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ORIGINAL PAPER

Viral skin infections in pediatric patients with atopic dermatitis – a single-center retrospective study

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ABSTRACT

Introduction: Atopic dermatitis (AD) is a chronic pediatric skin disease characterized by pruritus, eczematous lesions, and xerosis, and is often complicated by infections of different etiopathology. This study analyzed the most frequent viral skin infections in children with AD admitted to the dermatology department.

Material and methods: This retrospective single-center study enrolled 77 pediatric patients aged 1–18 years with a diagnosis of AD and coexisting viral skin infections caused by the *molluscum contagiosum* virus (MCV), *herpes simplex* virus (HSV), human papillomavirus (HPV), or enteroviruses. Patients were recruited over a five-year period, from January 2018 to December 2022. Collected data included age, sex, patient distribution by year and month, and treatment strategies.

Results: The cohort consisted of 36 males (46.8%) and 41 females (53.2%). Among the viral infections, those caused by MCV were the most prevalent, accounting for 49.4% of cases, while HPV infections were the least common, representing 9.1%. Although no statistically significant differences were found in the monthly distribution of infections, notable variations were observed between June and several other months. All patients with MCV infections underwent curettage. Only patients with HSV infections received systemic acyclovir therapy. Ten patients (13.0%) were treated with advanced therapies for AD, including cyclosporine, methotrexate, dupilumab, or phototherapy.

Conclusions: Viral skin infections are a clinically significant comorbidity in pediatric patients with AD, most commonly caused by the *molluscum contagiosum* virus. The highest incidence was observed in 2018, while the decline in 2019–2020 was likely influenced by the COVID-19 pandemic and related lockdown measures. Treatment strategies varied depending on the viral etiology, with MCV managed by curettage, while HSV was treated with systemic acyclovir. Eczema herpeticum was associated with a more severe disease course, emphasizing the need for early recognition and prompt antiviral therapy. These findings highlight the importance of individualized, etiology-driven management in pediatric patients with AD and viral skin infections.

KEY WORDS:

human papillomavirus, herpes simplex virus, enterovirus, viral skin infections, molluscum contagiosum virus.

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INTRODUCTION

Atopic dermatitis (AD, also known as atopic eczema) is one of the most important dermatological conditions in children. Affecting up to 20% of the general pediatric population [1], this chronic inflammatory skin disease is mainly characterized by erythematous lesions with pruritus, often associated with xerosis (dry skin) [2].

The diagnosis is primarily clinical, based on the diagnostic criteria proposed by Hanifin and Rajka, which include four major criteria (typical morphology and distribution, pruritus, chronic or chronically relapsing dermatitis, and a personal or family history of atopy) and more than 20 minor criteria. To establish the diagnosis of AD, a patient must present with at least three major and three minor criteria [3]. Other diagnostic frameworks include the Guidelines of care for the management of atopic dermatitis by the American Academy of Dermatology [4]. The UK Working Party criteria [5] and the Japanese guidelines [6] are more applicable in infants, as they account for age-specific morphology and shorter disease duration. However, these criteria are primarily intended for research purposes and are less frequently used in routine clinical practice. The typical onset of AD occurs in early childhood [7]. One of the most significant and common complications of AD are cutaneous infections, which result from impaired epidermal barrier function, cutaneous dysbiosis, and chronic inflammation. Although bacterial infections – most often caused by *Staphylococcus aureus* and presenting with honey-colored crusts – are the most frequently reported, it is important to differentiate them from lesions of viral origin [8]. The clinical manifestations of viral skin infections in AD usually appear as mild forms: verruca vulgaris (known as common warts) caused by human papillomavirus (HPV); characteristic pinkish nodules due to *molluscum contagiosum* virus (MCV); and eczema coxsackium, which often coexists with hand-foot-and-mouth disease caused by enteroviruses [1]. However, life-threatening complications such as eczema herpeticum (EH), caused by *herpes simplex* virus (HSV), can also occur. The risk of developing this dermatological emergency is higher in patients with untreated AD [9]. A major challenge in diagnosing skin infections in AD is that viral lesions do not always clearly indicate their etiology. As they may mimic bacterial infections, unnecessary topical or systemic antibiotics are sometimes prescribed. The aim of our study was to analyze the most frequent viral skin infections in children with AD hospitalized in the dermatology department in order to increase awareness of their viral etiology and to help prevent the unnecessary use of antibiotics.

