pt/
3. Barker DJP, Thornburg KL. The obstetric origins of health for a lifetime. Clin Obstet Gynecol. 2013;56(3):511-9.
4. Moreno Villares JM. Nutrition in early life and the programming of adult disease: the first 1000 days. Nutr Hosp. 2016;33:8-11.

5. Agosti M, Tandoi F, Morlacchi L, Bossi A. Nutritional and metabolic programming during the first thousand days of life. Pediatr Med Chir. 2017;39(2):157.
6. Gluckman PD, Hanson MA, Low FM. The role of developmental plasticity and epigenetics in human health. Birth Defects Res C Embryo Today. 2011;93(1):12-8.
7. Koletzko B, Brands B, Grote V, Kirchberg FF, Prell C, Rzehak P, et al. Long-term health impact of early nutrition: the power of programming. Ann Nutr Metab. 2017;70(3):161-9.
8. Langley-Evans SC. Nutrition in early life and the programming of adult disease: A review. J Hum Nutr Diet. 2015;28:1-14.
9. Rocha MBP, Couceiro ME, Madeira MIR. Creche: condições de implantação, localização, instalação e funcionamento. Lisboa: Direcção-Geral da Ação Social; 1996. p. 1-4.
10. Aranceta Bartrina J, Pérez Rodrigo C, Dalmau Serra J, Gil Hernández A, Lama More R, Martín Mateos MA, et al. School meals: state of the art and recommendations. An Pediatr (Barc). 2008;69(1):72-88.
11. Dev DA, McBride BA; STRONG Kids Research Team. Academy of nutrition and dietetics benchmarks for nutrition in child care 2011: are childcare providers across contexts meeting recommendations? J Acad Nutr Diet. 2013;113(10):1346-53.
12. World Health Organization. Population-based approaches to childhood obesity prevention 2012. World Health Organization. ISBN 9789241504782. Available from: https://iris.who.int/handle/10665/80149
13. Myszkowska-Ryciak J, Harton A. Eating healthy, growing healthy: outcome evaluation of the nutrition education program optimizing the nutritional value of preschool menus, poland. Nutrients. 2019; 11(10):2438.
14. Hu C, Ye D, Li Y, Huang Y, Li L, Gao Y, et al. Evaluation of a kindergarten-based nutrition education intervention for pre-school children in china. Pub Health Nutr. 2010;13(2):253-60.
15. Cândido NA, de Sousa TM, Dos Santos LC. Effectiveness of different interventions in public nurseries based on food and nutrition education: promoting breast-feeding and healthy complementary feeding. Pub Health Nutr. 2018;21(13):2454-61.
16. Bell AC, Davies L, Finch M, Wolfenden L, Francis JL, Sutherland R, et al. An implementation intervention to encourage healthy eating in centre-based child-care services: impact of the good for kids good for life programme. Pub Health Nutr. 2015;18(9):1610-9.
17. Williams CL, Bollella MC, Strobino BA, Spark A, Nicklas TA, Tolosi LB, et al. "Healthy-start": outcome of an intervention to promote a heart healthy diet in preschool children. J Am Coll Nutr. 2002;21(1):62-71.
18. Williams CL, Strobino BA, Bollella M, Brotanek J. Cardiovascular risk reduction in preschool children: the "healthy start" project. J Am Coll Nutr. 2004;23(2):117-23.
19. de Silva-Sanigorski AM, Bell AC, Kremer P, Nichols M, Crellin M, Smith M, et al. Reducing obesity in early childhood: results from romp & chomp, an australian community-wide intervention program. Am J Clin Nutr. 2010;91(4):831-40.
20. Teixeira B, Dias I, Conceição M, Nova L, Coelho BC, Ferreira L, et al. Projeto C2S - creche com sabor e saúde. Rel de Resultados. ISBN 978-972-98406-2-3.2023; Available from: https://hdl.handle.net/10216/149392
21. WHO guidelines approved by the guidelines review committee. infant and young child feeding: model chapter for textbooks for medical students and allied health professionals. WHO. 2009;ISBN-13:978-92.
22. Fewtrell M, Bronsky J, Campoy C, Domellöf M, Embleton N, Fidler Mis N, et al. Complementary feeding: A position paper by the european society for paediatric gastroenterology, hepatology, and nutrition (ESPGHAN) committee on nutrition. J Pediatr Gastroenterol Nutr. 2017;64(1):119-32.
23. Rêgo C, Lopes C, Durão C, Pinto E, Mansilha H, Pereira da S, et al. Alimentação saudável dos 0 aos 6 anos – linhas de orientação para profissionais E educadores. In: Ministério da saúde direção-geral da saúde 2019 ISBN.
24. Health Promotion Unit, Department of Health and Children. Food and nutrition guidelines for pre-school servicesDept of health & children. Dept of health & children.2004.
25. Matwiejczyk L, McWhinnie JA, Colmer K. An evaluation of a nutrition intervention at childcare centres in south australia. Health Promot J Austr. 2007;18(2):159-62.
26. Seward K, Wolfenden L, Finch M, Wiggers J, Wyse R, Jones J, et al. Improving the implementation of nutrition guidelines in childcare centres improves child dietary intake: findings of a randomised trial of an implementation intervention. Pub Health Nutr. 2018;21(3):607-17.
27. Scaglioni S, De Cosmi V, Ciappolino V, Parazzini F, Brambilla P, Agostoni C. Factors influencing children's eating behaviours. Nutrients. 2018;10(6):706.
28. Nicklaus S. Complementary feeding strategies to facilitate acceptance of fruits and vegetables: A narrative review of the literature. Int J Environ Res Public Health. 2016;13(11):1160.
29. Whiteley C, Matwiejczyk L. Preschool program improves young children's food literacy and attitudes to vegetables. J Nutr Educ Behav. 2015;47(4): 397-8.
30. Buttivant H, Knai C. Improving food provision in child care in england: a stakeholder analysis. Pub Health Nutr. 2012;15(3):554-60.
31. Gerritsen S, Wall C, Morton S. Child-care nutrition environments: results from a survey of policy and practice in new zealand early childhood education services. Pub Health Nutr. 2016;19(9):1531-42.
32. Nanney MS, LaRowe TL, Davey C, Frost N, Arcan C, O'Meara J. Obesity prevention in early child care settings. Health Educ Behav. 2017;44(1): 23-31.
33. World health organization. Obes Overw. 2021; Available from: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight
34. Fan W. Epidemiology in diabetes mellitus and cardiovascular disease. Cardiovasc Endocrinol. 2017;6(1):8-16.
35. Natale RA, Lopez-Mitnik G, Uhlhorn SB, Asfour L, Messiah SE. Effect of a child care center-based obesity prevention program on body mass index and nutrition practices among preschool-aged children. Health Promot Pract. 2014;15(5):695-705.

PORTUGUESE JOURNAL OF PEDIATRICS

PERMANYER

Check for updates

ORIGINAL ARTICLE

Effect of heat disinfection methods on the surface roughness of silicone nipples

Camila Nobre de Freitas[1], *Emerson Tavares de Sousa*[1], *Kelly Guedes de Oliveira Scudine*[2], *Regina Maria Puppin Rontani*[1], *Beatriz Tomé Martins de Moraes*[2], *and Paula Midori Castelo*[2]*

[1]Department of Pediatric Dentistry, Piracicaba Dental School, Piracicaba; [2]Department of Pharmaceutical Sciences, Universidade Federal de São Paulo (UNIFESP) Diadema, São Paulo. Brazil

Abstract

Introduction and Objective: Pacifier and silicone nipples have been widely used, although there is a lack of information on which disinfection procedures are most effective and safe. The aim was to evaluate the effect of heat disinfection methods on the surface of three different types of silicone pacifiers (conventional, orthodontic A and orthodontic B). **Method**: The pacifiers were randomly assigned into two groups of 10 specimens each according to the disinfection protocol, microwave (seven minutes) or boiling water (five minutes), performed once a day. They were subsequently immersed in artificial saliva (12 hours) and stored in a dry environment to mimic routine use for 30 days. The surface was evaluated with a scanning electron microscope and profilometer at baseline, 15 and 30 days. **Results:** The orthodontic B pacifier showed a higher surface roughness at baseline, but an increase in the surface roughness, saliences and pores was observed at 15 and 30 days in all specimens ($p < 0.001$; three-way mixed model), irrespective of the disinfection method. **Discussion:** There were remarkable changes to the surface of the silicone pacifiers after 15 and 30 days of heat disinfection procedures. Awareness of their harmful effect on the surface of a pacifier is important so as to improve the recommendations given to caregivers to ensure effective disinfection with the least possible damage.

Keywords: Pacifiers. Silicone elastomers. Disinfection. Sucking behavior. Microscopy.

Efeito dos métodos de desinfecção por calor na rugosidade da superfície de bicos de silicone

Resumo

Introduçao e Objetivo: Embora ainda amplamente utilizada, faltam informações sobre os procedimentos de desinfecção mais eficazes e seguros para chupetas e bicos de silicone. O objetivo foi avaliar o efeito de métodos de desinfecção térmica na superfície de três tipos de chupetas de silicone (convencional, ortodôntica A e ortodôntica B). **Método**: As chupetas foram distribuídas aleatoriamente em 2 grupos com 10 espécimes de cada chupeta, de acordo com o protocolo de desinfecção: micro-ondas (7 min) ou água fervente (5 min), realizado uma vez ao dia e posteriormente imersos em saliva artificial (12 h) e armazenadas em ambiente seco para mimetizar o uso rotineiro por 30 dias. A superfície foi avaliada por microscopia eletrônica de varredura e perfilômetro no início do estudo, 15 e 30 dias após. **Resultados**: A chupeta ortodôntica B apresentou

***Correspondence:**
Paula Midori Castelo
E-mail: paula.castelo@unifesp.br

Received: 24-05-2024
Accepted: 28-10-2024
https://pjp.spp.pt

Available online: 27-03-2025
Port J Pediatr. 2025;56(3):147-154
DOI: 10.24875/PJP.24000051

maior rugosidade superficial no início do estudo, embora tenha sido observado aumento da rugosidade superficial, saliências e poros aos 15 e 30 dias em todos os espécimes das três chupetas (p < 0,001; ANOVA modelo Misto de Três Vias), independentemente do método de desinfecção. **Discusâo:** Os resultados mostraram mudanças notáveis na superfície das chupetas de silicone após 15 e 30 dias de procedimentos de desinfecção térmica. Este conhecimento é importante para aprimorar as recomendações dadas aos pais/cuidadores para garantir uma desinfecção eficaz com o menor dano possível.

Palavras-chave: Chupetas. Elastômeros de silicone. Desinfecção. Comportamento de Sucção. Microscopia.

Keypoints

What is known
– There is a lack of information on the most effective and safe disinfection procedures for pacifiers.

What is added
– Remarkable changes to the surface of silicone pacifiers after 15 and 30 days of heat disinfection procedures, which can increase bacterial colonization.

Introduction

Although the prevalence of sucking habits varies across countries and cultures, they are very common in children and often introduced shortly after birth. Their widespread use can be attributed to some positive effects reported by parents, such as soothing the child[1] and relieving pain during painful experiences[2], besides being recommended to prevent the risk of sleep-related infant deaths[3]. However, in addition to their impact on the duration of breastfeeding[4,5] and orofacial development[6,7], pacifiers can also be considered a vehicle of contamination and microbial transmission due to their permanent contact with saliva and oral microflora[8]. Some authors have shown that the use of a pacifier can be associated with the occurrence of otitis media[9], dental caries[10] and intestinal parasitic infections. Considering the high prevalence in several countries, disinfection methods to eliminate contamination by oral microorganisms in pacifiers and nipples are an important issue in pediatrics, although there is no consensus on the most effective and safe disinfection procedure.

The methods for decontaminating and disinfecting pacifiers reported in the literature include distilled water, a neutral detergent[11], rinsing solutions such as alcohol-free mouthwash, chlorhexidine gluconate mouthwash, 70% hydrogen peroxide, 2.5% sodium hypochlorite, a commercially available antiseptic toothbrush rinse (Brushtox®)[11-16], and spray solutions containing 0.12% chlorhexidine[12], all with varying effectiveness. Boiling in water is another common procedure frequently used at home and is recommended by manufacturers and health professionals for pacifier and bottle nipple disinfection[12]. Microwave use has also become a routine procedure for disinfecting dental devices and materials, such as a prosthesis and pacifiers[17]. However, disinfection procedures can lead to changes to the surfaces of pacifiers, which may facilitate the colonization of microorganisms. The extent of the alteration to the surface may vary depending on the type of pacifier and according to the frequency and duration of the disinfection method.

While there are studies on the contamination of pacifiers in the literature[8,11-15], the current knowledge regarding the morphological changes to pacifier surfaces due to disinfection methods is very limited. To the best of our knowledge, no previous study has examined the effect of disinfection procedures on the roughness of pacifiers' silicone surfaces over time, which may vary depending on the composition of the material and the geometrical format. Such information is helpful to improve the recommendations given to caregivers to ensure the effective and safe disinfection of pacifiers and bottle nipples. Thus, the objective of this study was to assess the effect of heat disinfection methods on the surface roughness of three different types of pacifiers.

Methods

Specimen characteristics and disinfection procedures

This is an in vitro analytical study. Sixty silicone pacifiers in total, with 20 units of three different types of nipples, were used: conventional (n. 41,620 Kuka Baby + 6 m, São Paulo, Brazil), orthodontic A (n. 41,900 Kuka Baby + 6 m, São Paulo, Brazil) and orthodontic B (Super Soothie™ + 3 m 421335424791; SCF190/02 Philips Avent, Stamford, USA). These pacifiers were selected so that we could include the two anatomical models of pacifiers available commercially: conventional and orthodontic. The Super Soothie was also chosen for evaluation because it was introduced to the

market with a different nipple shape and visual appearance of the silicone nipple surface compared to the two usual models, and is very popular in Neonatal Intensive Care Units in the USA[18].

The pacifiers were randomly divided into two groups according to the disinfection protocol by a third person using software (Excel). In the first group, the conventional, orthodontic A and orthodontic B pacifiers (10 units each) underwent the disinfection process using a specific device and a microwave steam sterilizer (Philips Avent SCF281/05 Microwave Steam Sterilizer, Brazil and Midea microwave 1,100 watts, São Paulo, Brazil, respectively) adjusted to power level seven (corresponding to 70% of full power) for seven minutes, as described by Nelson-Filho et al.[19]. In the second group, the same number of pacifiers was subject to the boiling water procedure for five minutes, according to the recommendations of Silva RC, et al.[20].

After disinfection, the pacifiers were cooled to room temperature for 30 minutes and then immersed in artificial saliva at 37 °C (MA-033 oven, Marconi, Piracicaba, SP, Brazil) for 12 hours to mimic routine use, with the following composition: 2.2 g/L gastric mucin, 0.381 g/L sodium chloride, 0.231 g/L calcium chloride, 0.738 g/L potassium phosphate, 1.114 g/L potassium chloride, 0.02% sodium azide and a trace of sodium hydroxide to pH 7.0[19]. In the subsequent hours, pacifiers were stored in a dry environment to mimic routine use by a child. This procedure was repeated once a day for 30 days.

In order to perform pre- and post-treatment analysis (baseline, after 15 and 30 days of disinfection procedures), two standardized circular specimens measuring 5 mm in diameter were gathered from each nipple of the pacifiers using a tap (Krause 10; Santo André; Brazil), one for profilometer analysis and the other for scanning electron microscope (SEM) analysis. Each specimen was then washed in distilled water and placed in an ultrasonic bath for 10 minutes.

Profilometer analysis

All specimens were initially attached in a glass plate to a flat, parallel surface to facilitate the reading of the surface roughness. The specimens were then analyzed by the profilometer (Dektak d-150; Veeco, Plainview, New York, NY, USA) to randomly measure the surface roughness (Ra) at three sites (vertical, horizontal and oblique) on the surface of each sample using a blinded procedure. Three readings were performed on the profilometer measuring point. Initially, the specimen was positioned on the center of the surface, then to the right and left of the first reading, amounting to a 10 mm reading within 10 seconds. The parameter evaluated was the arithmetic mean of the surface roughness (Ra) determined from the three readings[20].

Scanning electron microscope (SEM) analysis

The specimens were dried and mounted on a holder using double-sided adhesive carbon tape. They were then sputter-coated with gold (Balzers-SCD 050 Sputter Coater, Liechtenstein) and examined using a scanning electron microscope (JEOL JSM 5600 LV, Tokyo, Japan) operating at 500 × magnification. The morphological analysis was performed using a blinded procedure and then described according to the images obtained by SEM.

Statistical analysis

Data were statistically analyzed using SPSS 24.0 software (IBM Corp., NY, USA), considering an α level of 5%, by one of the authors (PMC, Applied Statistics Spec). The exploratory statistics consisted of means and standard deviation, and normality was tested by using the Shapiro-Wilk test and quantile-quantile-plot (Q-Q plot) analysis. The variable “surface roughness” did not show normal distribution and was transformed by the log (Log).

A general linear model –three-way ANOVA mixed mode– was used to test the within-subjects factor (time: surface roughness at baseline and after treatment) and two between-subjects factors (type of pacifier and disinfection protocol) and the interaction between these factors in the observed roughness variance. The results of the Mauchly sphericity test and Levene’s test for equality of variances were evaluated as ANOVA premises; when necessary, the Huynh-Feldt correction was applied. The main effects were then tested for group and time comparisons. Bonferroni’s adjustment was applied for multiple comparisons.

Results

Table 1 shows the experimental trial employed to examine the change in the surface roughness of each type of pacifier (conventional, orthodontic A and orthodontic B), submitted to 15 and 30 days of heat disinfection procedures (boiled and microwave steamed).

The three-way ANOVA mixed model showed a significant time*pacifier interaction effect ($p < 0.001$) (Table 1). The main effects were then tested for group and time comparisons (one-way ANOVA repeated measures),

Table 1. Evaluation of the time pacifier disinfection effect on pacifier surface roughness (µm): a three-way mixed model

Pacifier	Disinfection	n	Surface roughness at baseline	Surface roughness after disinfection 15 days	Surface roughness after disinfection 30 days
			Mean (SD)	Mean (SD)	Mean (SD)
Conventional	Boiled	10	225.00[a] (44.16)	487.00[a] (130.09)	583.00[a] (101.00)
	Microwave	10	365.27[a] (116.23)	615.00[a] (193.11)	720.00[a] (174.40)
Orthodontic A	Boiled	10	245.37[a] (66.00)	456.00[a] (67.00)	586.25[a] (76.10)
	Microwave	10	413.02[a] (144.09)	563.02[a] (173.16)	625.42[a] (172.05)
Orthodontic B	Boiled	10	18246.00[b] (3044.00)	23717.14[b] (5225.26)	25079.00[b] (5523.00)
	Microwave	10	13256.2[b] (5372.00)	18684.03[b] (6244.33)	21675.08[b] (5750.00)
Three-way mixed model	**F**		**p**	**Partial eta squared**	**Power**
Time effect	47.486		< 0.001	0.468	1.000
Time pacifier effect	37.263		< 0.001	0.580	1.000
Time disinfection effect	0.502		0.501	0.009	0.110
Time pacifier disinfection effect	0.602		0.569	0.022	0.151

SD: standard deviation.
a ≠ b in the same column (p < 0.001; one-way ANOVA; Bonferroni's post-test).

which showed that the effect of time (disinfection treatment) was significant for all groups (p < 0.001). A difference in surface roughness between pacifiers was also found, with the roughness of the orthodontic B pacifier significantly greater than the conventional (p < 0.001) and orthodontic A models (p < 0.001). For all specimens, the change in the surface roughness was greater in the first 15 days compared to the subsequent 15 days (Fig. 1 and table 1).

However, the roughness did not differ when analyzing the type of disinfection, microwave steamed or boiled, as observed by the absence of a significant time disinfection effect.

The morphology analysis of the SEM images of the conventional and orthodontic A pacifiers show similar characteristics of the silicone surface at baseline, when no disinfection procedure had been performed: striaes, pores and saliences on the surface of the material are very discrete (Figs. 2A and 3A, respectively). The roughness, salience and pores on the surface after 15 and 30 days of disinfection procedures are of note (Figs. 2B and 2C, 3B and 3C, respectively).

The images of the orthodontic B pacifier showed the highest baseline surface roughness compared to the orthodontic A and conventional ones (Fig. 4A). The roughness, saliences and pores on the surface are even more pronounced after 15 and 30 days of disinfection procedures, with a remarkable irregular distribution of striaes (Fig. 4B) and saliences and pores (Fig. 4C).

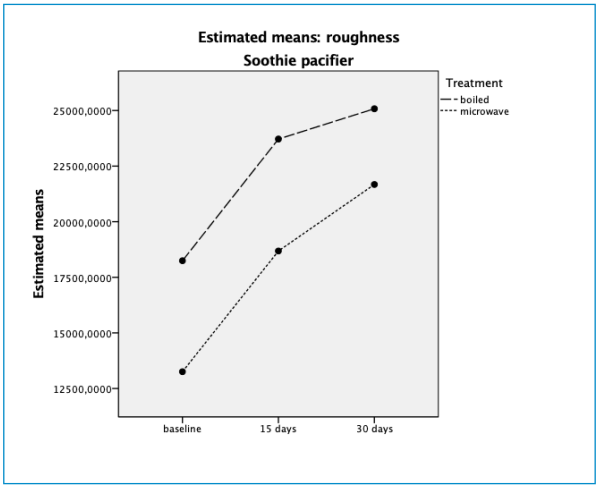

Figure 1. Effect of 15 and 30 days of heat disinfection on the surface roughness of the orthodontic B pacifier.

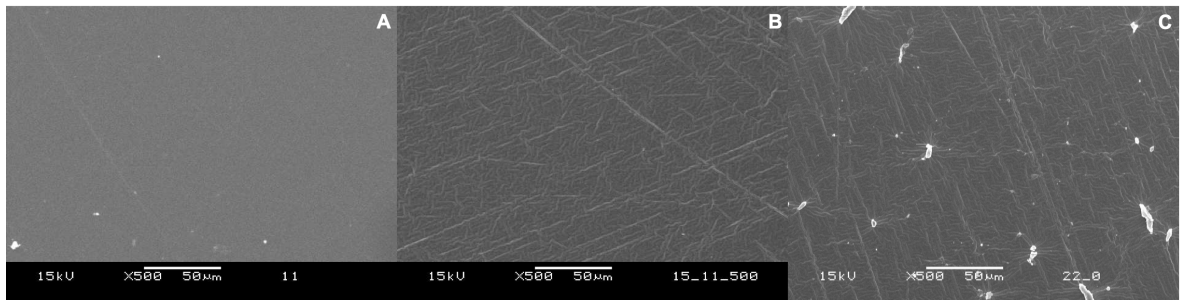

Figure 2. Representative scanning electron microscopy (SEM) images of the conventional pacifier atbaseline **(2A)** and after 15 days **(2B)** and 30 days **(2C)** of the disinfection procedures (original magnification: 500×).

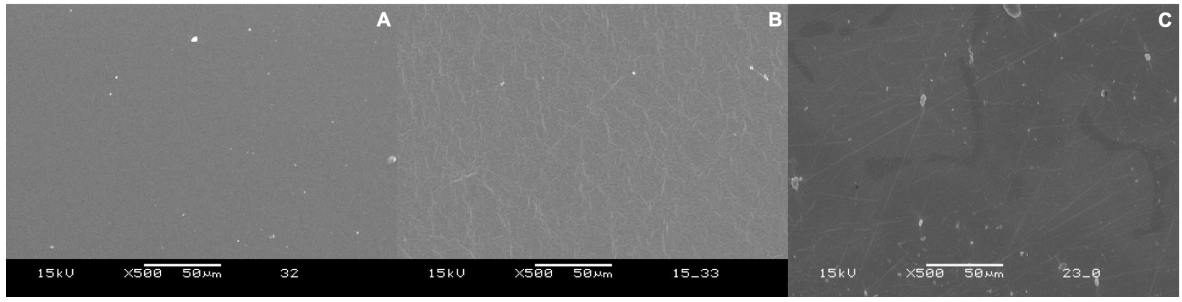

Figure 3. Representative scanning electron microscopy (SEM) images of the orthodontic A pacifier at baseline **(3A)** and after 15 days **(3B)** and 30 days **(3C)** of the disinfection procedures (original magnification: 500×).

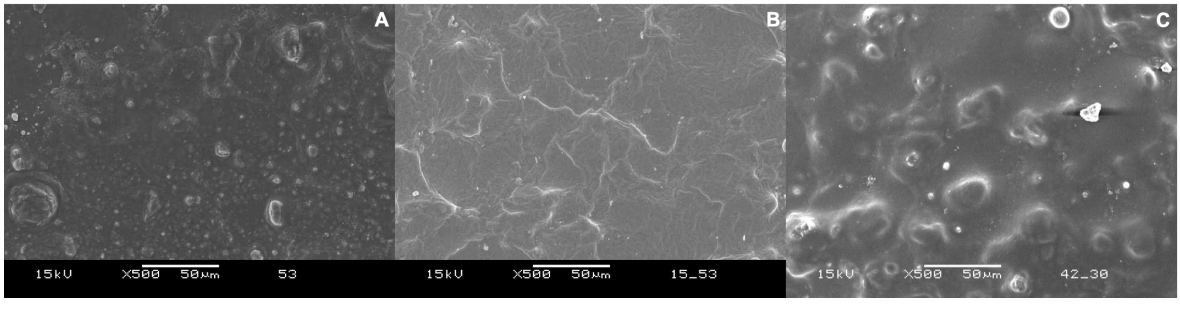

Figure 4. Representative scanning electron microscopy (SEM) images of the orthodontic B pacifier at baseline **(4A)** and after 15 days **(4B)** and 30 days **(4C)** of the disinfection procedures (original magnification: 500×).

Discussion

This study demonstrated the detrimental effects of heat disinfection procedures on the silicone surface of pacifiers after 15 and 30 days, evidenced by the formation of pores, striae, and increased surface roughness on all specimens. Even though silicone rubber, a blend of organic and inorganic compounds produced through the polycondensation of silanol groups, typically exhibits higher heat resistance compared to other materials[21,22], our findings demonstrated that the disinfection methods evaluated led to thermal degradation, altering the morphology of the material. When exposed to high temperatures during microwave disinfection or boiling, the silicone can soften, which can cause deformation or an uneven surface texture as the material cools and solidifies, thereby increasing the susceptibility of the material to microbial colonization.

An important aspect to consider is the relationship between surface roughness and bacterial colonization as rougher surfaces tend to retain more microorganisms, which can increase the risk of oral and systemic infections in children. Previous studies indicate that

bacterial adhesion is facilitated on irregular surfaces through the creation of microenvironments protected from shear forces and cleaning agents[23]. Moreover, a rougher surface increases the overall surface area, providing more sites for microbial adhesion. Therefore, the observed changes in pacifier surface roughness after the tested disinfection methods are clinically relevant and suggest the need for developing new disinfection recommendations or new materials that minimize this deterioration.

The microscope analysis showed porosity, roughness and bubbles in the surface of all specimens after 15 days of heat disinfection procedures, which also increased after 30 days. Similarly, Silva et al.[20] evaluated surface changes on pacifiers after a single heat disinfection process, observing pores and roughness on latex pacifiers and little blisters on silicone pacifiers. The change in surface roughness did not change in accordance with the heat disinfection method used, microwave or boiling water, but it is important to consider that the microwave procedure has some advantages in terms of user safety.

By observing the microscope images of the orthodontic B pacifier, and considering the results of the profilometer analysis, we can conclude that the orthodontic B pacifier has a rougher silicone surface than the orthodontic A and conventional models. This type of pacifier has been widely used[18], probably because it is made with softer silicone, which may affect sucking behavior and the child's preference. Suction is an innate function of the human being and sucking on a pacifier or feeding nipple is one of the first oromotor tasks an infant will do soon after birth[18]. The act of sucking on a pacifier produces a rich stream of sensory cues from cutaneous and deep afferents, especially the lip vermilion and the tip of the tongue, which are areas with high densities of mechanoreceptive afferents[24], and the physical characteristics of the nipple, such as size, shape, roughness and stiffness are an important source of afferent sensory information[18,25].

It is also important to note that previous studies suggest that pacifier use may disrupt the normal flow of saliva, increasing the incidence of dental caries[26,27]. The surface of the pacifier may affect oral sugar clearance, which would prolong conditions of low pH in plaque and thereby favor the selection of aciduric microorganisms that are responsible for the development of caries. According to Nelson-Filho et al.[19], pacifiers become contaminated by *Streptococcus mutans* immediately after their use and, thus, they should be routinely disinfected[12]; besides, it was observed that *Candida albicans* is able to grow and adhere to the silicone surface of pacifiers even in the absence of a nutrient culture medium[11]. A review of the literature[26] on the surface roughness of oral hard materials established that a surface roughness greater than 0.2 µm resulted in an increase in plaque accumulation and in the risk of bacterial contamination, thus increasing the risk for caries and periodontal inflammation. The effect of surface roughness on microorganism colonization might be explained by the fact that bacterial adhesion is more likely on surface irregularities, which may predispose the child to increased levels of salivary *lactobacilli spp* and *candida spp*[27] and, thus, to oral and systemic diseases.

Moreover, Comina et al.[8] assessed microbial contamination on the surface of 25 pacifiers provided by day-care centers and observed the presence of a biofilm on 80% of the samples. A previous study showed that using a 0.12% chlorhexidine solution spray and seven minutes of microwave irradiation were almost equally effective for disinfecting pacifiers, reducing the number of *Streptococcus mutans* colonies[23]. Lopes et al.[9] tested three disinfection protocols: 3.5% neutral detergent, 2.5% sodium hypochlorite and 15 minutes of boiling water. They found they all showed the same effectiveness in controlling *Candida albicans* in the surface of pacifiers. They also observed that vigorous cleaning with water was not sufficient to eliminate the contamination.

The above results, together with our findings, may help health professionals and caregivers to choose the most convenient and effective disinfection procedure. To date, there is no established consensus on the best pacifier disinfection protocol; according to the Canadian Paediatric Society[28], the pacifier should be subject to boiling water for five minutes before the first use and then kept clean by washing with hot, soapy water after each use. Another study[9] suggested that pacifiers should be disinfected in boiling water for 15 minutes weekly and Bachelli et al.[23] pointed out that sodium hypochlorite forms trihalomethanes, which may constitute a disadvantage of its use.

Another important aspect to be considered is that parents or caregivers should always check that the pacifiers and nipples are in good condition and be discarded if there are visible cracks, tears, swelling or if they have a grainy or sticky texture[29], and preferably every two months, before damage occurs[28]. These recommendations are consistent with the changes observed in the structural properties after 30 days of heat disinfection performed daily in this study. Future studies are needed to examine the association between microbial contamination and the surface roughness of nipples in pacifiers and bottles after repeated disinfection procedures.

Although there is a need to discourage the use of nonnutritive sucking habits and formulae to prevent the early cessation of breastfeeding and orofacial impairments[5,6,30], the use of pacifiers and bottles is still prevalent. Thus, the results of this study are helpful in allowing health professionals to improve the recommendations given to parents to ensure an effective disinfection procedure with the least damage possible to the silicone. Besides, the development of pacifiers that remain smooth with a uniform surface even after multiple disinfection procedures is desirable in order to reduce potential bacterial colonization. By way of a limitation of the study, the limited number of material types may be relevant as we tested only silicone rubbers. However, the use of latex pacifiers (natural rubber) has been discouraged.

Conclusion

The results showed the heat-damaging effect of disinfection procedures on the silicone surface of pacifiers after 15 and 30 days, as observed by the higher number of pores, striaes and roughness of the surface. This implies the need to guide parents and guardians in changing pacifiers regularly and frequently to reduce the risk of infections, considering that the surface roughness of the pacifier increases microbial colonization. Future research should focus on developing resistant silicone materials and evaluating other disinfection methods that ensure the least possible damage.

Author contributions

C. Nobre de Freitas: Conception and design of the study, report, review or other type of work or paper; Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. E. Tavares de Sousa: Conception and design of the study, report, review or other type of work or paper; Acquisition of data either from patients, research studies, or literature; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. K. Guedes de Oliveira Scudine: Conception and design of the study, report, review or other type of work or paper; Acquisition of data either from patients, research studies, or literature; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. R.M. Puppin Rontani: Conception and design of the study, report, review or other type of work or paper; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. B. Tomé Martins de Moraes: Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. P. Midori Castelo: Conception and design of the study, report, review or other type of work or paper; Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work.

Funding

This study received support from the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP, SP, Brazil, n. 2016/13867-0) and by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES, Brazil; Finance Code 001). The funding source was not involved in the data collection, analysis, and interpretation; neither in the manuscript writing and in the decision to submit it for publication.

Conflicts of interest

None.

Ethical considerations

Protection of humans and animals. The authors declare that no experiments involving humans or animals were conducted for this research.

Confidentiality, informed consent, and ethical approval. The study does not involve patient personal data nor requires ethical approval. The SAGER guidelines do not apply.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

References

1. Janwadkar A, Duran G, Irving TD, Shah D, Arevalo R, Sanchez M, et al. Perception of pacifier use among caregivers of infants 0-1 years of age. J Investig Med. 2023 Dec;71(8):941-5.
2. Li DK, Willinger M, Petitti DB, Odouli R, Liu L, Hoffman HJ. Use of a dummy (pacifier) during sleep and risk of sudden infant death syndrome (SIDS): population based case-control study. BMJ. 2006 Jan 7;332(7532):18-22.
3. Moon RY, Carlin RF, Hand I. Task force on sudden infant death syndrome and the committee on fetus and newborn. Sleep-related infant deaths: updated 2022 recommendations for reducing infant deaths in the sleep environment. Pediatrics. 2022 Jul 1;150:e2022057990.
4. López de Aberasturi Ibáñez de Garayo A, Santos Ibáñez N, Ramos Castro Y, García Franco M, Artola Gutiérrez C, Arara Vidal I. Prevalencia y determinantes de la lactancia materna: estudio Zorrotzaurre [Prevalence and determinants of breastfeeding: The Zorrotzaurre study]. Nutr Hosp. 2021; DOI: 10.20960/nh.03329.
5. Mosquera PS, Lourenço BH, Matijasevich A, Castro MC, Cardoso MA. Prevalence and predictors of breastfeeding in the MINA-brazil cohort. Rev Saude Publica. 2024;57 (Suppl 2):2s.
6. Scudine KG de O, de Freitas CN, Nascimento de Moraes KSG, Bommarito S, Possobon R de F, Boni RC, et al. Multidisciplinary evaluation

of pacifier removal on oro-dentofacial structures: a controlled clinical trial. Front Pediatr. 2021;9:703695.
7. Kanellopoulos AK, Costello SE. The effects of prolonged pacifier use on language development in infants and toddlers. Front Psychol. 2024;15:1349323. DOI: 10.3389/fpsyg.2024.1349323.
8. Comina E, Marion K, Renaud FNR, Dore J, Bergeron E, Freney J. Pacifiers: a microbial reservoir. Nurs Health Sci. 2006;8(4):216-23.
9. Salah M, Abdel-Aziz M, Al-Farok A, Jebrini A. Recurrent acute otitis media in infants: analysis of risk factors. Int J Pediatr Otorhinolaryngol. 2013 Oct;77(10):1665-9.
10. Vázquez-Nava F, Vázquez REM, Saldivar GAH, Beltrán GFJ, Almeida AVM, Vázquez RCF. Allergic rhinitis, feeding and oral habits, toothbrushing and socioeconomic status: effects on development of dental caries in primary dentition. Caries Res. 2008;42(2):141-7.
11. Lopes DF, Fernandes RT, Medeiros Y de L, Apolonio ACM. Disinfection of pacifier focusing on Candida albicans. Clin Pediatr (Phila). 2019 Dec;58(14):1540-3.
12. Nelson-Filho P, Louvain MC, Macari S, Lucisano MP, Silva RAB da, Queiroz AM de, et al. Microbial contamination and disinfection methods of pacifiers. J Appl Oral Sci. 2015 Oct;23(5):523-8.
13. Molaudzi M, Molepo J. In vitro efficacy of different solutions in the disinfection of silicone pacifiers. S Afr Dent J. 2017;72(4):158-61.
14. Molepo J, Molaudzi M. Contamination and disinfection of silicone pacifiers: an in vitro study. S Afr Dent J. 2015;70(8):351-3.
15. Pedroso J de F, Sangalli J, Brighenti FL, Tanaka MH, Koga-Ito CY. Control of bacterial biofilms formed on pacifiers by antimicrobial solutions in spray. Int J Paediatr Dent. 2018 Nov;28(6):578-86.
16. Pedroso RS, Siqueira RV. A study on protozoan cysts, helminth eggs and larvae in pacifiers. J Pediatr (Rio J). 1997;73(1):21-5.
17. Sanitá PV, Vergani CE, Giampaolo ET, Pavarina AC, Machado AL. Growth of candida species on complete dentures: effect of microwave disinfection. Mycoses. 2009 Mar;52(2):154-60.
18. Zimmerman E, Barlow SM. Pacifier stiffness alters the dynamics of the suck central pattern generator. J Neonatal Nurs. 2008 Jun;14(3):79-86.
19. Nelson-Filho P, Silva LA, Ds Silva RA, et al. Efficacy of microwaves and chlorhexidine on the disinfection of pacifiers and toothbrushes: an in vitro study. Pediatr Dent; 2011;33(1):10-3.
20. Silva RC, Spolidorio DMP, Zuanon ACC, et al. Pacifier disinfection procedure: superficial morphological aspects and microorganisms colonization. RSBO. 2008;5(1):30-3.
21. Castilho SD, Rocha MAM. Pacifier habit: history and multidisciplinary view. J Pediatr (Rio J). 2009;85(6):480-9.
22. Rochow EG. Silicon and silicones. Berlin: Springer Verlag; 1987. p. 99.
23. Chamele J, Bhat C, Saraf T, Jadhav A, Beg A, Jagtap C, et al. Efficacy of microwaves and chlorhexidine for disinfection of pacifiers and toothbrushes: an in vitro study. J Contemp Dent Pract. 2012 Sep 1;13(5):690-4.
24. Trulsson M, Essick GK. Mechanosensation. In: Miles T, Nauntofte B, Svensson P, editors. Clinical oral physiology Copenhagen: Quintessence; 2004. p. 165-97.
25. Oder AL, Stalling DL, Barlow SM. Short-term effects of pacifier texture on NNS in neurotypical infants. Int J Pediatr. 2013;2013:168459.
26. Bollenl CML, Lambrechts P, Quirynen M. Comparison of surface roughness of oral hard materials to the threshold surface roughness for bacterial plaque retention: a review of the literature. Dent Mater. 1997;13(4):258-69.
27. Ollila P, Niemelä M, Uhari M, Larmas M. Risk factors for colonization of salivary lactobacilli and candida in children. Acta Odontol Scand. 1997 Jan;55(1):9-13.
28. Canadian Paediatric Society. Pacifiers (soothers): a user's guide for parents. Paediatr Child Health. 2003 Oct;8(8):520-30.
29. Nelson AM. A comprehensive review of evidence and current recommendations related to pacifier usage. J Pediatr Nurs. 2012 Dec;27(6):690-9.
30. Freitas C de, Castelo PM, Noritomi PY, Scudine K de O, Rontani RMP, Miziara T, et al. Mechanical stress distribution over the palate by different pacifiers assessed by finite element analysis and clinical data. Clin Anat. 2024 Sep;37(6):620-627.

PORTUGUESE JOURNAL OF PEDIATRICS

PERMANYER

Check for updates

ORIGINAL ARTICLE

Quality medical care for adolescents: adolescents *versus* physicians' perception

Madalena Meira Nisa[1,2], Antonio Videira-Silva[3,4,5], Mariana Beatriz Fonseca Mourasup[6], Sofia Moeda[2], Sílvia Freira[2], and Helena Fonseca[2]*

[1]Serviço de Pediatria, Centro Hospitalar Tondela-Viseu, Viseu; [2]Adolescent Medicine Division, Department of Pediatrics, Hospital de Santa Maria, Centro Hospitalar Universitário Lisboa Norte, Lisbon; [3]Centro de Investigação em Desporto, Educação Física, Exercício e Saúde (CIDEFES), Universidade Lusófona, Lisbon; [4]Clínica Universitária de Pediatria, Faculdade de Medicina, Universidade de Lisboa, Lisbon; [5]CIFI2D, Universidade do Porto, Porto; [6]Faculdade de Medicina, Universidade de Lisboa, Lisbon. Portugal

Abstract

Introduction and Objectives: Adolescence is a key developmental period, requiring a distinct clinical approach. Aspects such as communication, confidentiality, and privacy are particularly relevant in adolescence, as indicators of the quality of health care according to the World Health Organization. This study aimed to assess the quality of health care provided to adolescents in a tertiary hospital, based on adolescents' and physicians' perspectives. **Method:** Adolescents attending the outpatient clinic and physicians who may regularly see adolescents in consultation (including pediatricians and other specialties) were invited to participate. Two content-matched questionnaires assessing medical care for adolescents were applied to both groups. **Results:** A total of 112 adolescents and 80 physicians participated. Most adolescents felt empathy with the doctor (98.1%), felt involved in therapeutic decisions (90.7%), and reported spending time alone with the doctor during the consultation (85.9%). Almost all physicians (98.8%) reported showing an empathetic attitude towards gender identity, sexual orientation, ethnicity, and religion and reported that they managed to establish a therapeutic relationship with the adolescents. There was a tendency for non-pediatricians to report a greater interest in seeing adolescents compared to pediatricians (Md = 4/5 versus Md = 3/5; $p = 0.057$). Most physicians (81.3%), but a minority of adolescents (37.1%), perceived that the concept of confidentiality was explained during the appointment ($p < 0.001$). **Discussion:** There seems to be a growing awareness in the medical community of the emergent need for differentiated care in adolescence. Yet, topics such as confidentiality still require improvement, which highlights the need to invest in medical training in this area, even among pediatricians.

Keywords: Adolescents. Quality medical care. Perceptions.

Cuidado médico de qualidade para adolescentes: percepção dos adolescentes versus a dos médicos

Resumo

Introdução e Objetivos: A adolescência é um período chave do desenvolvimento, exigindo uma abordagem clínica distinta. Aspetos como comunicação, confidencialidade e privacidade têm especial relevância, sendo indicadores da qualidade dos cuidados de saúde prestados segundo a Organização Mundial de Saúde. Este estudo teve como objetivo avaliar a qualidade dos cuidados de saúde prestados a adolescentes num hospital terciário, com base na perceção dos adolescentes e dos médicos.