MATERIAL AND METHODS

This retrospective single-center study was conducted to assess the prevalence and clinical features of selected viral skin infections in pediatric patients with AD. We included in the study pediatric patients with AD and concomitant viral skin infections caused by one of the following viruses: MCV, HSV, HPV, or enteroviruses. The inclusion criteria encompassed patients aged 1–18 years with a confirmed diagnosis of AD, along with a clinically or laboratory-confirmed viral skin infection. In total, 77 pediatric patients were enrolled in the study. The study was conducted over a five-year period, from January 2018 to December 2022. Comprehensive demographic data were collected for each patient, including age, sex, and other relevant characteristics. Patients were classified into four distinct categories based on the etiological origin of their viral skin infections: those infected with MCV, HSV, HPV, and enteroviruses. Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 29.0. (IBM Corp. Released 2022. Armonk, NY, USA). Categorical data were presented as a total number of cases and as percentages of the total number of patients studied.

STATISTICAL ANALYSIS

One-way ANOVA was used to compare the variables in order to reveal differences between samples. Pearson's χ^2 test was used to test the relationships among variables. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

Between 2018 and 2022, the study included 77 children with AD and coexisting viral skin infections who were admitted to the dermatology department. Females accounted for 41 cases (53.2%), and males for 36 cases (46.8%). The mean age was 6.8 years (SD ±3.86). The youngest patient was 1 year old and the oldest was 17 years old. Characteristics of the study group are presented in Table 1.

The distribution of patients over the years revealed no statistically significant correlations (Figure 1). The highest number of hospitalizations occurred in 2018, while the lowest numbers were recorded in 2019 and 2020, likely due to the COVID-19 pandemic and the associated lockdown restrictions. There was no statistically significant difference in the total distribution between months (one-way ANOVA, $F(11.48) = 1.185$, $p = 0.32$), but statistically significant differences were observed between June and several other months (Figure 2).

Pediatric patients with AD were found to have infections caused by four distinct viral pathogens. The most prevalent infection was MCV, identified in 38 patients (49.4%). *Molluscum contagiosum* virus infections were characterized by typical dome-shaped, round, pinkish-purple skin lesions (Figure 3). The *herpes simplex* virus was diagnosed in 23 patients (29.9%), of whom 4 (5.2% of the total cohort) presented with EH, an atypical form characterized by vesicular lesions superimposed on eczematous skin, often leading to significant morbidity

TABLE 1. Demographic data and comorbidities of atopic dermatitis patients diagnosed with viral skin infections ($N = 77$)

Characteristics	
Sex, *n* (%)	
Male	36 (46.8)
Female	41 (53.2)
Age category (years), *n* (%)	
1–6 years	41 (53.2)
7–12 years	28 (36.4)
13–17 years	8 (10.4)
Mean age ± SD (years)	6.8 ±3.86
Comorbidities, *n* (%)	
Pollen allergy	6 (7.9)
Food allergy	5 (6.5)
House dust mite allergy	2 (2.6)
Asthma	3 (3.9)
Granuloma annulare	2 (2.6)
Allergic rhinitis	1 (1.3)
Celiac disease	1 (1.3)
Impetigo contagiosum	1 (1.3)
Alopecia areata	1 (1.3)

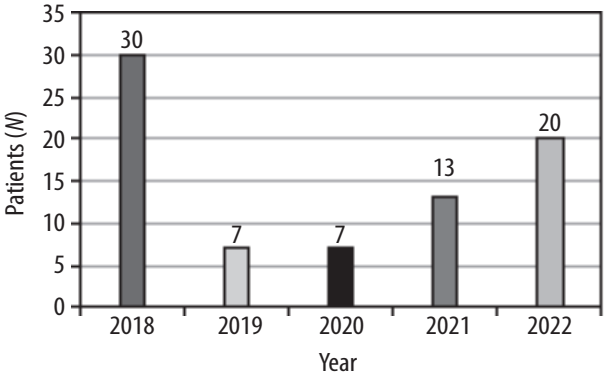

FIGURE 1. Number of atopic dermatitis cases with a viral infection over the years

The y-axis and the data labels of Figure 1 represent the total number of patients with the atopic dermatitis diagnosis and with at least one viral skin infection identified. There is no statistically significant correlation between years and number of cases (Pearson r = –0.227, p = 0.714, number of years = 5). It is noteworthy that there is a marked disproportion in the number of cases between the years (2018 – 30 cases; 2019–2020 – 7 cases each). This discrepancy is most likely related to the COVID-19 pandemic and the associated lockdown measures, which significantly limited exposure to other viral infections.