***Correspondence:**
Madalena Meira Nisa
E-mail: madalenamniza@gmail.com

Received: 07-08-2023
Accepted: 22-10-2024
https://pjp.spp.pt

Available online: 11-02-2025
Port J Pediatr. 2025;56(3):155-165
DOI: 10.24875/PJP.23000010

Métodos: Participaram no estudo adolescentes seguidos em consulta e médicos que observam adolescentes em consulta (independentemente da especialidade). Dois questionários complementares foram aplicados a ambos os grupos, de forma a avaliar o atendimento médico ao adolescente. **Resultados:** Participaram 112 adolescentes e 80 médicos. A maioria dos adolescentes sentiu empatia com o médico (98,1%), sentiu-se envolvido nas decisões terapêuticas (90,7%) e relatou ficar sozinho com o médico (85,9%). Quase todos os médicos (98,8%) relataram ter uma atitude empática em relação à identidade de género, orientação sexual, etnia e religião; e relataram estabelecer uma relação terapêutica com os adolescentes. Constatou-se uma tendência para os médicos não pediatras relatarem maior interesse em atender adolescentes em comparação com os médicos pediatras (Md = 4/5 *versus* Md = 3/5; p = 0,057). A maioria dos médicos (81,3%), mas não a maioria dos adolescentes (37,1%) considera que o conceito de confidencialidade foi explicado durante a consulta (p < 0,001). **Discussão:** Parece haver uma consciência crescente na comunidade médica da necessidade emergente de cuidados diferenciados na adolescência. Contudo, a abordagem de temas como confidencialidade, precisa de ser melhorada, evidenciando a necessidade de investir na formação médica nesta área, inclusive entre os pediatras.

Palavras-chave: Adolescentes. Qualidade dos cuidados de saúde. Perceções.

Keypoints

What is known
- Adolescence is a key period in the development of the individual.
- Adolescents need a clinical approach that is considerably distinct from that used at other ages.
- The World Health Organization has established indicators of the quality of health care in adolescence.

What is added
- This is a pioneering study in Portugal comparing the perspectives of adolescents and physicians on the quality of health care provided.
- There seems to be a growing awareness in the medical community of the need for differentiated care in adolescence.
- The approach to some topics, such as suicidal ideation, obtaining informed consent, and explaining the concept of confidentiality still needs improvement.
- The low level of interest among pediatricians in observing adolescents reinforces the need to invest in training in this area.

Introduction

The World Health Organization (WHO) defines adolescence as the age between 10 and 19 years old[1]. This is a key period in the development of the individual, with several changes taking place at the biological, cognitive, and psychosocial levels[2,3]. Over the last few decades, there has been an epidemiological shift in the health problems affecting adolescents worldwide[1]. This has included a reduction in the prevalence of most infectious diseases and an increase in mental health problems, intentional and unintentional violence, substance use, sexually transmitted infections, unplanned pregnancy, abortion, obesity, and chronic illness[1]. Many of these major health problems reflect the high rates of risky behaviors typical of this age, motivated by the delayed maturation of the prefrontal cortex, which controls impulses and critical capacity[4]. Besides genetic and biological factors, social context also contributes to these problems (stressful life, insertion in unsafe communities, family dysfunction, lack of resources for physical exercise and adequate nutrition, amongst others)[5].

Therefore, it is evident that there is a need for a differentiated clinical approach to adolescents, as an adolescent is neither a child nor an adult[1]. Aspects such as communication, confidentiality, privacy, informed consent, and prevention/anticipatory care require particular attention[5,6]. This new paradigm in adolescent treatment requires health professionals to have specific knowledge about this age group, namely their biopsychosocial development, particularities in interviewing adolescents, ethical-legal aspects, nutrition, mental health, substance use and other risky behaviors, sexual health, prevalent pathologies, and chronic diseases[5]. According to the WHO, the concept of a quality service in adolescence is based on eight global standards: adolescent health literacy; community support; adequate provision of services (adequate language regarding information, counseling, diagnoses, and treatments); increase in the competence of professionals; improvement of the characteristics of the facilities; equity and non-discrimination; improvement in available data and its quality; and more active adolescent participation in the decisions about their health[7,8,9,10].

It is extremely important to develop and implement national quality standards and a monitoring system to better respond to the health needs of this population sector, aiming to reach the standards recommended by the WHO. This continuous improvement in the provision of care to adolescents will have to be interconnected with the training of not only pediatricians, but also other physicians dedicated to other areas who may see adolescents, since they have a very relevant role in their health care.

As such, this study aims to assess the quality of health care provided to adolescents in the context of a consultation in a tertiary-level hospital. It takes into account the perceptions of adolescents and physicians, analyzing potential differences in the perceptions of pediatricians and non-pediatricians. It also aims to identify the aspects that should be improved in order to meet the needs of this particular population sector.

Method

Participants

This exploratory study used a non-probabilistic, non-intentional, convenience sample of adolescents attending an outpatient clinic, as well as an independent sample of physicians who may regularly see adolescents in consultation (regardless of the specialty), in a tertiary-level hospital in Portugal. Exclusion criteria included cognitive alterations or mental issues in adolescents that could compromise their interpretation and response to the questionnaires.

Informed consent/assent was signed by all the participants (i.e., adolescents and physicians).

This study was approved by the Ethics Committee of the Faculty of Medicine of the University of Lisbon, Portugal (2023) and is in accordance with the 1964 Helsinki Declaration and its subsequent amendments or comparable ethical standards.

Procedures

Two content-matched questionnaires were administered to adolescents (in the hospital waiting room) and physicians (online) throughout one month.

Questionnaire

The questionnaires were drafted based on a WHO document that had been developed and validated to assess the quality of health services provided to adolescents according to defined global standards for quality services to adolescents[9].

The questionnaires were split into two sections: i) sociodemographic characteristics and ii) perceptions of medical care for adolescents (section II).

Statistical analyses

Data analysis was performed using the IBM SPSS statistics software (version 28.0, IBM, New York, USA). Descriptive characteristics, i.e., median (interquartile range [IR]), were calculated for skewed outcomes. Chi-squared tests were used to analyze differences between adolescents' and physicians' perceptions and between pediatricians' and non-pediatricians' perceptions. Additionally, for variables showing significant differences between pediatricians' and non-pediatricians' perceptions, regression models were computed, which were also adjusted for the length of time since finishing their medical degree and age. A p-value of ≤ 0.05 was considered statistically significant.

Results

Sample characteristics

A total of 112 adolescents (59.8% females), with a median age of 15 years (95% CI: 13.91-14.79), participated in this study. The majority (n = 63, 64.9%) were seen in a pediatric consultation. The remainder were seen in seven other specialties.

Eighty physicians (86.3% females), with a median age of 31 years (95% CI: 33.9-39), participated in this study. Almost 70% (n = 54, 67.5%) of the physicians were dedicated to pediatrics, with the rest from 13 other specialties. Approximately half of the physicians (n = 38, 47.5%) were specialists and the median time since finishing their medical degree was seven years (95% CI: 9.8-14.8).

The participants' characteristics are presented in table 1.

Adolescents' perceptions

Regarding the adolescents' responses to the questionnaires (n = 112), 98.1% felt empathy with the doctor during the appointment, 90.7% felt involved in therapeutic decisions, 86.5% considered the appointment's scheduling convenient, 85.9% reported spending some time alone with the doctor during the consultation and having the perception of privacy during observation,

Table 1. Demographic characteristics of adolescents and physicians interviewed

Variable	Age (years) Median (IR) [Age; range]	Gender (feminine) n (%)	Consultation specialty, n (%)	Professional grade (specialist) n (%)	Time since finishing MD (years) Median (IR) [Time; range]
Adolescents (n = 112)*	15 (4) [10; 18]	67 (59.8%)	Pediatrics, 63 (64.9%) Rheumatology, 7 (7.2%) Neurosurgery, 7 (7.2%) Pediatric Surgery, 6 (6.2%) Endocrinology, 6 (6.2%) Dermatology, 5 (5.2%) Genetics, 2 (2.1%) Pediatric Cardiology, 1 (1%)		
Physicians (n = 80)	31 (15) [25; 66]	69 (86.3%)	Pediatrics, 54 (67.5%) Immunoallergology, 4 (5%) Child Psychiatry, 4 (5%) Pediatric Surgery, 2 (2,5%) Dermatology, 2 (2.5%) PMR, 2 (2.5%) GFM, 1 (1.3%) Neurosurgery, 1 (1.3%) Neurology, 1 (1.3%) Stomatology, 1 (1.3%) Endocrinology, 1 (1.3%) Genetics, 1 (1.3%) Psychiatry, 1 (1.3%) Rheumatology, 1 (1.3%) Not applicable, 4 (5 %)	38 (47.5%)	7 (14) [1; 43]

*Out of all the adolescents, only 97 answered the consultation specialty.
GFM: general and family medicine; IR: interquartile range; MD: medical degree; PMR: physical medicine and rehabilitation; SD: standard deviation.

and 78.4% reported being asked for informed consent prior to any treatment, procedure, or examination. Most of the adolescents reported that the physicians evaluated eating habits (67.3%), physical activity (73.8%), and school environment (74.3%). A minority of adolescents (37.1%) reported that the concept of confidentiality was explained to them and that the physician asked about home or family (46.2%), substance abuse (21.9%), healthy sexuality (12.4%), and the presence of self-injurious behaviors or suicidal ideation (43.7%).

The overall totals for adolescents' answers to the questionnaire are presented in table 2.

Physicians' perceptions

Almost all physicians (98.8%) reported that, exceptionally, they may see an adolescent in follow-up with no appointment who comes looking for help; consider having an empathetic attitude towards gender identity, sexual orientation, ethnicity, and religion; and reported that they managed to establish a therapeutic relationship with the adolescents. Seventy-one (91.3%) physicians reported promoting the autonomy of adolescents, involving them in therapeutic decisions and asking them for informed consent, before any treatment, procedure, or examination. Most of the physicians also reported respecting adolescents' preferences when scheduling appointments (82.5%), being aware of the rights of adolescents as users of health services (82.5%), explaining the concept of confidentiality to the adolescent (81.3%), and having companions (78.8%). Half of the physicians reported asking directly about self-injurious behaviors and suicidal ideation and 32.5% reported not reserving a moment during consultation to be alone with the adolescent.

Half of the physicians (n = 40) reported that adolescents correspond to 25-49% of their clinical practice and 25 (31.3%) reported that adolescents represent less than 25%. Regarding their interest in seeing adolescents, 33.8% of physicians reported a level 4 of interest and 32.5% reported a level 3 of interest. When dealing with transgender adolescents, 46.3% of physicians answered by addressing them by the name of the trans sex and 43.8% answered "Never happened to me".

When comparing responses from pediatricians and non-pediatricians (n = 54 versus n = 26), there was a greater chance of the biopsychosocial sphere (β = 1.58, p = 0.009), puberty (β = 1.72, p = 0.002),

Table 2. Adolescents' answers to the questionnaire

Questions applied to adolescents (n = 112)	Yes, n (%)
Are appointments scheduled at times that are convenient for you and that take into account your school hours/holidays?	96 (85.7%)
Has the concept of confidentiality and its exceptions been explained to you?	39 (34.8%)
Do you usually spend some time alone with the doctor during the consultation?	73 (65.2%)
Is your consultation frequently interrupted by telephone calls or people entering the medical office?	25 (22.3%)
Does your doctor ask you about your eating habits?	70 (62.5%)
Does your doctor ask you about physical activity?	79 (70.5%)
Does your doctor ask you about school?	78 (69.6%)
Does your doctor ask you about family/home?	49 (43.7%)
Does your doctor ask you about substance abuse (including alcohol and tobacco)?	23 (20.5%)
Does your doctor ask you about your sexuality?	13 (11.6%)
Does your doctor ask you directly about self-injurious behaviors and suicidal ideation?	45 (40.2%)
Before any treatment, procedure, or examination, does your doctor ask you for informed consent?	80 (71.4%)
During your observation, do you have a perception of privacy (windows and doors closed, use of a folding screen)?	73 (65.2%)
Do you feel that you are involved in therapeutic decisions and that your opinion and preferences are taken into account?	88 (78.5%)
Do you feel empathy with your doctor during the consultation?	104 (92.9%)

and anthropometry ($\beta = 2.1$, $p = 0.001$) being assessed by pediatricians, regardless of the professional's age and years of experience (Table 3). Regarding the biopsychosocial sphere, significant differences were observed in the evaluation of eating behaviors ($p < 0.001$), physical activity ($p = 0.002$), school environment ($p = 0.004$), family/home ($p = 0.001$), and risk behaviors ($p = 0.046$), with these parameters being assessed more consistently by pediatricians. Also, there was a tendency for non-pediatricians to report a greater interest in seeing adolescents compared to pediatricians (Md = 4/5 versus Md = 3/5; $p = 0.057$). No significant differences were observed in the perception of the percentage of adolescents seen in clinical practice ($p = 0.062$) or in other variables.

Out of all the pediatricians (n = 54), 15 (27.8%) reported not allowing a moment during the consultation to be alone with the adolescent, 10 (18.5%) reported not explaining the concept of confidentiality, and 7 (13.0%) mentioned not asking the adolescent for informed consent before treatments, procedures, or physical examinations.

The overall totals for physicians' answers to the questionnaire are presented in table 4.

Perceptions of adolescents compared to physicians

Most physicians (81.3%), compared to 37.1% of adolescents, reported that the concept of confidentiality and its exceptions were explained during the appointment ($p < 0.001$). Other statistically significant differences were noted in the assessment of family life/home (70% versus 46.2%, $p = 0.001$), substance use (62.5% versus 21.9%, $p < 0.001$), and sexuality (56.3% versus 12.4%, $p < 0.001$). No other statistically significant differences relevant to the study were found.

An overall comparison of adolescents' and physicians' answers is presented in table 5.

Discussion

Adolescents' perceptions

Adolescents' perceptions regarding medical care highlighted several positive aspects, namely the establishment of empathy with the physician during the consultation and the empowerment of adolescents through their involvement in medical decisions, aspects that are known to be crucial in the therapeutic process, increasing therapeutic adherence[11,12,13]. Appointment scheduling according to the adolescent's school hours or holidays is also reported by most adolescents, a strategy that is known to reduce the number of missed appointments or drop-outs, which is common in this age group[11]. The majority of adolescents (65.2%) mentioned spending some time alone with the physician during the consultation, with this being a higher percentage than those found in other studies carried out in countries such as Belgium (35%) or the United States of America (30.6-34.6%). This is a very positive point, as this gives the adolescent the message that the physician is primarily interested in him or her, helping in the establishment of a rapport and a sense of trust[11,14,16,16]. Most of the adolescents also reported that the physicians evaluated eating habits, physical activity, and school, themes that are part of the HEEADSSS

Table 3. Regression models with biopsychosocial, puberty, and anthropometric assessment as dependent variables (pediatricians' versus non-pediatricians' answers to the questionnaire)

Variable	Model 1			Model 2*			Model 3†		
	Beta	Standard error	p	Beta	Standard error	p	Beta	Standard error	p
Biopsychosocial assessment									
Specialty (Ref Pediatricians)	–1.609	0.592	p = 0.007	–1.630	0.596	p = 0.006	–1.575	0.603	p = 0.009
Puberty assessment									
Specialty (Ref Pediatricians)	–1.735	0.544	p = 0.001	–1.746	0.555	p = 0.002	–1.715	0.559	p = 0.002
Anthropometric assessment									
Specialty (Ref Pediatricians)	–2.079	0.584	p < 0.001	–2.101	0.589	p < 0.001	–2.060	0.595	p = 0.001

*Model 2 – adjusted for time since finishing medical degree.
†Model 3 – adjusted for time since finishing medical degree and age.

(Home, Education/Employment, Eating, Activities, Drugs/Substance use, Sexuality, Suicide, Safety) psychosocial interview, a useful tool, firstly described by Cohen et al. (1991)[17], that provides a framework for clinicians to comprehensively evaluate different domains of adolescents' lives, helping to identify potential areas of concern or areas where intervention may be needed. It aids in understanding the holistic needs of adolescents and tailoring interventions accordingly[18]. On the other hand, only a minority reported being asked about other important items in the HEEADSSS psychosocial interview, such as home or family, substance abuse, healthy sexuality, and the presence of self-injurious behaviors or suicidal ideation. It is recommended that adolescents are asked directly about suicidal ideation, which does not increase the risk of committing the act, a common myth among healthcare professionals[19,20]. This topic should be addressed in consultations and given even more importance in adolescents with mood swings, substance abuse, voluntary ingestion of medication, acute intoxication, accidents, or self-inflicted injuries[11,19].

Finally, an explanation of the concept of confidentiality was only reported by a minority of the adolescents. Confidentiality in a healthcare setting is defined as an agreement between the patient and the provider that the information discussed during or after the encounter will not be shared with other parties without the explicit permission of the patient, with the exception of the risk of imminent harm to the patient or others or suspected abuse[21]. It is best classified as a rule of biomedical ethics that derives from the moral principle of autonomy and accompanies other rules like promise-keeping, truthfulness, and privacy[21]. This is a mandatory aspect of consultations with adolescents because if an assurance of confidentiality is not extended, this may raise a barrier to health care and may lead to the adolescent withholding information, delaying entry into health care, or even refusing treatment[21]. Other authors have reported that most adolescents desire confidentiality when questioned about their specific healthcare needs[22].

Physicians' perceptions

Physicians' perceptions regarding adolescents' medical care fulfilled many of the criteria for a quality service in adolescence: most of the physicians reported observing an adolescent with no appointment; having an empathetic attitude towards gender identity, sexual orientation, ethnicity, and religion; being aware of the rights of adolescents as users of health services; and promoting the autonomy of the adolescents. These points highlight the importance of opportunism, non-discrimination, equity of care, competence of health professionals, and more active participation of adolescents in decisions, all of which are part of the standards recommended by the WHO[7,8,9,10].

On the other hand, half of the physicians reported not asking directly about self-injurious behaviors and suicidal ideation, consistent with the myth described in the above section among healthcare professionals, and approximately one third reported not allowing a moment during the consultation to be alone with the adolescent, which may create an obstacle to the health care of this population sector since the adolescent may withhold information in the presence of the caregiver[11].

Table 4. Overall physicians' answers and pediatricians' versus non-pediatricians' answers to the questionnaire

Questions applied to physicians	Overall (n = 80)	Pediatricians (n = 54)	Non-pediatricians (n = 26)	p
	Yes, n (%)			
Are you aware of the rights of adolescents as users of health services?	66 (82.5%)	47 (87%)	19 (73.1%)	0.124
When scheduling appointments for adolescents, do you keep school hours/holidays in mind?	55 (68.8%)	38 (70.4%)	17 (65.4%)	0.652
Exceptionally, would you observe an adolescent followed by you who had no appointment and who came looking for help?	79 (98.8%)	53 (98.1%)	26 (100%)	0.482
Do you explain the concept of confidentiality and its exceptions to the adolescent?	65 (81.3%)	44 (81.5%)	21 (80.8%)	0.939
Do you explain the concept of confidentiality and its exceptions to the companions?	63 (78.8%)	42 (77.8%)	21 (80.8%)	0.759
Do you reserve a moment during the consultation to be alone with the adolescent?	54 (67.5%)	39 (72.2%)	15 (57.7%)	0.194
Is your consultation frequently interrupted by telephone calls or people entering the medical office?	36 (45%)	25 (46.3%)	11 (42.3%)	0.737
Do you usually take notes/write on the computer while interviewing the adolescent?	62 (77.5%)	42 (77.8%)	20 (76.9%)	0.932
Do you think you show an empathetic attitude towards gender identity, sexual orientation, ethnicity, or religion?	79 (98.8%)	53 (98.1%)	26 (100%)	0.485
Do you routinely carry out a biopsychosocial assessment of the adolescent?	64 (80%)	48 (88.9%)	16 (61.5%)	0.004
Eating habits	59 (73.8%)	47 (87.0%)	12 (46.2%)	< 0.001
Physical activity	65 (81.3%)	49 (90.7%)	16 (61.5%)	0.002
School	64 (80%)	48 (88.9%)	16 (61.5%)	0.004
Family/Home	56 (70%)	44 (81.5%)	12 (46.2%)	0.001
Risky behaviors	55 (68.8%)	41 (75.9%)	14 (53.8%)	0.046
Substance abuse (including alcohol and tobacco)	50 (62.5%)	36 (66.7%)	14 (53.8%)	0.267
Healthy sexuality	45 (56.3%)	34 (63%)	11 (42.3%)	0.081
Do you ask directly about self-injurious behaviors and suicidal ideation?	40 (50%)	28 (51.9%)	12 (46.2%)	0.633
Before any treatment, procedure, or examination, do you ask the adolescent for informed consent?	73 (91.3%)	47 (87%)	26 (100%)	0.055
During the observation of the adolescent, do you provide a guarantee of their privacy (windows and doors closed, use of a folding screen)?	68 (85%)	45 (83.3%)	23 (88.5%)	0.547
Are you usually accompanied by another health professional during the examination of the adolescent?	45 (56.3%)	32 (59.3%)	13 (50%)	0.434
Do you routinely assess the adolescent's pubertal stage?	40 (50%)	34 (63%)	6 (23.1%)	0.001
Do you routinely assess the adolescent's anthropometric data?	61 (76.3%)	48 (88.9%)	13 (50%)	< 0.001
Have you participated in the development and/or provided information leaflets directed to adolescents?	21 (26.3%)	14 (25.9%)	7 (26.9%)	0.294
Do you promote autonomy of adolescents, involving them in therapeutic decisions?	73 (91.3%)	49 (90.7%)	24 (92.3%)	0.816
Do you prepare adolescents for the transition to adult care?	60 (75%)	42 (77.8%)	18 (69.2%)	0.408
Do you believe that during your consultations you manage to establish a therapeutic relationship with the adolescents?	79 (98.8%)	53 (98.1%)	26 (100%)	0.485

(Continues)

Table 4. Overall physicians' answers and pediatricians' versus non-pediatricians' answers to the questionnaire *(continued)*

Questions applied to physicians	Overall (n = 80)	Pediatricians (n = 54)	Non-pediatricians (n = 26)	p
	Yes, n (%)			
In your clinical practice, what is the approximate percentage of adolescents that you observe?				0.062
< 25 %	25 (31.3%)	13 (24.1%)	12 (46.2%)	
25-49%	40 (50%)	32 (59.3%)	8 (30.8%)	
50-75%	10 (12.5%)	5 (9.3%)	5 (19.2%)	
> 75%	5 (6.3%)	4 (7.4%)	1 (1.3%)	
On a scale of 1 to 5, where 1 is "not at all interested" and 5 is "very interested", where is your interest in observing adolescents?				0.150
1	4 (5%)	3 (5.6%)	1 (3.8%)	
2	9 (11.3%)	7 (13%)	2 (7.7%)	
3	26 (32.5%)	21 (38.9%)	5 (19.2%)	
4	27 (33.8%)	17 (31.5%)	10 (38.%)	
5	14 (17.5%)	6 (11.1%)	8 (30.8%)	
When dealing with transgender adolescents, how do you address them?				0.091
By the name of the phenotypic sex	1 (1.3%)	26 (48.1%)	11 (42.3%)	
By the name of the trans sex	37 (46.3%)	0 (0%)	1 (3.8%)	
No gender identification	7 (8.8%)	7 (13%)	0 (0%)	
Avoid using the name	0 (0%)	0 (0%)	0 (0%)	
Never happened to me	35 (43.8%)	21 (38.9%)	14 (53.8%)	

Table 5. Adolescents' versus physicians' answers to the questionnaire

Data evaluated in the questionnaire	Adolescents (n = 112) (Yes) n (%)	Physicians (n = 80) (Yes) n (%)	p
Appointment scheduling according to the adolescent's school hours/holidays	96 (86.5%)	55 (68.8%)	0.003
Explanation of the concept of confidentiality and its exceptions to the adolescent	38 (37.1%)	65 (81.3%)	< 0.001
Time alone with the adolescent during the consultation	73 (85.9%)	54 (67.5%)	0.005
Frequent interruption of the consultation by telephone calls or people entering the medical office	25 (24.3%)	36 (45%)	0.003
Assessment of eating habits	70 (67.3%)	59 (73.8%)	0.344
Assessment of physical activity	79 (73.8%)	65 (81.3%)	0.233
Assessment of school	78 (74.3%)	64 (80%)	0.362
Assessment of family life and home	49 (46.2%)	56 (70%)	0.001
Assessment of substance abuse (including alcohol and tobacco)	23 (21.9%)	50 (62.5%)	< 0.001
Assessment of a healthy sexuality	13 (12.4%)	45 (56.3%)	< 0.001
Assessment of self-injurious behaviors and suicidal ideation	45 (43.7%)	40 (50%)	0.396
Ask for informed consent before any treatment, procedure, or examination	80 (78.4%)	73 (91.3%)	0.019
Perception of privacy (windows and doors closed, use of a folding screen)	73 (85.9%)	68 (85%)	0.872
Involvement in therapeutic decisions	88 (90.7%)	73 (91.3%)	0.903
Empathy between doctor and adolescent during the consultation	104 (98.1%)	79 (98.8%)	0.733

Half of the total number of physicians surveyed indicated that the observation of adolescents corresponds to between a quarter and a half of their clinical practice, which is a considerable percentage and highlights the importance of training physicians in this area to achieve higher quality standards. Most physicians showed an interest in taking care of adolescents, which is a positive sign and reveals motivation. The perception that exists is that, despite the increasing training in this area, many physicians do not yet feel adequately prepared to provide adequate care to this age group[5]. When dealing with transgender adolescents, 46.3% of the physicians answered by addressing them by the name of the trans sex, revealing an empathetic attitude toward this growing community of adolescents.

As expected, the biopsychosocial sphere is more routinely evaluated by pediatricians than by physicians dedicated to other areas, even after adjusting for time since finishing their medical degree and for age. This is an area for improvement, considering that the percentage of adolescents seen is similar in both groups. Pediatricians revealed less interest in observing adolescents, despite the medical specialty of pediatrics in Portugal spanning the age range from 0 to 18 years old. One possible explanation for this finding is the significant variation and gaps that exist in adolescent medicine outpatient care training in pediatric residency programs, compared to training in other areas[23]. This may be due, not only to their seeking less training in this field, but also to the limited availability of such training programs. This reinforces the complexity of health in adolescence and the need to invest in training among physicians, especially pediatricians.

Finally, it should be noted that 12% of pediatricians did not ask adolescents for informed consent before treatments, procedures, or examinations. Informed consent describes the process during which the patient learns the risks and benefits of alternative approaches to management and freely authorizes a course of action proposed by the clinician[21]. This is a legal obligation for adolescents over 16 years of age (mental health law in Portugal) and a moral and ethical concept for those under 16 years of age, since until this age it is the caregivers who give consent legally[24]. Seeking the assent of a minor who is not legally authorized to consent demonstrates respect for the decision-making skills of a non-autonomous individual to the extent that he or she is able to participate in the decision[21]. This is particularly relevant for adolescents who are cognitively mature despite being below the age of legal majority and still dependent upon adults for their basic healthcare decisions[21].

Perceptions of adolescents compared to physicians

When comparing responses from pediatricians and adolescents, the most relevant aspect to mention is the discrepancy between the perception of the explanation of confidentiality between adolescents and physicians, which is lower in adolescents, with a statistically significant difference. This may reveal that, even though the physician conveys this information, it is not understood by the recipient, in this case, the adolescent. This is a barrier to establishing a trusting, empathetic, and respectful relationship with the adolescent[1]. It is also important to explain its exceptions, not only to the adolescent but also to caregivers. Finally, adolescents also report a lower perception of assessment of family or home life, substance abuse, and healthy sexuality, compared to physicians. It is extremely relevant to assess these components in the biopsychosocial sphere because they reveal the adolescent's social context and assess the presence of risky behaviors, enabling the physician to act in prevention and anticipatory care.

Limitations and strengths

The main limitations of this study are its cross-sectional nature and the sample size.

In addition, a bias based on social desirability may have influenced study results, as has been previously reported[25]. However, strategies such as the option to answer the questionnaire in a private room, anonymity, and confidentiality were adopted in order to minimize the occurrence of bias.

Moreover, since this study included participants (i.e., adolescents and physicians) from a tertiary-level healthcare center, its findings may not be generalized to other population sectors.

Despite its limitations, to the best of our knowledge, this study, based on global WHO standards, is unique as it includes both adolescents' and physicians' perceptions of the quality of medical care provided to adolescents. The results and conclusions of this study may be relevant to improve the medical care provided to this age group.

Conclusions

The results of this study show that there seems to be a growing awareness in the medical community of the emergent need for differentiated care in this age group, as has already been demonstrated in previous studies[26]. However, the approach to some topics, such as suicidal

ideation, obtaining informed consent, and explaining the concept of confidentiality, must be tackled further. Regarding confidentiality, a discrepancy was noticed between the adolescents' and physicians' perceptions, which represented a minority in adolescents, perhaps as a result of the difficulty in transmitting or receiving the information. The low level of interest among pediatricians in observing adolescents should be highlighted, even though Pediatrics as a specialty fully comprises this age group. In conclusion, the results reinforce the complexity of providing high-quality health care to adolescents and the need to continue investing in medical training in this field.

Author contributions

S. Freira: Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. H. Fonseca: Conception and design of the study, report, review or other type of work or paper; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. A. Videira-Silva: Conception and design of the study, report, review or other type of work or paper; Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. M.B. Fonseca Moura: Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. Acquisition of data either from patients, research studies, or literature. S. Moeda: Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work.

Funding

None.

Conflicts of interest

None.

Ethical considerations

Protection of humans and animals. The authors declare that no experiments involving humans or animals were conducted for this research.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from patients, and received approval from the Ethics Committee. The SAGER guidelines were followed according to the nature of the study.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

References

1. Michaud PA, Schrier L, Ross-Russel R, Heijden L, Dossche L, Copley S, Alterio T, Mazur A, Dembinski L, Hadjipanayis A, Torso A, Fonseca H, Ambresin AE. Paediatric departments need to improve residents' training in adolescent medicine and health: a position paper of the European Academy of Paediatrics. 2018, European Journal of Pediatrics 177: 479:487.
2. Fonseca, H. Compreender os Adolescentes: Um desafio para Pais e Educadores (6ª edição). 2002, Editorial Presença.
3. Organization for Economic Co-operation and Development., World Health Organization., & World Bank Group. Delivering quality health services: a global imperative for universal health coverage. 2018, OECD Publishing.
4. Arain M, Haque M, Johal L, Mathur P, Nel W, Rais A, Sandhu R, Sharma S. Maturation of the adolescent brain. Neuropsychiatric Disease and Treatment 2013:9 449-461.
5. Mendes M, Fonseca H. Avaliação das necessidades de formação dos Pediatras em Medicina do Adolescente. Curso de Mestrado em Saúde do Adolescente (1ª edição). 2011, Instituto de Formação Avançada, Faculdade de Medicina, Universidade de Lisboa.
6. Payne D, Martin C, Viner R, Skinner R. Adolescent Medicina in Paediatric Practice. 2005, Arch Dis Child; 90:1133-1137.
7. World Health Organization. Global Standards For Quality Health-Care Services For Adolescents Volume 1: Standards And Criteria A Guide To Implement A Standards-Driven Approach To Improve The Quality Of Health-Care Services For Adolescents, 2015.
8. World Health Organization. Global Standards For Quality Health-Care Services For Adolescents Volume 2: Implementation Guide A Guide To Implement A Standards-Driven Approach To Improve The Quality Of Health-Care Services For Adolescents, 2015.
9. World Health Organization. Global Standards For Quality Health-Care Services For Adolescents The Quality Of Health-Care Services For Adolescents. Volume 3, 2015.
10. World Health Organization. Global Standards For Quality Health-Care Services For Adolescents The Quality Of Health-Care Services For Adolescents. Volume 4, 2015.
11. Neinstein L, Gordon C, Katzman D, Rosen D, Woods E. 2007, Adolescent Health Care: A Practical Guide 5th Edition.
12. Wied M, Graaff J, Rooij G, Scheepers F, Hoekstra P, Branje S, Schoot R. The Role of client empathy in treatment outcome in a sample of adolescents referred to forensic youth psychiatric services. Children and Youth Service Review 118 (2020) 105301.
13. Waselewski M, Amaro X, Huerto R, Berger J, Silva M, Siroky K, Torres A, Chang T. Youth preferences for healthcare providers and healthcare interactions: a qualitative study. BMC Prim Care. 2024; 25:63.
14. Deneyer M, Devroey D, Groot E, Buyl R, Clybouw C, Vandenplas Y. Informative privacy and confidentiality for adolescents: The attitude of Flemish pediatrician anno 2010. 2011, European Journal of Pediatrics, 170(9), 1159-1163.
15. Klein JD, Resnick EA, Danawala S, Grilo SA, Catallozzi M, Li B, Gorzkowski J, Kaseeska K, Santelli JS. Receipt of Private Time Among Adolescents and Young Adults With and Without Special Healthcare Needs. 2022, Journal of Adolescent Health, 70(3), 414-420.
16. Sieving RE, Mehus C, Gewirtz O'Brien JR, Steiner RJ, Wang S, Catallozzi M, Gorzkowski J, Grilo SA, Kaseeska K, McRee AL, Santelli J, Klein JD. Correlates of Sexual and Reproductive Health Discussions During Preventive Visits: Findings From a National Sample of U.A. Adolescents. 2022, Journal of Adolescent Health, 70 (3), 421-428.
17. E Cohen, RG Mackenzie, GL Yates. HEADSS, a psychosocial risk assessment instrument: implications for designing effective intervention programs for runaway youth. J Adolesc Health. 1991 Nov;12(7):539-44. doi: 10.1016/0197-0070(91)90084-y.
18. Fonseca H. Helping Adolescents Develop Resilience: Steps the Pediatrician Can Take in the Office. 2010, Adolesc Med 21 152-160.
19. Ribeiro H, Ponto A (2018). Urgências Psiquiátricas. 235-247.
20. Díez J, Miguel A. Urgencias psiquiátricas en la infancia y la adolescencia. I Curso de psiquiatria del niño y del adolescente para pediatras. Tema 18, Módulo 9.
21. Sigman G, Silber T, English A, Epner J. Confidential Health Care for Adolescents: Position Paper of the Society for Adolescent Medicine. 1997, Journal of Adolescent Health; 21:408-415.

22. Mc Guire JM, Parnell TF, Blau BI, Abbot DW. Demands for privacy among adolescents in multimodal alcohol and other drug abuse treatment. J Counsel Dev 1994;73:74-8.
23. Fox H, McManus M, Klein J, Diaz A, Elster A, Felice M, Kaplan D, Wibbelsman C, Wilson J. Adolescent medicine training in pediatric residency programs. Pediatrics. 2010 Jan; 125(1):165-72.
24. Proposta de Lei nº 24/XV/1.ª (Lei de Saúde Mental).
25. Bispo Júnior JP. Social desirability bias in qualitative health research. Rev Saude Publica. 2022 Dec 9;56:101. doi: 10.11606/s1518-8787.2022056004164. PMID: 36515303; PMCID: PMC9749714.
26. Al-Makadma A, Al-Tannir M. The perception of adolescent medicine among health care professionals in Saudi Arabia. J Adolesc Health. 2010 Dec;47(6):608-9.
27. Nair M, Baltag V, Bose K, Boschi-Pinto C, Lambrechts T, Mathai M. Improving the Quality of Health Care Services for Adolescents, Globally: A Standards-Driven Approach. 2015, Journal of Adolescent Health, 57(3), 288-298.
28. Mehra S, Sogarwal R, Nair V, Satpati M, Tiwari R, Dwivedi K. Determinants of youth friendly services influencing cliente satisfaction: A study of client's perspectives in India. 2013, Indian Journal of Public Health Research and Development, 4(2), 221-226.
29. Direção Geral da Saúde. Norma nº 015/2013 de 03/10/2013 atualizada a 04/11/2015. Consentimento informado. 2013.
30. Costa M, Lúcia V, Formigli A, Costa MC. Avaliação da qualidade de serviço de saúde para adolescentes Quality evaluation of health care service for adolescents. 2001, In Rev Saúde Pública (Vol. 35, Issue 2).
31. Gleeson C, Robinson M, Neal R. A review of teenagers' perceived needs and access to primary health care: implications for health services. 2002, Primary Health Care Research and Development; 3:184-193.

PORTUGUESE JOURNAL OF PEDIATRICS

PERMANYER

Check for updates

CASE REPORT

Angiomatoid fibrous histiocytoma – an adolescent with an unusual presentation and course

Sara Isabel de Almeida[1], Sofia Cochito Sousa[2], Cristina Mendes[3], Rafael Cabrera[3], and Ana Lacerda[3]*

[1]Paediatric Department, Hospital Beatriz Ângelo, Loures; [2]Paediatric Department, Hospital de Santa Maria, Centro Hospitalar Universitário Lisboa Norte, Lisbon; [3]Department of Paediatric Oncology, Portuguese Institute of Oncology, Lisbon. Portugal

Abstract

Introduction: Angiomatoid fibrous histiocytoma is a rare soft tissue neoplasm, which usually presents as an indolent mass in children and young adults and is often mistaken for a hematoma or hemangioma. Suspecting this diagnosis from imaging findings may be challenging, leading to diagnostic delays. Prognosis is generally favorable and metastases are infrequent at presentation. **Case report:** We describe the case of an adolescent who presented with a two-month history of a growing mass in the left scapular region, where diagnosis was made possible through surgical biopsy. **Discussion:** There were loco-regional lymphatic invasions and lung metastases at admission, and despite surgery and chemotherapy the disease rapidly progressed to death.

Keywords: Child. Histiocytoma malignant fibrous. Neoplasm metastasis. Soft tissue injuries. Soft tissue neoplasms.

Histiocitoma fibroso angiomatóide — um adolescente com apresentação e curso clínico atípicos

Resumo

Introdução: O histiocitoma fibroso angiomatóide é uma neoplasia rara de tecidos moles, que se apresenta geralmente como uma massa indolente em crianças e adultos jovens, sendo com frequência confundida com um hematoma ou hemangioma. Suspeitar desta entidade através da imagiologia pode ser desafiante, levando a atraso diagnóstico. O prognóstico é habitualmente favorável e as metástases são pouco frequentes na apresentação inicial. **Relato de caso:** Apresentamos o caso de um adolescente com uma massa com crescimento progressivo com 2 meses de evolução na região escapular esquerda, cujo diagnóstico foi possível através de biópsia cirúrgica. Na admissão apresentava envolvimentos dos gânglios linfáticos loco-regionais e metástases pulmonares. **Discussão:** Apesar de excisão cirúrgica e quimioterapia, ocorreu rápida progressão da doença com desfecho fatal.

Palavras-chave: Histiocitoma fibroso maligno. Neoplasia metastática. Lesões de tecidos moles. Neoplasias de tecidos moles.

***Correspondence:**
Sara Isabel de Almeida
E-mail: saraisabelalmeida@gmail.com

Received: 19-10-2023
Accepted: 19-02-2024
https://pjp.spp.pt

Available online: 06-11-2024
Port J Pediatr. 2025;56(3):166-171
DOI: 10.24875/PJP.M24000458

Keypoints

What is known

- AFH is a rare soft tissue tumor usually presenting in children and young adults.
- Differential diagnosis of AFH includes hematoma and hemangioma, making it challenging.
- It generally has a benign course. Metastatic disease is infrequent, especially at presentation.

What is added

- Despite its generally benign course, atypical cases may present metastases at the initial examination and a high degree of suspicion is needed.
- Metastases are most commonly found in regional lymph nodes and the lungs, the latter generally associated with a fatal outcome.
- AFH's malignant potential is not yet fully understood, and treatment options should take this into account.

Introduction

Angiomatoid fibrous histiocytoma (AFH) is a rare soft tissue neoplasm which was first described by Enzinger in 1979 as an "angiomatoid malignant fibrous histiocytoma"[1]. Although uncertainty remains about the precise line of differentiation, it is currently no longer considered "malignant" due to its benign microscopic presentation and favorable prognosis. As such, since 2013 the World Health Organization has classified AFH as an "intermediate tumor of uncertain differentiation"[2,3].

AFH represents approximately 0.3% of all soft tissue tumours[4], affecting mostly children and young adults (median age at diagnosis of 14 and 20 years of age in two case series)[5,6]. It presents as a soft tissue mass in the deep dermis and subcutis of the extremities[7,8], usually indolent and with tenderness or pain, meaning it is often mistaken for a hematoma or a hemangioma[9]. Most patients have a good prognosis since the disease is metastatic in less than 1% of cases and the recurrence rate is lower than 15%[10,11]. But while it usually has a benign course, the malignant potential of this neoplasm is revealed by some descriptions of metastatic disease leading to death (in up to 14.3% of cases)[8].

In this report we present a case of AFH in a male teenager, emphasizing the diagnostic challenges and the rare aggressive progression of the disease.

Case report

A 13-year-old male born in Guinea-Bissau was referred at age 11 to a children's hospital in Europe for endocrine evaluation due to his tall stature, morbid obesity (maximum weight of 145 kg and body mass index of 39 kg/m^2), type 2 diabetes mellitus and hepatic steatosis. After being referred, he was under regular follow-up in a pediatric endocrinology unit, being treated with metformin.

He presented to the pediatric emergency department with a 24-hour history of bilateral temporal headache. While there, he incidentally complained of a mass in the left scapular region that he had noticed two months previously, which had gradually grown since then. The mass was painless and there were no local inflammatory signs. He also reported anorexia, with 18% weight loss (24 kg) during the previous six months, and fatigue. He denied any other symptoms, namely fever, asthenia, anorexia, night sweats, respiratory compromise or mobility impairment.

The laboratory tests revealed anemia (hemoglobin 6.5 g/dL), thrombocytosis (platelets 791000/μL), elevated LDH (1388 U/L, normal range [NR] 100-250 U/L), AST (61 U/L, NR 0-40 U/L), GGT (73 U/L, NR 0-60 U/L) and C-reactive protein (9.95 mg/dL, NR < 0.5 mg/dL). Total bilirubin and the erythrocyte sedimentation rate were normal. SARS-CoV-2 was identified in nasopharyngeal secretions.

A computerized tomography (CT) showed a large (15 x 12 x 8.5 cm) soft tissue mass involving the posterior muscle group of the left shoulder, presumably centered on the infraspinatus, with regular contours, not enhanced by contrast, but with a lower liquid level with high density, suggestive of a recent hemorrhage (Fig. 1), and a slight diffuse parietal thickening and at least one regular, slightly thickened septation. There were no underlying scapular bone changes. In the lung, there were multiple bilateral rounded images, suggestive of secondary lesions, coexisting with diffuse ground-glass opacities that were interpreted as being caused by SARS-CoV-2 pneumonia. There were also a few repletion defects in the subsegmental branches at the lung bases, suggesting peripheral pulmonary embolism, for which he was started on enoxaparin. He also started enalapril due to newly-diagnosed arterial hypertension. Due to the pandemic, he had to be admitted to a COVID-19 ward despite the oncological suspicion until the SARS-CoV-2 infection was resolved and later transferred to a pediatric oncology department when he was SARS-CoV-2 negative.

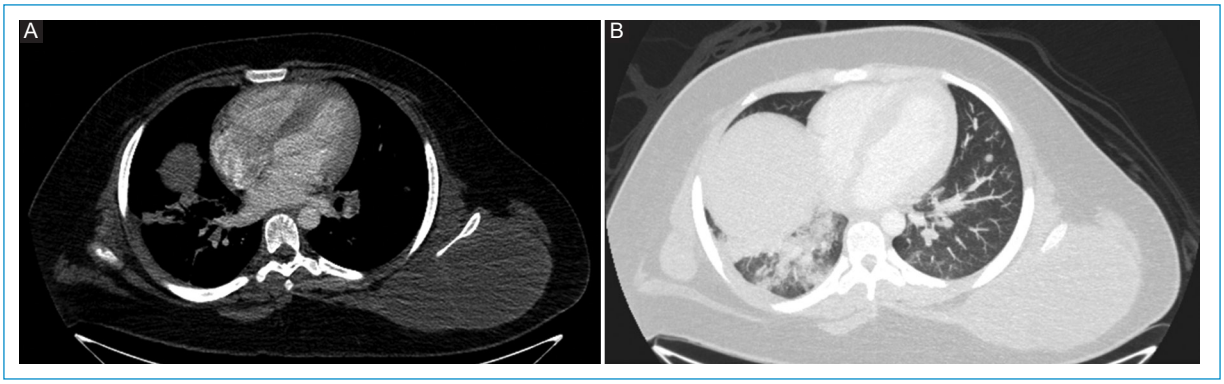

Figure 1. Axial mediastinal window **A:** CT image showing a mass involving the posterior muscle group of the left shoulder, apparently centered on the infraspinatus, with regular contours, with a lower liquid level with high density, suggestive of a recent hemorrhage; and lung window **B:** CT image where it is possible to identify a rounded lesion in the left inferior lobe, suggestive of metastasis, and ground-glass opacities in both inferior lobes.

To help establish a diagnosis and staging, an 18-fluorodeoxyglucose positron emission tomography (18-FDG PET) with CT was performed. It showed a large soft tissue lesion (19 x 13 x 20 cm) of the scapular region, mainly with low uptake, but showing peripheral uptake (SUV max. 8.4) and uptake in the left axillary lymph nodes (SUV max. 4.3), with no significant uptake by the lung lesions.

The first two image-guided biopsies of the left scapular mass were inconclusive. Seven weeks after presentation, when he finally gathered clinical conditions, he was taken to the operating room, where a large septate hematoma (30 x 10 cm) was identified. The surgeon drained three liters of blood, performed a biopsy and surgical resection to the extent possible.

Histological examination revealed a large hematoma with a fibrous pseudocapsule, with reparative changes, fibrin deposition and inflammation. In some areas, nodules of a mesenchymal lesion with cystic pseudoangiomatous spaces were seen. They were composed of plump spindle and epithelioid cells with scant cytoplasm, with an occasional lymphoplasmacytic peripheral infiltrate (Fig. 2). Neoplastic cells were positive for CD99, desmin and synaptophysin, whereas myogenin and MyoD1 were negative. EWSR1 gene rearrangements (22q12.2) were confirmed by FISH and the array CGH also revealed the loss of chromosome 14 and partial loss of chromosomic regions 22q12-q13. Postoperative magnetic resonance imaging (MRI) revealed recurrent left scapular mass (14.8 x 5.7 cm) with a diffusely heterogeneous pseudocapsule of hematic content, supraclavicular and axillary lymph nodes (the largest measuring 4.1 cm, with hematic content) and the pulmonary lesions already revealed in the previous CT were also observed, presenting with contrast enhancement.

Clinical progression of the scapular mass was observed during the postoperative period. These findings were consistent with the diagnosis of AFH with associated hemorrhage, with regional (lymph node) and distant (bilateral lung) metastases.

He was started on chemotherapy with doxorubicin and ifosfamide, according to the non-rhabdomyosarcoma soft tissue sarcoma 2005 protocol (EpSSG non-rhabdomyosarcoma soft tissue sarcomas). However, local and metastatic progression was observed after three cycles of chemotherapy, including the development of alveolar hemorrhage. He also developed severe acute renal injury (creatinine 7.85 mg/dL and GFR 16 mL/min/1.73 m^2), probably secondary to the chemotherapy toxicity, and pulmonary aspergillosis, whose diagnosis was based on clinical presentation (fever, dyspnea and chest pain) and radiological findings on CT (multiple solid nodules surrounded by a halo of ground-glass opacity revealing the probable cause of alveolar hemorrhage due to angioinvasive aspergillosis). Bronchoalveolar lavage could not be performed due to the lack of safe clinical conditions.

In view of these complications and the manifest incurability, his family decided to return to Guinea-Bissau providing him with supportive measures only, including pain relief, medical treatment for acute renal injury and referral to the local hospital for follow-up. He died two months later, seven months after diagnosis.

Discussion

This case highlights the importance of the initial workup and suspicion since AFH is often mistaken for

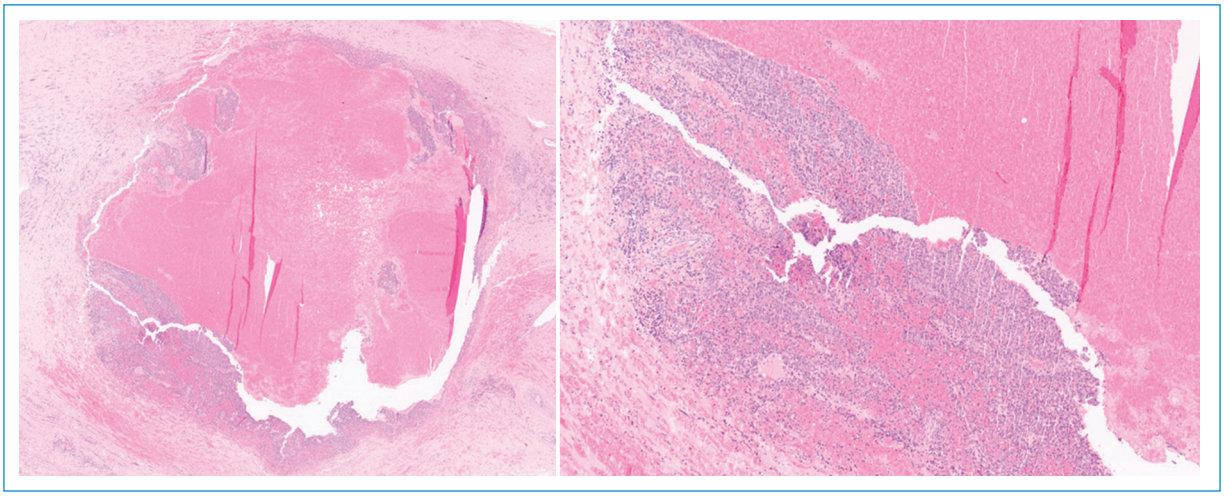

Figure 2. Low-power view of a tumor nodule with a pseudoangiomatous central cystic space, surrounded by fibrin and fibrous tissue (left). On medium power, a monotonous population of round cells with scant cytoplasm can be seen (right). Through immunohistochemistry, these cells tested positive for CD99 and desmin (not shown).

more common lesions, such as post-traumatic hematomas or vascular malformations or tumors, leading to a delayed diagnosis and treatment[8,12].

Most cases present as an indolent and painless mass, even though some reports refer to local tenderness and systemic symptoms[9]. In our case, medical care was sought due to acute symptoms, probably related to a SARS-CoV-2 infection, and the patient incidentally complained of a painless mass, weight loss and fatigue.

Ultrasonography and MRI are the preferred methods to evaluate soft tissue masses[13]. However, the imaging findings of AFH are nonspecific[12,14] and the absence of pathognomonic signs and characteristics, as well as the rarity of this tumor, may lead to diagnostic delays and/or misdiagnoses. Some reports reveal some common, yet nonspecific features which include intralesional cystic areas with fluid-fluid levels, an enhanced fibrous pseudocapsule, hemosiderin, and in some cases perilesional oedema[12-14]. FDG PET-CT can be used for staging and treatment response, however the interpretation of this must be well-considered, since the biopsy of suspicious nodes was frequently found to be benign in the histopathological examination[15,16].

Uncommonly, and in contrast with the often benign course of AFH, in our case, the first evaluation revealed loco-regional nodal and bilateral lung metastases. While Enzinger et al. described a series of 24 cases with 21% showing metastatic disease and with 12% deaths[1], Fanburg et al., describing 158 patients, reported only 1% metastatic cases, 2% with recurrences and no deaths[6]. However, these case series were published before recent advances in cytogenetic testing and therefore may have included other malignant neoplasms. More recently, Saito et al. reported a series of seven cases in which two patients presented with tumor recurrence and metastases and one of whom died from disease progression[8]. When present, metastases are most commonly found in regional lymph nodes and lungs, but may also present in the brain, liver and bone[17,18]. Certain factors are associated with an increased probability of local and distant metastases, namely head and neck locations, the tumor depth and irregular margins[5].

Our case is one of a few reports of AFH with nodal and lung metastases at the time of diagnosis and with a fatal outcome. Potter et al. described a three-year-old boy who also presented with nodal and lung metastases at diagnosis but had a good response to tocilizumab[19], which was not considered in our patient due to the lack of clinical conditions. A literature review identified 16 cases of metastatic AFH described in the last four decades, none of which had metastasis at diagnosis, which appeared between five months and 16 years after resection of the primary tumour[18]. However, the occurrence of lung metastases was universally linked to a fatal outcome.

In our case, the morbid obesity of the adolescent and the contingencies related to the COVID-19 pandemic may have contributed to a delayed presentation, diagnosis, and most of all to the fatal outcome.

The diagnosis of AFH is based on histopathology and immunohistology findings[8,9,13,14]. If the pathognomonic hallmarks of the disease are present in the histological examination, it is often possible to make a relatively straightforward diagnosis. These include a dense fibrous pseudocapsule, a perilesional lymphoplasmacytic

infiltrate, blood-filled cystic areas lined with tumor cells, with stromal hemorrhage or hemosiderin deposition, and multinodular aggregates of histiocytoid and spindle-shaped tumor cells in a fascicular growth pattern[1,2,20,21]. Further immunohistochemical studies may help distinguish AFH from other lesions, with the cells often showing positivity for CD68, CD99, epithelial membrane antigen and desmin at variable frequencies[19,20], a pattern displayed in our case.

As for molecular analysis, RT-PCR and FISH studies may detect the three translocations that have been associated with AFH: *FUS-ATF1, EWSR1-ATF1, or EWSR1-CREB1* fusion genes[13,21,22]. Rearrangements of *EWSR1* are common in AFH (present in 76% in a case series) and are therefore useful in confirming this diagnosis[21,23], as happened in our case. No specific rearrangement is associated with metastatic disease or a worse outcome[18].

The treatment of choice is a wide surgical resection, which must include the excision of any involved lymph nodes. Unfortunately, this was not possible in our case, due to the involvement of the thoracic wall. Adjuvant radiotherapy is frequently used when a total excision cannot be achieved or in the case of recurrent disease, which was not considered in our patient due to the extent of the disease and anticipated toxicities, namely lung injury. Chemotherapy is often used in patients with distant metastases, yet in most cases, it does not seem to improve the outcome[18,23]. Immunotherapy with PD-1/PD-L1 inhibitors is being investigated[24]; crizotinib has produced durable responses in ALK-positive tumors[25] and tocilizumab can be used for treating paraneoplastic inflammatory syndrome associated with AFH[26], but these agents still need further research.

Despite starting chemotherapy after the initial surgery, our patient showed rapid disease progression, as well as severe treatment-related complications which precluded the continuation of intensive treatment.

This case, with its rare aggressive presentation and rapid progression, underlines the fact that the correct diagnosis and adequate treatment of AFH remains challenging. A high degree of suspicion from all members of the Oncology multidisciplinary team is needed in a disease whose malignant potential is not yet fully understood.

Author contributions

S.I. de Almeida: Conception and design of the study, report, review or other type of work or paper; Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. S. Cochito Sousa: Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. C. Mendes: Conception and design of the study, report, review or other type of work or paper; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. R. Cabrera: Analysis or interpretation of data either from patients, research studies, or literature; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. A. Lacerda: Conception and design of the study, report, review or other type of work or paper; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work.

Funding

This work did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

Conflicts of interest

None.

Ethical considerations

Protection of humans and animals. The authors declare that the procedures followed complied with the ethical standards of the responsible human experimentation committee and adhered to the World Medical Association and the Declaration of Helsinki. The procedures were approved by the institutional Ethics Committee.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from patients, and received approval from the Ethics Committee. The SAGER guidelines were followed according to the nature of the study.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

References

1. Enzinger FM. Angiomatoid malignant fibrous histiocytoma: a distinct fibrohistiocytic tumor of children and young adults simulating a vascular neoplasm. Cancer. 1979 Dec;44[6]:2147-57.
2. Antonescu CR, Rossi S. Angiomatoid fibrous histiocytoma. In: Fletcher CDM, Bridge JA, Hogendoorn PCW, Mertens F, editors. WHO classification of tumours of soft tissue and bone. 4th ed. Lyon: IARC; 2013. p. 204-5.

3. Bansal A, Goyal S, Goyal A, Jana M. WHO classification of soft tissue tumours 2020: An update and simplified approach for radiologists. Eur J Radiol. 2021;143[82]:109937.
4. Ogden S, Harave S, McPartland J, Brennan B, Jeys L, Lostyet P, et al. Angiomatoid fibrous histiocytoma: A case of local recurrence and metastases to loco-regional lymph nodes that responded to chemotherapy. Pediatr Blood Cancer. 2017;64[6]:1-3.]
5. Costa MJ, Weiss SW. Angiomatoid malignant fibrous histiocytoma. A follow-up study of 108 cases with evaluation of possible histologic predictors of outcome. Am J Surg Pathol. 1990 Dec;14[12]:1126-32. PMID: 2174650.
6. Fanburg-Smith JC, Miettinen M. Angiomatoid "malignant" fibrous histiocytoma: a clinicopathologic study of 158 cases and further exploration of the myoid phenotype. Hum Pathol. 1999;30:1336-1343.
7. Mangham DC. World Health Organisation classification of tumours: pathology and genetics of tumours of soft tissue and bone. J Bone Joint Surg Br. 2004;86-B[3]:466-466.
8. Saito K, Kobayashi E, Yoshida A, Araki Y, Kubota D, Tanzawa Y, et al. Angiomatoid fibrous histiocytoma: a series of seven cases including genetically confirmed aggressive cases and a literature review. BMC Musculoskelet Disord. 2017;18[1]:1-8.
9. Thway K, Fisher C. Angiomatoid fibrous histiocytoma: The current status of pathology and genetics. Arch Pathol Lab Med. 2015;139[5]:674-682.
10. Weiss SW, Goldblum JR. Fibrohistiocytic tumors of intermediate malignancy. In: Weiss SW, Goldblum JR, editors. Enzinger and Weiss's soft tissue tumors. Philadelphia: Elsevier Ltd; 2008. p. 390-4.
11. Fletcher CD. The evolving classification of soft tissue tumours: An update based on the new WHO classification. Histopathology. 2006;48:3-12.
12. Khader M, Alyafei T, Ibrahim S, Elaiwy O. Angiomatoid fibrous histiocytoma [AFH] unusual clinical presentation and unique radiological findings. BJR Case Rep. 2021;7[2]:20190069.
13. Yikilmaz A, Ngan BY, Navarro OM. Imaging of childhood angiomatoid fibrous histiocytoma with pathological correlation. Pediatr Radiol. 2015;45[12]:1796-1802.
14. Bauer A, Jackson B, Marner E, Gilbertson-Dahdalet D. Angiomatoid fibrous histiocytoma: A case report and review of the literature. J Radiol Case Rep. 2012;6[11]:8-15.
15. Colangeli M, Rimondi E, Spinnato P, Donati DM, Manfrini M. Difficult diagnosis of angiomatoid fibrous histiocytoma of the leg mimicking a benign condition. J Radiol Case Rep. 2019;13(4):38-45.
16. Morawietz L. CORR Insights: Pathologically Benign Lymph Nodes Can Mimic Malignancy on Imaging in Patients With Angiomatoid Fibrous Histiocytoma. Clin Orthop Relat Res. 2017;475(9):2280-2282.
17. Martinez SJ, Moreno CC, Vinson EN, Dodd LG, Brigman BE. Angiomatoid fibrous histiocytoma: novel MR imaging findings. Skeletal Radiol. 2016;45[5]661-670.
18. Maher OM, Prieto VG, Stewart J, Herzog CE. Characterization of Metastatic Angiomatoid Fibrous Histiocytoma. J Pediatr Hematol Oncol. 2015;37[4]: e268-e271.
19. Potter SL, Quintanilla NM, Johnston DK, Naik-Mathuria B, Venkatramaniet R. Therapeutic response of metastatic angiomatoid fibrous histiocytoma carrying EWSR1-CREB1 fusion to the interleukin-6 receptor antibody tocilizumab. Pediatr Blood Cancer. 2018;e27291.
20. Lemos MM, Karlen J, Tani E. Fine-needle aspiration cytology of angiomatoid malignant fibrous histiocytoma. Diagn Cytopathol. 2005;33[2]:116-121.
21. Tanas MR, Rubin BP, Montgomery EA, Turner SL, Cook JR, Tubbset RR, et al. Utility of FISH in the diagnosis of angiomatoid fibrous histiocytoma: A series of 18 cases. Mod Pathol. 2010;23[1]:93-97.
22. Lee HS, Kim T, Kim JS, Lee HR, Joo M, Parket JY, et al. Angiomatoid fibrous histiocytoma is a second tumor in a young adult with testicular cancer. Cancer Res Treat. 2013;45[3]:239-243.
23. Matsumura T, Yamaguchi T, Tochigi N, Wada T, Yamashita T, Hasegawa T. Angiomatoid fibrous histiocytoma including cases with pleomorphic features analysed by fluorescence in situ hybridisation. J Clin Pathol. 2010;63[2]:124-128.
24. Byers J, Yin H, Rytting H, et al. PD-L1 expression in angiomatoid fibrous histiocytoma. Sci Rep. 2021;11(1):1-7.
25. Ngo C, Grinda T, Boilève A, et al. Durable response to crizotinib in metastatic angiomatoid fibrous histiocytoma with EWSR1–CREB1 fusion and ALK overexpression. Ann Oncol. 2022;33(8):848-850.
26. Eberst L, Cassier PA, Brahmi M, Tirode F, Blay JY. Tocilizumab for the treatment of paraneoplastic inflammatory syndrome associated with angiomatoid fibrous histiocytoma. ESMO Open. 2020;5(3):1-2.

PORTUGUESE JOURNAL OF PEDIATRICS

PERMANYER

Check for updates

CASE REPORT

Mauriac syndrome in an adolescent – case report: a rare complication of type 1 diabetes mellitus

Biana Moreira, Teresa Botelho Brito, Inês Fernandes, and Susana Parente*

Department of Pediatrics, Centro Hospitalar de Setúbal, Setúbal, Portugal

Abstract

Introduction: Mauriac syndrome is a rare complication of type 1 diabetes mellitus associated with poor metabolic control, which is particularly rare since the introduction of intensive insulin therapy. It is characterized by hepatomegaly, dyslipidemia, growth failure, and delayed puberty. **Case report:** We present the case of a 14-year-old male with Mauriac syndrome, with poor metabolic control since his diagnosis of type 1 diabetes mellitus at age two, with further deterioration during adolescence due to insulin omission and consultation absenteeism. Early recognition of this syndrome is crucial, given its reversibility with appropriate glycemic control. **Discussion:** This case underscores the importance of a personalized approach to patient care, highlighting the challenges of therapeutic compliance during adolescence, which often necessitates a multidisciplinary team and a comprehensive understanding of the patient's circumstances.

Keywords: Type 1 diabetes mellitus. Diabetes complications. Adolescent. Hepatomegaly.

Síndrome de Mauriac num adolescente – caso clínico: uma complicação rara da diabetes mellitus tipo 1

Resumo

Introdução: A síndrome de Mauriac é uma complicação da diabetes mellitus tipo 1 com mau controlo metabólico, muito rara desde a introdução da terapêutica intensiva com insulina. Caracteriza-se por hepatomegalia, dislipidemia, atraso do crescimento estaturo-ponderal e atraso pubertário. **Relato de caso:** Descrevemos o caso de um adolescente do sexo masculino de 14 anos com síndrome de Mauriac, com mau controlo metabólico desde o diagnóstico de diabetes mellitus tipo 1 (2 anos), mais relevante desde a entrada na adolescência, por omissão da administração da insulina e absentismo às consultas. O reconhecimento precoce desta entidade é extremamente importante, dada a reversibilidade com o controlo metabólico adequado. **Discussão:** Este caso pretende sublinhar a importância de uma abordagem personalizada a cada doente, uma vez que a adesão à terapêutica pode ser muito desafiante, sobretudo durante a adolescência, por vezes necessitando do trabalho em equipa multidisciplinar e a compreensão dos variados aspetos de cada doente.

Palavras-chave: Diabetes mellitus tipo 1. Complicações de diabetes. Adolescente. Hepatomegalia.

***Correspondence:**
Biana Moreira
Email: mbianamoreira@gmail.com

Received: 29-08-2023
Accepted: 14-08-2024
https://pjp.spp.pt

Available online: 06-11-2024
Port J Pediatr. 2025;56(3):172-176
DOI: 10.24875/PJP.23000019

Keypoints

What is known

- Mauriac syndrome is a complication of type 1 diabetes mellitus with poor metabolic control, that has become a rarity since the introduction of intensive insulin therapy.
- It is characterized by hepatomegaly, dyslipidemia, growth failure, and delayed puberty.
- Early recognition of MS is extremely important, given its reversibility with adequate glycemic control.

What is added

- There are multifaceted challenges in managing type 1 diabetes mellitus during adolescence, particularly the impact of social, emotional, and behavioral factors on therapeutic compliance, requiring the incorporation of psychological and social support into medical care.
- The unique revelation of the patient's competence in managing insulin dosages while caring for his younger sister underscores the complex interplay between family dynamics and self-care in chronic disease management.

Introduction

Type 1 diabetes mellitus (T1DM) is a chronic metabolic disease affecting 0.16% of the Portuguese population as of 2015[1]. Mauriac syndrome (MS), is a complication of T1DM, primarily affecting adolescents with poor glycemic control. It is characterized by hepatomegaly due to hepatic glycogenosis (HG), dyslipidemia, growth failure, and delayed puberty. This syndrome has become rare since the introduction of intensive insulin therapy[2].

The physiopathology of MS is not fully understood and likely results from a combination of factors, including wide fluctuations in plasma glucose levels, periods of hyperglycemia, and hyperinsulinism[2]. Early recognition is essential as it is fully reversible with adequate glycemic control[3-5]. However, achieving therapeutic compliance can be challenging during adolescence[4], often requiring a comprehensive multidisciplinary approach.

Case report

We present the case of a 14-year-old male diagnosed with T1DM at the age of two, from a low socioeconomic background. His family history includes an eight-year-old sister with T1DM and celiac disease. He has exhibited poor metabolic control since diagnosis, which worsened during adolescence, with multiple emergency department admissions due to diabetic ketoacidosis and recurrent hypoglycemic episodes. The patient was on intensive insulin therapy (1.3 units/kg/day). Despite the efforts of a multidisciplinary team and structured admissions to optimize metabolic control and educate the patient and family, a pattern of consultation absenteeism and insulin omission emerged, particularly during the COVID-19 pandemic.

Follow-up revealed suboptimal glycemic control, abdominal distention, and growth retardation. His stature was below the 3rd percentile (Z-score—6.72; growth rate: 2 cm/year) (Fig. 1) and his body mass index was 16.1 kg/m² (percentile 3). Physical examination revealed a protuberant abdomen and hepatomegaly, with no jaundice, splenomegaly, oedema, or ascites. Secondary sexual characters were absent (Tanner stage 1), with a two-year delay in bone age.

Laboratory analysis showed poor metabolic control: glycemia 305 mg/dL, HbA1c 11% (72% above target); dyslipidemia (triglycerides 277 mg/dL; total cholesterol 170 mg/dL; low-density lipoprotein 56 mg/dL), and elevated hepatic enzymes (aspartate aminotransferase 63 U/L; alanine aminotransferase 109 U/L). Hormone levels were pre-pubertal, with suboptimal FSH, LH, and testosterone readings. Insulin Growth Factor-1 (IGF-1) was also below normal (92 ng/mL). Hemogram, coagulation, renal function, iron metabolism, and bilirubin were normal. Microalbuminuria was under 1.10 μg/dL. Viral serologies were negative for hepatitis A, B, C, and HIV. Liver autoantibodies, including anti-mitochondrial, anti-smooth muscle, and anti-liver-kidney microsome antibodies, were negative. Inborn errors of metabolism profiles were normal. Anti-thyroglobulin, anti-transglutaminase, and anti-gliadin antibodies were also negative.

Abdominal ultrasonography confirmed moderate hepatomegaly, with a regular liver contour and homogenous echostructure.

The combination of hepatomegaly, elevated aminotransferases, dyslipidemia, growth failure, and delayed puberty in an adolescent with T1DM and poor metabolic control strongly indicated MS. He was electively admitted for one month to achieve metabolic control. During this period, the multidisciplinary team's efforts, including pharmacological therapy with antidepressants and individual and family therapy sessions, were crucial. Discussions addressing the patient's emotional challenges (emotional turmoil and despair facing his condition), fear of needles, and insulin omission at school facilitated therapeutic compliance. He was discharged with an insulin dose of 1 unit/kg/day, HbA1c 7% and normalization of aminotransferases, although lipid profiles remained abnormal.

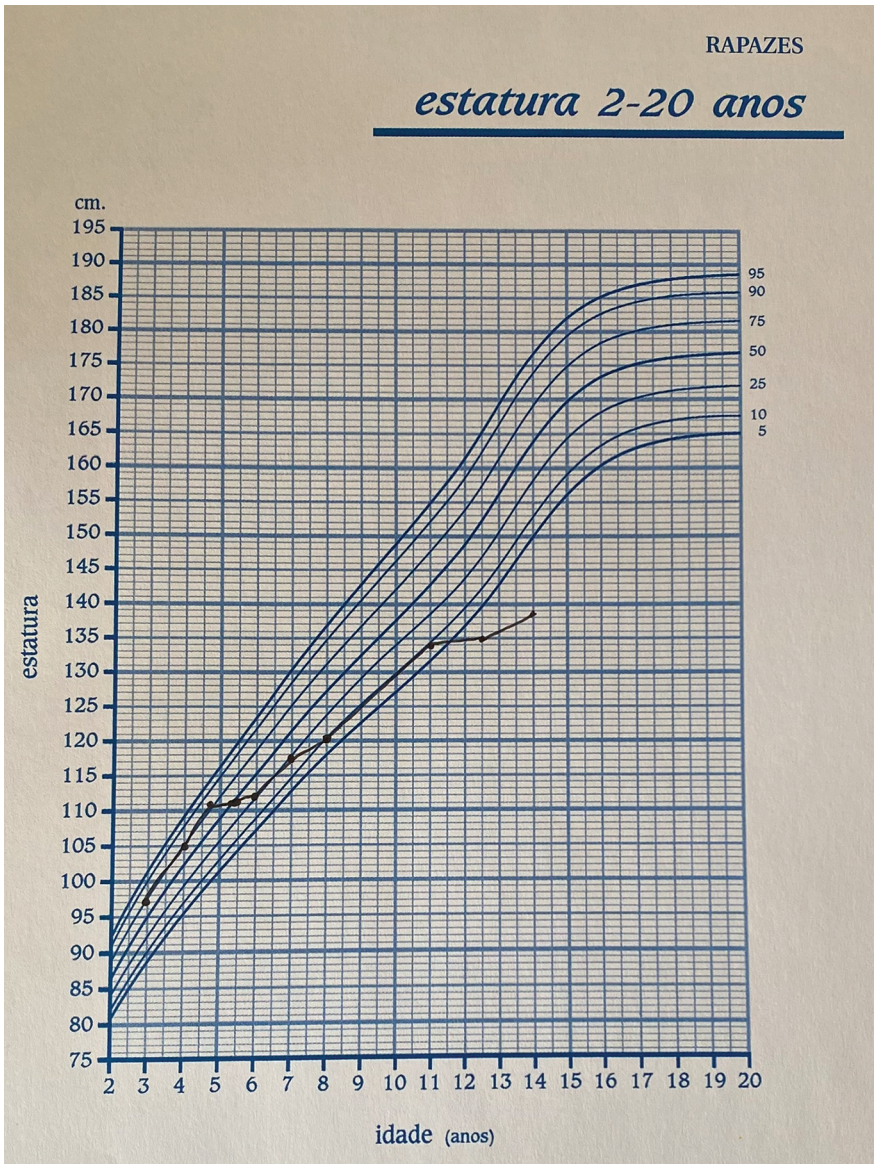

Figure 1. Graph showing the adolescent's evolution of height (cm) over his age (years), revealing the progressive reduction in growth rate.

Six months later, the patient showed positive progress with good metabolic control (HbA1c 7.7%, 82% on target), age-appropriate puberty hormones, normalization of IGF-1, and a growth of 3.2 cm. Statin therapy was initiated for persistent dyslipidemia.

Discussion

In MS, hepatomegaly is caused by hepatic glycogenosis (HG). High glucose levels promote the transport of glucose into hepatocytes and hyperinsulinemia stimulates glycogen synthesis. Episodes of hyperinsulinism, with transient hypoglycemia, stimulate cortisol production, leading to further hepatic deposition of glycogen-causing elevated aminotransferases[5-6].

In Portugal, the exact incidence of Mauriac Syndrome is not well-documented, reflecting its rarity in the modern era of intensive T1DM care. This case underscores the importance of recognizing MS, even in the context of advanced insulin therapies, particularly in adolescents with poor glycemic control. The presence of significant social, emotional, and behavioral factors, such as insulin omission and consultation absenteeism exacerbated by the COVID-19 pandemic, highlights the

multifaceted challenges in managing T1DM during adolescence.

This case contributes to the existing literature by providing a contemporary example of MS in a Portuguese adolescent, emphasizing the ongoing need for vigilance for this condition. It also underscores the importance of a multidisciplinary and personalized approach to T1DM management, particularly during adolescence, a period marked by unique adherence challenges.

The differential diagnosis includes other causes of liver injury, such as infectious, metabolic, obstructive, or autoimmune diseases[5]. One important differential diagnosis is non-alcoholic fatty liver disease (NAFLD), more common in type 2 diabetes mellitus or obese patients[5-8]. The final diagnosis usually involves a liver biopsy[3,5-8]. In our patient, the presence of hepatomegaly, elevated aminotransferases, dyslipidemia, growth failure, delayed puberty in an adolescent with T1DM, and poor metabolic control strongly suggested HG. The normalization of hepatomegaly and liver enzymes after four weeks of good metabolic control corroborates this hypothesis, enabling us to avoid an invasive examination, such as a liver biopsy[3,7-8].

Various mechanisms may contribute to growth retardation in MS, including increased growth hormone (GH), decreased IGF-1, impaired hormone bioactivity, and resistant or defective hormone receptors. Autoimmune conditions, like celiac disease and hypothyroidism, could also cause growth delay in T1DM patients[9]. However, relevant antibodies (anti-thyroglobulin, anti-transglutaminase, and anti-gliadin) were negative in our patient.

Therapeutic adherence is particularly challenging during adolescence, often requiring medical, psychological, and psychiatric interventions[4,9]. This complex landscape requires balancing understanding and acceptance of the condition while fostering patient autonomy. A notable aspect of our patient's journey was his competence in insulin dosage calculation and administration, a skill developed while caring for his younger sister. This dual role paradoxically correlated with proficient metabolic control, highlighting the practical aspects of self-care beyond theoretical understanding.

Improved metabolic control during hospitalization and an enhanced well-being gave the patient the confidence to change. This case underscores the intricate challenges of treatment adherence in chronic adolescent conditions. Multidisciplinary teamwork was crucial, integrating meticulous metabolic control, close surveillance, and fostering condition acceptance and emotional support.

This case highlights the importance of recognizing rare pathologies like Mauriac Syndrome, particularly in the context of treatment adherence challenges. It also emphasizes the necessity of multidisciplinary team interventions in managing T1DM, addressing both the patient and their family as a whole. We believe that the diagnosis of a chronic disease like T1DM should always involve multidisciplinary consultations for optimal glycemic control, complication prevention, and overall well-being and self-care.

Author contributions

B. Moreira, T. Brito, I. Fernandes: Conception and design of the case report; Acquisition of data either from patients, research studies, or literature; Analysis and interpretation of data either from patients, research studies and literature; Drafting the article; Critical review of the article for important intellectual content; Final approval of the version to be published. S. Parente: Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work.

Funding

None.

Conflicts of interest

None.

Ethical considerations

Protection of humans and animals. The authors declare that the procedures followed complied with the ethical standards of the responsible human experimentation committee and adhered to the World Medical Association and the Declaration of Helsinki. The procedures were approved by the institutional Ethics Committee.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from patients, and received approval from the Ethics Committee. The SAGER guidelines were followed according to the nature of the study.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

References

1. Diabetes: Factos e Números – O Ano de 2015 – Relatório Anual do Observatório Nacional da Diabetes. Lisboa: Sociedade Portuguesa de Diabetologia. Available at: https://www.sns.gov.pt/wp-content/uploads/2017/03/OND-2017_Anexo2.pdf

2. Alhajjaj AH, Aljishi FK. *Mauriac Syndrome Still Exists in Poorly Controlled Type 1 Diabetes: A Report of Two Cases and Literature Review*. Cureus. 2021;13(4):e14704. Published 2021 Apr 26. doi:10.7759/cureus.14704
3. Pinto MJF, Melo N, Flores L, Cunha F. *Mauriac Syndrome: A Rare Complication of Type 1 Diabetes Mellitus*. Eur J Case Rep Intern Med. 2018;5(12):000969. Published 2018 Dec 27. doi:10.12890/2018_000969
4. Moreno Tirado A, González Lázaro P, Montero Benítez MZ, Jiménez Torrecilla P. *Hepatopathy of Mauriac syndrome. The importance of therapeutic adherence* [published online ahead of print, 2023 Feb 13]. Rev Esp Enferm Dig. 2023;10.17235/reed.2023.9513/2023. doi:10.17235/reed.2023.9513/2023
5. Patita M, Nunes G, Alves de Matos A, Coelho H, Fonseca C, Fonseca J. *Mauriac Syndrome: A Rare Hepatic Glycogenosis in Poorly Controlled Type 1 Diabetes*. GE Port J Gastroenterol. 2019;26(5):370-374. doi:10.1159/000496094
6. Abu NA, Lim CB, Nor NSM. *Glycogenic hepatopathy in children with poorly controlled type 1 diabetes mellitus*. Clin Pediatr Endocrinol. 2021;30(2):93-97. doi:10.1297/cpe.30.93
7. Lombardo F, Passanisi S, Gasbarro A, Tuccari G, Ieni A, Salzano G. *Hepatomegaly and type 1 diabetes: a clinical case of Mauriac's syndrome*. Ital J Pediatr. 2019;45(1):3. Published 2019 Jan 7. doi:10.1186/s13052-018-0598-2
8. Khoury J, Zohar Y, Shehadeh N, Saadi T. *Glycogenic hepatopathy*. Hepatobiliary Pancreat Dis Int. 2018;17(2):113-118. doi:10.1016/j.hbpd.2018.02.006
9. Bizzarri C, Timpanaro TA, Matteoli MC, Patera IP, Cappa M, Cianfarani S. Growth *Trajectory in Children with Type 1 Diabetes Mellitus: The Impact of Insulin Treatment and Metabolic Control*. Horm Res Paediatr. 2018;89(3):172-177. doi:10.1159/000486698

PORTUGUESE JOURNAL OF PEDIATRICS

PERMANYER

Check for updates

CASE REPORT

Perinatal neuroblastoma: a case report of Pepper syndrome

Bárbara Ribeiro Aguiar[1], Joana Ribeiro[2], Diana Martins[2], Sara Noéme Prado[1], and Hugo Cavaco[1]*

[1]Department of Pediatrics; [2]Department of Obstetrics and Gynaecology. Hospital Beatriz Ângelo, Loures, Portugal

Abstract

Introduction: Perinatal neuroblastoma is the most common malignant tumor in the neonatal period. Stage MS occurs in children under the age of 12 months and is a subgroup of localized primary tumors, with metastases limited to the liver, skin or bone marrow. It is also characterized by a high incidence of spontaneous regression and an excellent survival rate. Pepper syndrome is extremely rare in the neonatal period and results from massive hepatic infiltration by neuroblastoma in advanced stages (M and MS), conditioning respiratory compromise, liver failure and coagulopathy. **Case report:** This case presents this rare form of neonatal neuroblastoma, with rapid metastatic growth and a guarded prognosis due to mechanical complications characteristic of Pepper syndrome. **Discussion:** Despite the adoption of chemotherapy and intensive support therapy, rapid metastatic growth resulted in progressive worsening with liver failure, peri-ventricular hemorrhage and death.

Keywords: Newborn. Neuroblastoma. Pepper syndrome. Case report.

Neuroblastoma perinatal: um relato de caso da síndrome de Pepper

Resumo

Introdução: O neuroblastoma perinatal é o tumor maligno mais frequente no período neonatal. O estádio MS ocorre em crianças com menos de 12 meses e é um subgrupo de tumores primários localizados, com metástases limitadas ao fígado, pele ou medula óssea. Também se caracteriza por uma elevada incidência de regressão espontânea e uma excelente taxa de sobrevivência. A síndroma de Pepper é extremamente rara no período neonatal e resulta da infiltração maciça do fígado pelo neuroblastoma em estádios avançados (M e MS), condicionando comprometimento respiratório, insuficiência hepática e coagulopatia. **Relato de caso:** Este caso representa esta rara apresentação de neuroblastoma neonatal, com crescimento metastático rápido e prognóstico reservado devido a complicações mecânicas, características da síndroma de Pepper. **Discussão:** Apesar da instituição de quimioterapia e terapia de suporte intensiva, o crescimento metastático rápido resultou em agravamento progressivo com insuficiência hepática, hemorragia periventricular e morte.

Palavras-chave: Recém-nascido. Neuroblastoma. Síndroma de pepper. Caso clínico.

***Correspondence:**
Bárbara Ribeiro Aguiar
E-mail: barbara.ribeiro.aguiar@hbeatrizangelo.pt

Received: 10-10-2023
Accepted: 24-09-2024
https://pjp.spp.pt

Available online: 20-03-2025
Port J Pediatr. 2025;56(3):177-181
DOI: 10.24875/PJP.23000040

Keypoints

What is known
- Perinatal neuroblastoma is the most common malignant tumor in the neonatal period.
- Pepper syndrome, resulting from massive hepatic infiltration by neuroblastoma in advanced stages (M/MS) is extremely rare in the neonatal period.
- Clinical presentation of Pepper syndrome includes progressive abdominal distension and respiratory compromise.

What is added
- The progressive clinical deterioration described serves as a reminder of a possible atypical evolution of neonatal neuroblastoma.
- This case emphasizes the guarded prognosis associated with Pepper syndrome and the need for the consideration of palliative care when appropriate.

Introduction

Neonatal tumors represent 2% of pediatric malignant tumors. The most common is neonatal neuroblastoma, with an incidence of 0.6/100,000 live births[1-7]. It is the most undifferentiated form of neuroblastic tumors. Perinatal neuroblastoma typically develops between the prenatal period and the first three months of life and is usually diagnosed during the third trimester of pregnancy[1-6].

The incidence is higher in Caucasian males and family cases are extremely rare[8-11]. An association between certain variables and subsequent neuroblastoma development has been identified, including neonatal hemolytic disease, a low Apgar score at the first minute and neonatal respiratory distress[8,9]. Maternal characteristics include young age, anemia, exposure to nitrosatable compounds and wood dust and the consumption of toxins during pregnancy[8-15].

The site is variable, but in about 90% of cases it has an adrenal origin[1,7]. About half of patients present metastatic disease at the time of diagnosis[5]. The typical clinical presentation is the finding of a mass (cystic, solid or mixed) in a routine fetal ultrasound, usually on the right abdomen, which does not usually cause symptoms in the perinatal period[1,2,7]. However, large or widely-spread metastatic tumors may lead to fetal hydrops, polyhydramnios, maternal preeclampsia, placental insufficiency or progression dystocia with possible fetal or maternal injury[1,7]. The main differential diagnosis of a fetal adrenal mass is adrenal hemorrhage, since it is the most common etiology in this period. Other differential diagnoses should be considered, such as an adrenal cyst or abscess, a bronchogenic cyst or splenic cyst, a liver tumor, retroperitoneal teratoma, extra-lobar pulmonary sequestration and renal anomalies[1-3,7,16]. Fetal magnetic resonance imaging (MRI) is an important complement to prenatal ultrasound in the etiologic investigation[7,16].

A newborn's clinical presentation of neuroblastoma can be asymptomatic, but it can also lead to respiratory distress or complications of anemia or thrombocytopenia, secondary to bone marrow involvement[17]. The likelihood that a palpable abdominal mass in the early neonatal period corresponds to a neuroblastoma is greater than 80%[1]. Occasionally, massive abdominal distension may be present due to the existence of liver metastases (Pepper syndrome)[1,18]. Pepper syndrome is rare in the neonatal period[18] and results from massive hepatic infiltration by neuroblastoma, conditioning progressive abdominal growth and respiratory compromise in its advanced stages (M and MS). About 30% of newborns die with a severe presentation[18].

Urinary catecholamines are useful in diagnosing a neuroblastoma, but an elevation of these is absent in two thirds of patients diagnosed in the prenatal period[1,16]. Scintigraphy with 123I-methyliodobenzylguanidine (123I-MIBG), computed tomography (CT) and abdominal MRI enable an initial characterization of the tumor and an assessment of its response to treatment and evolution over time[1,17]. Bone marrow aspiration and biopsy is recommended to assess its metastatic involvement.

Age at diagnosis, disease stage and genomic amplification of the MYCN oncogene are the three main determinants of prognosis[19]. Combined with the degree of tumor differentiation, changes in the 11q chromosomal region, tumor DNA content and histological category enables risk stratification of the neuroblastoma[19-21]. The most common genetic anomaly, present in about 20% of cases, is MYCN amplification, associated with a more advanced stage and an unfavorable prognosis[9,19]. However, a high expression of TrkA, a neurotrophin receptor, is associated with favorable clinical and biological characteristics[22]. More recently, the CHD5 protein, expressed in low-risk neuroblastic tumors, has been identified as a marker of prognosis and a potential marker of treatment response[20].

The International Neuroblastoma Staging System (INSS) provided the initial neuroblastoma classification system, with most patients with perinatal neuroblastoma

being in stages 1 or 2[1,2]. Recently, the International Neuroblastoma Risk Group Staging System (INRGSS) incorporated pre-surgical risk factors, determined prior to any treatment, which allowed more consistent staging worldwide[17,21]. Disease extension is inversely correlated with prognosis[9], with the exception of the MS stage, which represents about 7-10% of all neuroblastomas and occurs in children under 12 months of age[4,5]. Stage MS neuroblastoma is a subgroup of localized primary tumors, histologically undifferentiated, with metastases limited to the liver, skin and/or bone marrow, with no radiologically detected bone lesion and with no MYCN amplification[5,17]. It has a high incidence of spontaneous regression and an excellent survival rate[4,5,20]. The poor clinical outcome is related to the systemic effects of the disease, namely the respiratory compromise caused by massive abdominal distention[4], despite an aggressive multimodal therapeutic approach[17,18].

Consequently, the treatment of neuroblastoma generally encompasses a wide spectrum of options, from pregnancy with ultrasound monitoring or isolated surgical resection to, in the most advanced stages, a multimodal approach with chemotherapy, surgery, radiotherapy and stem cell transplantation in high-risk neuroblastoma. Advances in immunotherapy have been improving the prognosis in high-risk neuroblastomas[19,23,24]. Strategies designed to reach biologically relevant targets and pathways represent the future of treatment in neuroblastoma[17,25,26].

Case report

We present the case of a female neonate, born in a hospital in the metropolitan area of Lisbon, from a healthy 27-year-old mother, with adequate pregnancy surveillance.

The third-trimester routine ultrasound at 33 weeks of gestation identified a para-renal solid mass measuring 42 × 37 mm. At the 36th week, the mass showed an increase in size (53 × 41 × 40 mm) and was localized near the upper edge of the right kidney, with a normal cleavage plane. The liver was enlarged, a varicosed umbilical vein was identified and the amniotic fluid index was reduced. Fetal magnetic resonance was not performed in time due to hospitalization because of decreased fetal movements and a biophysical profile score of 2/8 with fetal Doppler compromise. A cesarean delivery was performed at 37 weeks of gestation. The newborn, weighing 2720 g, with an Apgar score of 8/9, was admitted to the neonatal unit. Physical examination revealed abdominal distension (abdominal perimeter of 35 cm) with a visible venous plexus (Fig. 1), stable vital signs and no feeding intolerance or respiratory distress. Abdominal CT: solid heterogeneous adrenal mass measuring 50 × 40 mm and significant hepatomegaly reaching the pelvic cavity, multiple liver nodules of varying sizes and significant deformation of the inferior vena cava and normal configuration of the renal vessels (Fig. 2). Blood tests showed an elevation of

Figure 1. Picture taken immediately after birth, with abdominal distension and visible venous plexus.

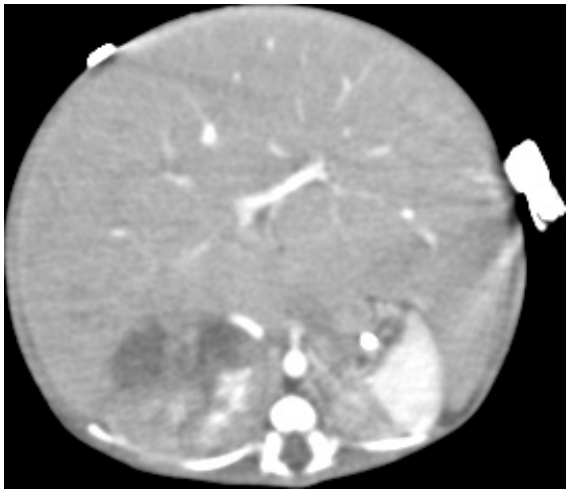

Figure 2. Abdominal CT with contrast performed on the fifth day of life, showing liver metastasis.

Figure 3. Rectal prolapse due to increased intra-abdominal pressure.

Figure 4. Clinical deterioration with enlargement of abdominal perimeter and anasarca.

vanillylmandelic acid and neuron-specific enolase. Those findings suggested the diagnosis of stage M/MS neuroblastoma (INRGSS), with massive hepatic metastasis – Pepper syndrome.

Progressive massive hepatomegaly and progression to compartment syndrome with respiratory and hepatic failure, progressive anemia, consumption coagulopathy, anuria, ileus and rectal prolapse (Fig. 3). Ascites requiring paracentesis on day seven and spontaneous drainage of ascitic fluid afterwards. A grade 3 periventricular hemorrhage since day three was diagnosed, complicated with periventricular infarction.

Chemotherapy with vincristine and cyclophosphamide was initiated with no response and physical deterioration with enlargement of the abdominal perimeter (Fig. 4) and anasarca was inevitable. Analgesia with opioids from day seven were needed due to significant pain and discomfort.

Despite intensive support therapy (invasive ventilation, furosemide, multiple transfusions of plasma, platelets and red blood cells, fibrinogen and vitamin K) there was progressive clinical deterioration.

In a multidisciplinary team evaluation, it was decided not to proceed with further investigation or more invasive treatments. After a family meeting, palliative care was decided on day 10. Death occurred on the fifteenth day of life.

Discussion

This case represents an extremely rare presentation of neonatal neuroblastoma, with diffuse hepatic metastasis and guarded prognosis due to mechanical complications characteristic of Pepper syndrome[18]. The large size of the tumor caused placental insufficiency, requiring delivery before fetal MRI could be performed as an additional measure to the prenatal ultrasound. In this case, surgical intervention was precluded due to abdominal compartment syndrome, progressive respiratory distress and coagulopathy. Despite the adoption of chemotherapy with vincristine and cyclophosphamide and intensive supportive therapy, rapid metastatic growth resulted in progressive worsening with liver failure, peri-ventricular hemorrhage and death.

This case report is relevant as it shows an atypical evolution of a neonatal neuroblastoma, with poor prognosis and culminating in the death of a newborn, and it opens the spectrum to the differential diagnosis of a neonatal abdominal mass.

Previous presentations

Presented as a digital poster in the 1as Jornadas Digitais de Pediatria of the Sociedade Portuguesa de Pediatria, on the 22nd of October, 2020.

Author contributions

B. Ribeiro Aguiar: Intellectual contribution to the conception of the article, bibliographical search, drafting of the manuscript, critical reviewing of the content of the article, approval of the final version. J. Ribeiro: Intellectual contribution to the conception of the article, drafting of the manuscript, critical reviewing of the content of the article, approval of the final version. D. Martins: Intellectual contribution to the conception of the article, drafting of the manuscript, critical reviewing of the content of the article, approval of the final version. S.N. Prado: Intellectual contribution to the conception of the article, drafting of the manuscript, critical reviewing of the content of the article, approval of the final version. H. Cavaco: Intellectual

contribution to the conception of the article, drafting of the manuscript, critical reviewing of the content of the article, approval of the final version.

Funding

There were no external funding sources for the writing of this paper.

Conflicts of interest

None.

Ethical considerations

Protection of humans and animals. The authors declare that no experiments involving humans or animals were conducted for this research.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from patients, and received approval from the Ethics Committee. The SAGER guidelines were followed according to the nature of the study.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

References

1. Nuchtern JG. Perinatal neuroblastoma. Semin Pediatr Surg. 2006;15(1):10-16.
2. Oliveira A, Jerónimo M, Fonseca M, Heitor F, Perinatal MGN. Um desafio para o neonatologista. Acta Pediatr Port. 2015;46:136-139.
3. Cass DL. Fetal abdominal tumors and cysts. Transl Pediatr. 2021;10(5):1530-1541.
4. Moppett J, Haddadin I, Foot ABM. Neonatal neuroblastoma. Arch Dis Child Fetal Neonatal Ed. 1999;81(2):F134–F137.
5. Chaturvedi A, Katzman PJ, Franco A. Neonatal neuroblastoma 4s with diffuse liver metastases (Pepper syndrome) without an adrenal/extraadrenal primary identified on imaging. Radiology Case. 2018;12(3):18-27.
6. Yang CL, Serra-Roma A, Gualandi M, Bodmer N, Niggli F, Schulte JH, et al. Lineage-restricted sympathoadrenal progenitors confer neuroblastoma origin and its tumorigenicity. Oncotarget. 2020;11(24):2357-2371.
7. Houlihan C, Jampolsky M, Shilad A, Principe D. Prenatal diagnosis of neuroblastoma with sonography and magnetic resonance imaging. J Ultrasound Med. 2004;23:547-550.
8. Bluhm E, McNeil E, Cnattingius S, Gridley G, El Ghormli L, Fraumeni JF Jr. Prenatal and perinatal risk factors for neuroblastoma. Int J Cancer. 2008;123(12):2885-2890.
9. Johnson KJ, Puumala SE, Soler JT, Spector LG. Perinatal characteristics and risk of neuroblastoma. Int J Cancer. 2008;123:1166-1172.
10. Gulrajani NB, Montes S, McGough D, Wimberly CE, Khattab A, Semmes EC, et al. Assisted reproductive technology and association with childhood cancer subtypes. Cancer Med. 2023;12(3):3410-3418.
11. Sirirungreung A, Hansen J, He D, Huang X, Ritz B, Heck JE. Exposure to nitrosatable drugs during pregnancy and childhood cancer: A matched case-control study in Denmark, 1996-2016. Pharmacoepidemiol Drug Saf. 2023;32(4):496-505.
12. Volk J, Heck JE, Schmiegelow K, Hansen J. Parental occupational organic dust exposure and selected childhood cancers in Denmark 1968-2016. Cancer Epidemiol. 2020;65:101667.
13. Rios P, Bailey HD, Poulalhon C, Valteau-Couanet D, Schleiermacher G, Bergeron C. Parental smoking, maternal alcohol consumption during pregnancy and the risk of neuroblastoma in children: A pooled analysis of the ESCALE and ESTELLE French studies. Int J Cancer. 2019;145(11):2907-2916.
14. Friedrich P, Itriago E, Rodriguez-Galindo C, Ribeiro K. Racial and ethnic disparities in the incidence of pediatric extracranial embryonal tumors. JNCI J Natl Cancer Inst. 2017;109(10):djx050.
15. Rios P, Bailey HD, Orsi L, Lacour B, Valteau-Couanet D, Levy D, et al. Risk of neuroblastoma, birth-related characteristics, congenital malformations and perinatal exposures: A pooled analysis of the ESCALE and ESTELLE French studies (SFCE). Int J Cancer. 2016;139:1936-1948.
16. Sauvat F, Sarnacki S, Brisse H, Medioni J, Rubie H, Aigrain Y, et al. Outcome of suprarenal localized masses diagnosed during the perinatal period. Cancer. 2002;94:2474-2480.
17. Whittle SB, Smith V, Doherty E, Zhao S, McCarty S, Zage PE. Overview and recent advances in the treatment of neuroblastoma. Expert Rev Anticancer Ther. 2017;17(4):369-386.
18. Fernández M, Armenta C, Camarena I. Síndrome de Pepper en un neonato. Rev Mex Pediatr. 2006;73(4):172-176.
19. Cheung NK, Dyer MA. Neuroblastoma: Developmental biology, cancer genomics, and immunotherapy. Nat Rev Cancer. 2013;13(6):397-411.
20. Garcia I, Mayol G, Rodríguez E, Suñol M, Gershon TR, Ríos J, et al. Expression of the neuron-specific protein CHD5 is an independent marker of outcome in neuroblastoma. Mol Cancer. 2010;9:277.
21. Cohn SL, Pearson ADJ, London WB, Monclair T, Ambros PF, Brodeur GM, et al. The International Neuroblastoma Risk Group (INRG) classification system: An INRG task force report. J Clin Oncol. 2008;27:289-297.
22. Brodeur GM. Spontaneous regression of neuroblastoma. Cell Tissue Res. 2018;372(2):277-286.
23. Yu AL, Gilman AL, Ozkaynak MF, London WB, Kreissman SG, Chen HX, et al. Anti-GD2 antibody with GM-CSF, interleukin-2, and isotretinoin for neuroblastoma. N Engl J Med. 2010;363:1324-1334.
24. Cheung NKV, Cheung IY, Kushner BH, Ostrovnaya I, Chamberlain E, Kramer K, et al. Murine anti-GD2 monoclonal antibody 3F8 combined with granulocyte-macrophage colony-stimulating factor and 13-cis-retinoic acid in high-risk patients with stage 4 neuroblastoma in first remission. J Clin Oncol. 2012;30(26):3264-3270.
25. Jacob M, Wiedemann S, Brücher D, Pieper NM, Birkhold M, Särchen V, et al. Increased MCL1 dependency leads to new applications of BH3-mimetics in drug-resistant neuroblastoma. Br J Cancer. 2023;129(10):1667-1678.
26. Liu T, Li T, Ke S. Role of the CASZ1 transcription factor in tissue development and disease. Eur J Med Res. 2023;28(1):562.

PORTUGUESE JOURNAL OF PEDIATRICS

PERMANYER

Check for updates

CASE REPORT

Acute osteomyelitis in a neonate: a case report

*Sónia Andrade Santos**, *Sandra Soares Cardoso*, *Joana Magalhães*, *Clara Diogo*, *Inês Balacó*, *Cristina Alves*, *and Isabel Andrade*

Pediatric Department, Centro Hospitalar Tondela-Viseu, Viseu, Portugal

Abstract

Introduction: Acute osteomyelitis is rare in neonates and remains a diagnostic and therapeutic challenge. **Case report:** Female neonate, 25 days old, assessed after presenting with a limp right arm, irritability, and pain from that very day. Spontaneous movements of the right arm were absent, with no signs of inflammation or trauma, no markers of inflammation, and normal arm radiography. She was admitted for monitoring, maintaining pseudoparalysis. On the second day, she presented with fever, positive markers of inflammation and an ultrasound suggesting right humerus osteomyelitis. She was started on cefotaxime and vancomycin. MSSA was isolated in the blood culture. She was transferred to a tertiary hospital due to loss of venous access and hospitalized on flucloxacillin. She completed six weeks of intravenous antibiotics and was discharged after 43 days, having improved. Radiography showed signs of bone remodeling and she was discharged without sequelae, with an Orthopedics follow-up consultation in one year. **Discussion:** Early diagnosis and prompt treatment may prevent complications. The authors highlight the importance of diagnostic suspicion, even in neonates with no risk factors.

Keywords: Osteomyelitis. Neonate. Staphylococcus aureus.

Osteomielite aguda em recém-nascido: um caso clínico

Resumo

Introdução: A osteomielite aguda é rara no período neonatal, constituindo um desafio diagnóstico e terapêutico. **Relato de caso:** Recém-nascida de 25 dias, avaliada por membro superior direito (MSD) pendente, dor à mobilização e irritabilidade desde o próprio dia. À observação sem mobilidade ativa do MSD, sem sinais inflamatórios ou lesões traumáticas, parâmetros inflamatórios negativos e radiografia sem alterações. Internada para vigilância, mantendo pseudoparalisia. Febre em D2, parâmetros inflamatórios positivos e ecografia sugestiva de osteomielite do úmero direito, iniciando cefotaxima e vancomicina. Isolado MSSA na hemocultura. Transferida para hospital terciário por perda de acesso vascular, internada sob flucloxacilina. Completou 6 semanas de antibioterapia endovenosa. Alta após 43 dias, melhorada, com sinais de remodelação óssea na radiografia, para consulta de Ortopedia, tendo alta após um ano, sem sequelas. **Discussão:** O diagnóstico precoce e tratamento adequado são fundamentais para evitar complicações. Salienta-se a importância da suspeição diagnóstica, mesmo em recém-nascidos sem fatores de risco.

Palavras-chave: Osteomielite. Recém-nascido. Staphylococcus aureus.

***Correspondence:**
Sónia Andrade Santos
E-mail: soniaandradesantos91@gmail.com

Received: 19-10-2024
Accepted: 17-09-2024
https://pjp.spp.pt

Available online: 25-06-2025
Port J Pediatr. 2025;56(3):182-186
DOI: 10.24875/PJP.23000045

Keypoints

What is known
- Acute osteomyelitis is rare in neonates.
- *Staphylococcus aureus* is the most common pathogen in neonatal osteomyelitis.
- Intravenous antibiotics are first-line treatment, and must be adjusted according to the bacteria and antibiotic sensitivity test.

What is added
- A case with a rare location of osteomyelitis of the humerus.
- Neonate with no risk factors for acute osteomyelitis and no indications from laboratory or imaging tests at the onset of symptoms.

Introduction

Osteomyelitis is an inflammatory process of the bone and marrow, usually resulting from bacterial infection, which can be classified as acute when symptoms are present for less than two weeks[1]. Children under five years old account for approximately 50% of the pediatric cases of osteomyelitis, with a male/female ratio of 2:1. For neonatal osteomyelitis, an estimated incidence of 1-7/1000 hospital admissions has been reported[1,2]. Although uncommon, it can result in severe long-term consequences such as joint destruction and growth failure, especially if not diagnosed and treated early[3].

The most common mechanism of infection is hematogenous inoculation of the bone during an episode of bacteriemia, but it can also result from direct inoculation or be spread from a contiguous site of infection[4]. Risk factors include prematurity, trauma, sepsis, bacteriemia, previous central venous catheter or chronic catheterization, and immunodeficiency[5].

Osteomyelitis most frequently involves the metaphysis of long bones, mainly in the lower limbs, with femur and tibia accounting for about 50% of all cases. The rich metaphyseal blood supply, with vascular loops and turbulent flow, facilitates bacterial colonization. *Staphylococcus aureus* is the most common pathogen in neonatal osteomyelitis, found in 70-90% of positive culture cases[5,6].

The classic presentation is fever, localized signs of swelling, pain, and limitation of movement. Diagnosing osteomyelitis in neonates in the early stages of the disease can be challenging because clinical presentation is nonspecific. As a result, treatment is often delayed[1,4].

We present the case of a healthy newborn with no known risk factors, with acute osteomyelitis of the humerus, a rare location, to demonstrate the importance of a high index of suspicion to identify and treat this condition early.

Case report

Female newborn; pregnancy monitored by a private Obstetrician and Primary Health Care with no events referred; third trimester serologies with no sign of infection, negative Group B *Streptococcus*, and three normal prenatal ultrasounds. She was born by cesarean section at 41 weeks of gestation, with an Apgar score of 9/9/10. Admission to the maternity ward was uneventful and she was discharged on the third day as clinically well. No incidents were mentioned during the first three weeks of life.

On the 25th day of life the newborn was brought to the pediatric emergency department of a local level II hospital because her mother noticed the right arm became limp from that very day, with irritability and discomfort when manipulated. There were no signs of fever, feeding intolerance, swelling, or flushing, and no history of trauma. The neonate exhibited a limited and painful range of motion in the right shoulder and elbow, with an absence of spontaneous movements in that arm, but active mobility was maintained in the wrist. There was no evidence of focal tenderness, inflammation, or trauma in the shoulder, arm, or elbow. Movements in the left arm remained within the typical frequency and range. Considering the diagnostic hypotheses of acute osteomyelitis, septic arthritis, or trauma, laboratory blood tests were conducted, revealing a C-reactive protein (CRP) level of 1.18 mg/dl and a procalcitonin level of 0.03 mg/dL, with other values within normal ranges. Plain radiography of the right arm was performed, showing normal results, and she was seen by Orthopedics. A blood culture sample was collected.

She was hospitalized for monitoring at the Special Care Unit for Newborns, with paracetamol for pain control. Twelve hours after admission, clinical examination and blood tests were similar, and a second blood culture sample was collected.

On the second day of hospitalization, with pain and pseudoparalysis persisting in the right arm, she presented with fever and an increase in markers of inflammation (CRP 4.1 mg/dl). An ultrasound was performed, suggesting osteomyelitis of the right humerus, with no signs of adjacent septic arthritis (Fig. 1). She was started on empiric intravenous (IV) antibiotic therapy

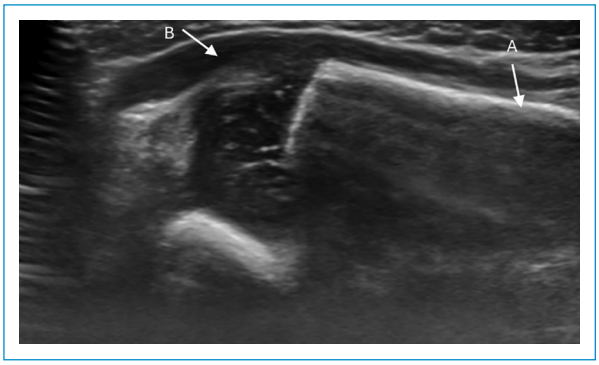

Figure 1. Soft-tissue ultrasound with signs of acute osteomyelitis of the right humerus (**A**) and no signs of joint effusion (**B**).

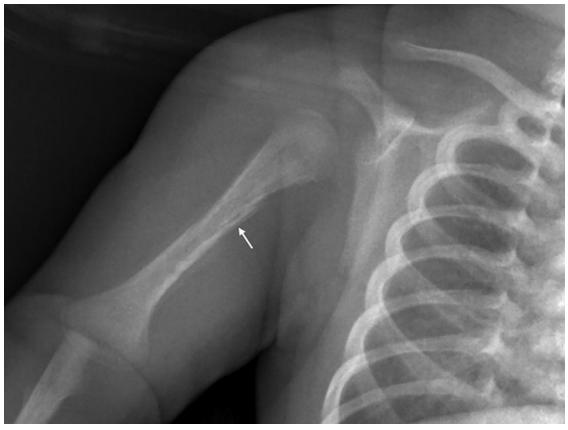

Figure 2. Anteroposterior radiograph showing signs of pandiaphysitis of the right humerus, with irregular periostitis and possible cortical rupture.

Figure 3. MRI coronal section of the right humerus, showing extensive alterations in the muscle groups of the right arm, medullary signal abnormality of the humerus, with extensive periosteal reaction and multiple collections adjacent to the bone suggesting infection, the largest of which measures approximately 16 × 6 mm.

with cefotaxime and vancomycin, with clinical improvement and no fever after 48 hours. On the fifth day, the result of the first blood culture was positive for meticillin-sensitive *Staphylococcus aureus* (MSSA), so cefotaxime was suspended. On the eleventh day, due to loss of peripheral venous access sites and the need for a central access site to ensure full IV antibiotic treatment, she was transferred to the tertiary referral hospital. Upon admission, a radiograph of the humerus was performed, showing signs of pandiaphysitis, with irregular periostitis and possible cortical rupture (Fig. 2). A multidisciplinary team from Pediatric Orthopedics, Pediatric Infectious Diseases and Pediatrics decided on admission to the Pediatric Orthopedics Department with IV flucloxacillin (150 mg/Kg/day in three divided doses). A central venous catheter (CVC) was placed in the left internal jugular vein under general anesthesia, without incident.

Magnetic resonance imaging (MRI) was performed on the thirteenth day, showing extensive periostitis and multiple abscesses adjacent to the bone (Fig. 3). Surgical drainage was not required once she responded well and MSSA was identified in the blood culture, allowing targeted antibiotic therapy.

On the twenty-fifth day she had the CVC replaced due to swelling of the left hemiface, with the signs of inflammation resolving completely after the procedure.

She underwent a total of six weeks of IV antibiotic therapy (eight days of vancomycin and thirty-three days of flucloxacillin), showing progressive improvement clinically and in terms of laboratory testing (upon hospital discharge: sedimentation rate 16 mm/h, CRP < 0.04 mg/dl). She was discharged on the forty-third day, with signs of bone remodeling on the humerus in the radiography (Fig. 4A) and was referred for a Pediatric Orthopedics consultation.

After hospital discharge, she maintained good active and passive mobility of the right upper limb. She was discharged from Pediatric Orthopedics after one year of follow-up, without sequelae, and with a normal plain radiograph for her age (Fig. 4B), with her family physician continuing to monitor her.

Figure 4. **A**: radiography showing signs of humeral remodeling with extensive periosteal reaction. Bone-within-a-bone appearance, expected in the context of acute osteomyelitis at this age. **B**: normal radiograph for age with adequate corticalization.

Discussion

The diagnosis of osteomyelitis in neonates can be challenging because of its nonspecific clinical presentation and normal radiograph in the early stages. As a result, treatment is often delayed. The outcome is dependent on rapid diagnosis and the immediate initiation of treatment[7,8].

This case required a high index of suspicion from the medical doctors, as symptoms and signs were minor and nonspecific at first, and auxiliary examinations were normal on the first assessment. The location of osteomyelitis in the humerus is uncommon, especially in newborns with no risk factors or history of trauma. Admitting a patient for close monitoring, allowing prompt investigation and treatment as needed is always an option, and it was what allowed early diagnosis and the implementation of therapy.

Blood cultures allowed for the identification of *S. aureus*, the most common bacterial agent in osteomyelitis etiology in this age, and treatment was adjusted accordingly[9].

Ultrasound and MRI play a crucial role in the diagnosis and management of acute osteomyelitis: ultrasound is useful for recognizing fluid collections in joints and soft tissues, while MRI is beneficial for locating the lesion, providing valuable insights into the extent of bone involvement, monitoring the progression of the disease, and guiding appropriate treatment strategies[10].

Studies show that up to 90% of patients with an early diagnosis of osteomyelitis can be cured with conservative antibiotic treatment, especially when initiated within the first few days after the onset of symptoms. Surgery is usually not needed, as was seen in our case, unless aspiration or drainage is required, for instance in cases of abscesses not responding to antibiotics, which in some cases could delay recovery. IV antibiotics for four to six weeks is first-line treatment, but the duration and route of administration are currently under debate, and more studies are needed in neonates, whose full treatment must be administered through IV access[1,8]. This brought an additional challenge in this case, with the neonate being transferred to a tertiary hospital and undergoing a CVC twice, under general anesthesia, due to the patient's age and size. According to literature, 20% of patients with acute osteomyelitis treated with long-term IV therapy had two or more CVCs placed during their treatment, with the majority of the initial CVCs being removed as a result of catheter malfunction or catheter-associated bloodstream infection[11]. Despite these documented complications, and even though our patient displayed one of these, we maintained IV antibiotics for six weeks, as recommended in neonates.

Potential complications of acute osteomyelitis include septic arthritis, subperiosteal abscess, pyomyositis, deep vein thrombosis, sepsis, and multiorgan failure. Although the mortality rate is less than 1%, it is crucial to recognize that permanent disabilities can still occur, such as growth arrest with limb length discrepancy, chronic pain, or rigidity. Moreover, acute osteomyelitis can evolve to the chronic form[6]. In our case, subperiosteal abscesses responded well to antibiotic therapy and no other complications or morbidities were recorded.

This case had a good outcome, probably due to early diagnosis, which prevented involvement of the growth plate and epiphysis. The blood culture was positive for MSSA, which allowed for targeted antibiotic therapy, which could be adjusted as soon as the culture result was provided. Correct treatment was administered with a total of six weeks of IV antibiotic therapy, five of which included 150 mg/kg/day of IV flucloxacillin (the dosage for osteoarticular infection). The authors highlight the importance of diagnostic suspicion, even in neonates with no known risk factors, and the work of a multidisciplinary team in a rare and challenging case like this.

Acknowledgements

The authors wish to express their appreciation for the collaboration of the colleagues involved in the multidisciplinary care and their overall contribution to the decision-making process.

Previous presentations

Oral presentation in 49º Congresso Português de Neonatologia, 2021.

Author contributions

S. Andrade Santos: Conception and design of the study, report, review or other type of work or paper; Agreement to be accountable for the accuracy or integrity of the work. S. Soares Cardoso: Acquisition of data either from patients, research studies, or literatura; Analysis or interpretation of data either from patients, research studies, or literature; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work; J. Magalhães: Analysis or interpretation of data either from patients, research studies, or literature; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. C. Diogo: Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. I. Andrade: Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work.

Funding

There were no external funding sources for the writing of this paper.

Conflicts of interest

The authors declare that there were no conflicts of interest in drafting this paper.

Ethical considerations

Protection of humans and animals. The authors declare that no experiments involving humans or animals were conducted for this research.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from patients, and received approval from the Ethics Committee. The SAGER guidelines were followed according to the nature of the study.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

References

1. Saavedra-Lozano J, Falup-Pecurariu O, Faust SN, Girschick H, Hartwig N, Kaplan S, et al. Bone and joint infections. Pediatr Infect Dis J. 2017 Aug;36(8):788-99.
2. Riise ØR, Kirkhus E, Handeland KS, Flatø B, Reiseter T, Cvancarova M, et al. Childhood osteomyelitis-incidence and differentiation from other acute onset musculoskeletal features in a population-based study. BMC Pediatr. 2008;8:45-54.
3. Fisher RG. Neonatal osteomyelitis. Neoreviews. 2011;12(7). DOI: 10.1542/neo.12-7-e374.
4. Thakolkaran N, Shetty AK. Acute hematogenous osteomyelitis in children. Ochsner J. 2019;19(2):116-22.
5. Popescu B, Tevanov I, Carp M, Ulici A. Acute hematogenous osteomyelitis in pediatric patients: epidemiology and risk factors of a poor outcome. J Int Med Res. 2020;48(4). DOI: 10.1177/0300060520910889.
6. Chiappini E, Mastrangelo G, Lazzeri S. A case of acute osteomyelitis: an update on diagnosis and treatment. Int J Environ Res Public Health. 2016 May 27;13(6):539.
7. Kiechl-Kohlendorfer U, Griesmaier E. Neonatal osteomyelitis. Neonatal Bact Infect. 2013;12:33-9.
8. Zhan C, Zhou B, Du J, Chen L. Clinical analysis of 17 cases of neonatal osteomyelitis: a retrospective study. Medicine (Balt). 2019;98(2):14129.
9. Street M, Puna R, Huang M, Crawford H. Pediatric acute hematogenous osteomyelitis. J Pediatr Orthop. 2015;35(6):634-9.
10. Thomsen I, Creech CB. Advances in the diagnosis and management of pediatric osteomyelitis. Curr Infect Dis Rep. 2011;13(5):451-60.
11. Ruebner R, Keren R, Coffin S, Chu J, Horn D, Zaoutis TE. Complications of central venous catheters used for the treatment of acute hematogenous osteomyelitis. Pediatrics. 2006;117(4):1210-5.

PORTUGUESE JOURNAL OF PEDIATRICS

PERMANYER

Check for updates

IMAGES IN PEDIATRICS

An uncommon cause of headache

Uma causa incomum de cefaleia

Mariana Sousa Santos[1], Ester Pereira[1], José A. Costa[2], and Fernanda Rodrigues[3]*

[1]Pediatrics Department, Centro Hospitalar de Leiria, Leiria; [2]Neurosurgery Service, Hospital Pediátrico, Centro Hospitalar e Universitário de Coimbra, Coimbra; [3]Emergency Service and Infectious Diseases Unit, Hospital Pediátrico, Centro Hospitalar e Universitário de Coimbra, Coimbra. Portugal

Keypoints

What is known

- Brain abscesses are rare infections of the central nervous system.
- The classic triad of manifestations consists of fever, headache, and focal neurological deficits.
- The presence of *Streptococcus intermedius* should make us suspect an oropharyngeal source.

What is added

- Fever can be absent and neurological deficits may be subtle, making differential diagnosis more challenging.
- Both brain abscesses and neoplastic lesions show surrounding edema, indistinguishable by CT, making MRI crucial for diagnosis.

A 15-year-old male was brought to the emergency department because of a frontal headache lasting four days, which made him wake up in the night and led to vomiting since the day before. He also reported discomfort in the lower left limb that was associated with previous soccer training. The patient denied having fever. On observation, he was in good general condition and hemodynamically stable. At the neurological examination, he scored 15 points on the Glasgow Coma Scale, displayed adequate speech, and was oriented in time and space. However, he had decreased muscle strength against resistance in the left upper and lower limbs (grade 4), with positive Barré and Mingazzini tests on the same side. Osteotendinous reflexes were present and meningeal signs were absent.

Complete blood count, ionogram, liver and kidney function, uric acid and lactic dehydrogenase tests were normal, with a C-reactive protein of 36.1 mg/L. A computed tomography scan revealed an expansive right frontal lobe lesion measuring 22 x 38 x 27 mm, hypodense, with a thin ring uptake after intravenous iodinated contrast, and with marked surrounding edema. Diagnostic hypotheses of an abscess or neoplastic lesion were considered, and a magnetic resonance imaging (MRI) was performed, confirming the diagnosis of a brain abscess, which led to a mass effect with obliteration of the cortical grooves and a midline shift to the left. The MRI also showed normal ventilation of the sinus cavities and no abnormal mastoid fillings.

Surgical drainage was performed (by aspiration) and intravenous antibiotic therapy with ceftriaxone and metronidazole was started. The symptoms of intracranial hypertension (vomiting and headache) ceased and the neurological deficits progressively improved. *Streptococcus intermedius* was isolated from the drained purulent contents. Antibiotic treatment was maintained for 6 weeks. He is clinically well and remains on levetiracetam to this day.

***Correspondence:**
Mariana Sousa Santos
E-mail: marianamss.94@gmail.com

Received: 23-08-2023
Accepted: 11-06-2024
https://pjp.spp.pt

Available online: 02-07-2024
Port J Pediatr. 2025;56(3):187-189
DOI: 10.24875/PJP.23000021

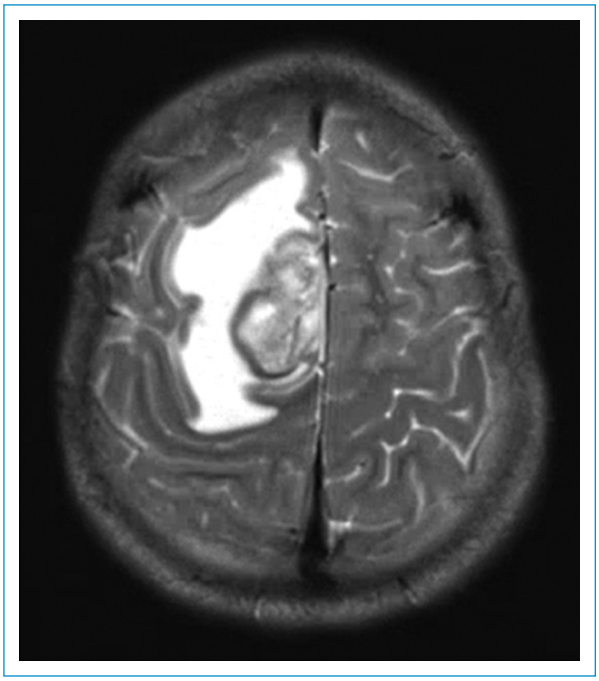

Figure 1. MRI, transverse plane.

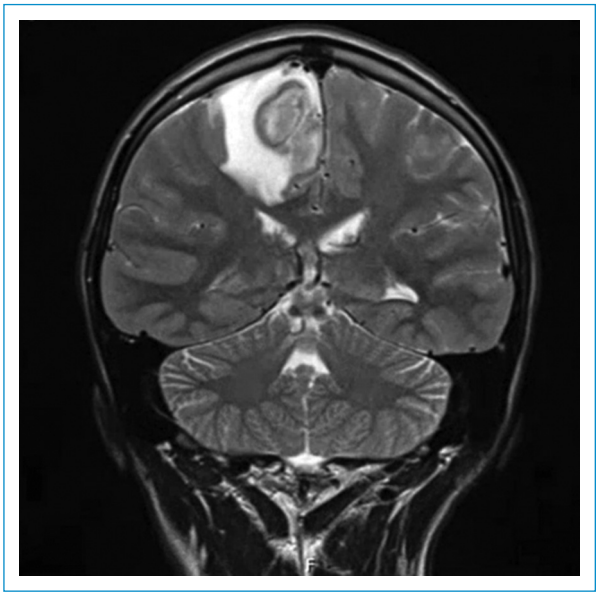

Figure 2. MRI, coronal plane.

The air-filled paranasal sinuses on the MRI, the absence of abnormal mastoid fillings as well as other symptoms, the isolated microorganism, and the personal history of dental cavities under treatment increased the likelihood that the origin of the disease was odontogenic.

Brain abscesses are rare focal infections of the brain parenchyma that are characterized by the accumulation of purulent content and surrounding edema[1,2]. They may result from direct inoculation (head trauma, neurosurgical procedures), from contiguous spread (through sinusitis or mastoiditis, for example) or from hematogenous spread (from a distant source of infection)[3]. Odontogenic infections occur in teeth and their supporting structures and dental cavities are often found at the source. Through contiguous or hematogenous spread, this type of infection can move to the brain parenchyma and form an abscess, with the frontal lobe being the most affected in these cases[2].

Streptococcus intermedius is a gram-positive bacterium that is part of the *Streptococcus anginosus* (or *Streptococcus milleri*) group. Members of this group are part of the normal microbiota, being frequently involved in brain and liver abscesses and thoracic empyemas. Previous dental manipulation is a risk factor for infections by these agents[5].

The classic triad of manifestations consists of fever, headache, and focal neurological deficits, but it is present in only a small percentage of cases[1,3,4]. Fever may be absent in more than 60% of cases[3]. Nausea and vomiting (due to increased intracranial pressure), seizures, and changes in the state of consciousness are common[1,3]. Symptoms can be subtle, especially at the beginning, so the average duration between the onset and the diagnosis is seven to 11 days[1]. In this case, with no fever, the subtle neurological deficits prompted an investigation that led to an earlier diagnosis.

Author contributions

M. Sousa Santos: Conception and design of the study, report, review or other type of work or paper; Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. E. Pereira: Conception and design of the study, report, review or other type of work or paper; Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. J.A. Costa: Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. F. Rodrigues: Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Final approval of the version to be

published; Agreement to be accountable for the accuracy or integrity of the work.

Funding

None.

Conflicts of interest

None.

Ethical considerations

Protection of humans and animals. The authors declare that the procedures followed complied with the ethical standards of the responsible human experimentation committee and adhered to the World Medical Association and the Declaration of Helsinki. The procedures were approved by the institutional Ethics Committee.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from patients, and received approval from the Ethics Committee. The SAGER guidelines were followed according to the nature of the study.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

References

1. Mameli C, Genoni T, Madia C, Doneda C, Penagini F, Zuccotti G. Brain abscess in pediatric age: a review. Child's Nerv Syst. 2019;35(7):1117-28.
2. Burgos-Larraín LF, Vázquez-Portela Á, Cobo-Vázquez CM, Sáez-Alcaide LM, Sánchez-Labrador L, Meniz-García C. Brain complications from odontogenic infections: A systematic review. J Stomatol Oral Maxillofac Surg. 2022;123(6):e794-800.
3. de Andres Crespo M, McKinnon C, Halliday J. What you need to know about brain abscesses. Br J Hosp Med. 2020;81(8):1-7.
4. Issa E, Salloum T, Tokajian S. From Normal Flora to Brain Abscesses: A Review of Streptococcus intermedius. Front Microbiol. 2020; 11(May):1-12.
5. Lajolo C, Favia G, Limongelli L, Tempesta A, Zuppa A, Cordaro M, et al. Brain abscess of odontogenic origin in children: A systematic review of the literature with emphasis on therapeutic aspects and a new case presentation. Acta Otorhinolaryngol Ital. 2019;39(2):67-74.

PORTUGUESE JOURNAL OF PEDIATRICS

PERMANYER

Check for updates

Ludwig's angina: a rare and life-threatening case report

Angina de Ludwig: um caso clínico raro e potencialmente fatal

Catarina Cezanne, Inês Foz, Elda Costa, and Joana Martins*

Serviço de Pediatria, Hospital Garcia de Orta, Almada, Portugal

Keypoints

What is known

- Ludwig's angina is a rare bacterial cellulitis of the tongue and floor of the mouth.
- It can be life-threatening if not treated promptly.

What is added

- Routine frenuloplasty to correct speech disorders may serve as a trigger for Ludwig's angina, though this is rare.

A healthy 10-year-old boy was admitted to the emergency department 20 hours after a frenuloplasty was performed at the dentist to correct speech disturbances. He presented with progressively worsening bilateral submandibular pain associated with marked swelling of the cervical and submandibular regions. He denied fever, breathing difficulties, or other symptoms. On examination, he was hemodynamically stable, eupneic, and presented with drooling and a muffled voice. His tongue and the floor of his mouth were swollen, resulting in trismus. The anterior cervical region was swollen up to the angle of the mandible, and it was painful on palpation with no adenopathy (Fig. 1). An urgent consultation with otorhinolaryngology was conducted and Ludwig's angina was diagnosed. The patient was hospitalized and started on intravenous clindamycin and corticosteroids. A computed tomography of the neck was subsequently performed, which demonstrated increased attenuation of the subcutaneous fat of the submandibular and submental spaces, supporting the diagnosis.

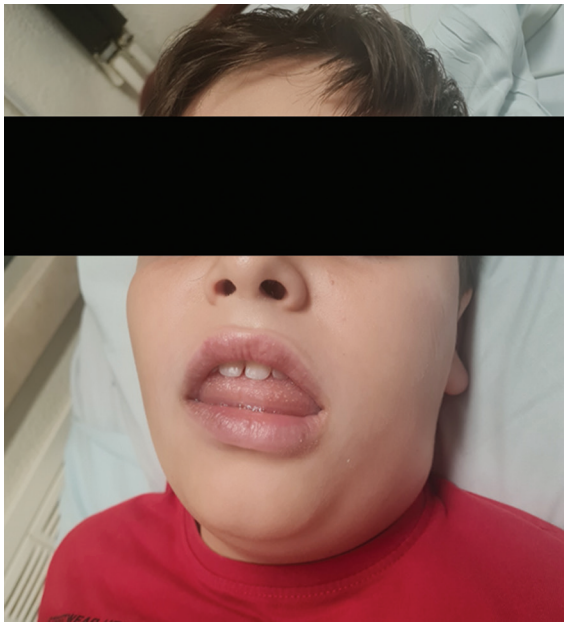

Figure 1. Boy with Ludwig's angina.

***Correspondence:**
Catarina Cezanne
E-mail: catarina.cezanne@hgo.min-saude.pt

Received: 31-07-2023
Accepted: 06-05-2024
https://pjp.spp.pt

Available online: 10-06-2024
Port J Pediatr. 2025;56(3):190-191
DOI: 10.24875/PJP.23000008

Laboratory evaluation showed leukocytosis with neutrophilia and a C-reactive protein of 6 mg/dL. During hospitalization, the patient continued to display no signs of respiratory distress and the signs of inflammation showed progressive improvement. Pain was controlled with analgesia. The patient was discharged on D6 and clinically improved under oral clindamycin for 10 days.

Ludwig's angina is a rare cellulitis of the tongue and floor of the mouth with the potential for acute progression that can be fatal, with airway obstruction being the leading cause of death[1-5]. Most cases are due to odontogenic infection, contiguous spread from oropharyngeal infection, or trauma to the mandible or floor of the mouth[1,4,5]. Early recognition, aggressive empiric antibiotic therapy, and serial airway evaluation are the mainstays of treatment; glucocorticoids promote antibiotic penetration and lessen airway edema[1,4]. We present this case to highlight the importance of early recognition of this rare diagnosis in the emergency department.

Author contributions

C. Cezanne: Conception and design of the study, report, review or other type of work or paper; Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work; I. Foz: Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work; E. Marques da Costa: Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work; J. Sousa Martins: Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work.

Funding

None.

Conflicts of interest

None.

Ethical considerations

Protection of humans and animals. The authors declare that the procedures followed complied with the ethical standards of the responsible human experimentation committee and adhered to the World Medical Association and the Declaration of Helsinki. The procedures were approved by the institutional Ethics Committee.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from patients, and received approval from the Ethics Committee. The SAGER guidelines were followed according to the nature of the study.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

References

1. Bridwell R, Gottlieb M, Koyfman A, Long B. Diagnosis and management of Ludwig's angina: An evidence-based review. Vol. 41, American Journal of Emergency Medicine. W.B. Saunders; 2021. p. 1-5.
2. Lin QL, Du HL, Xiong HY, Li B, Liu J, Xing XH. Characteristics and outcomes of Ludwig's angina in patients admitted to the intensive care unit: A 6-year retrospective study of 29 patients. J Dent Sci. 2020 Dec 1;15(4):445-50.
3. Lin HW, O'Neill A, Rahbar R, Skinner ML. Ludwig's angina following Frenuloplasty in an adolescent. International Journal of Pediatric Otorhinolaryngology. 2009 Sept;73(9):1313-5. doi:10.1016/j.ijporl.2009.05.022
4. Kovalev V. A Severe Case of Ludwig's Angina with a Complicated Clinical Course. Cureus. 2020 Apr 16;
5. Romero J, Elkattawy S, Romero A, Latif A, Al-Fiky E, Al-Nasseri A, et al. Ludwig's Angina. Eur J Case Rep Intern Med. 2022;9(6).