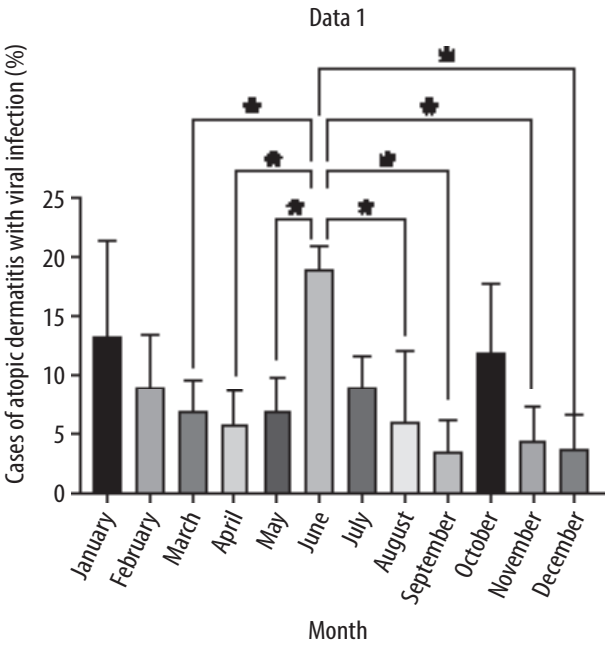

FIGURE 2. Distribution of the percentage of atopic dermatitis cases with viral infection over the calendar months

The y-axis represents the total percentage of cases of atopic dermatitis with viral coinfection. The data represent the means of the total yearly percentage ± standard error of the mean (SEM), averaged in 2018–2022. One-way ANOVA followed by post-hoc uncorrected Fisher's LSD analysis revealed that the percentage of AD cases in June was significantly higher than in March, April, May, August, September, November, and December ($p < 0.05$ (*), $p = 0.0497, 0.03, 0.046, 0.0332, 0.012, 0.0174,$ and 0.0139, respectively).

(Figure 4). Laboratory confirmation was performed for enterovirus infections by measuring IgM antibody levels. Enteroviruses were identified in 9 patients (11.7%) who presented with diffuse or localized papular and papular-erythematous lesions on the trunk and/or limbs. The mean IgM antibody level in this subgroup was 21.3 g/l, consistent with an acute or recent infection.

Human papillomavirus infection was detected in 7 patients (9.1%), characterized by typical cutaneous verrucae (Figure 5). Coinfections were identified in 3 patients (3.9%) based on the concurrent clinical presentation of lesions typical of more than one viral pathogen, with laboratory confirmation in the case of enteroviruses.

A total of 10 patients (13.0%) received advanced treatment for their AD. This included cyclosporine in 6 patients (7.9%), methotrexate in 1 patient (1.3%), and dupilumab in 1 patient (1.3%). 2 patients (2.6%) received phototherapy.

Treatment strategies were tailored according to viral etiology. All patients with MCV infection ($n = 38$, 100%) were managed with curettage. *Herpes simplex* virus-positive patients received systemic acyclovir: intravenously in 5 cases and orally in 1 case.

Antibiotics were prescribed in 6 cases (7.9%), predominantly due to the presence of incidental staphylococcal skin infections, which were effectively treated with oral ceftriaxone or clarithromycin. One patient (1.3%) with concurrent impetigo contagiosum was treated with oral amoxicillin-clavulanic acid, underscoring the need for a comprehensive approach to managing secondary bacterial infections alongside viral skin infections in patients with AD.

DISCUSSION

Atopic dermatitis is a major dermatological concern in the pediatric population. The literature indicates a sex-related discrepancy in the incidence of AD, with

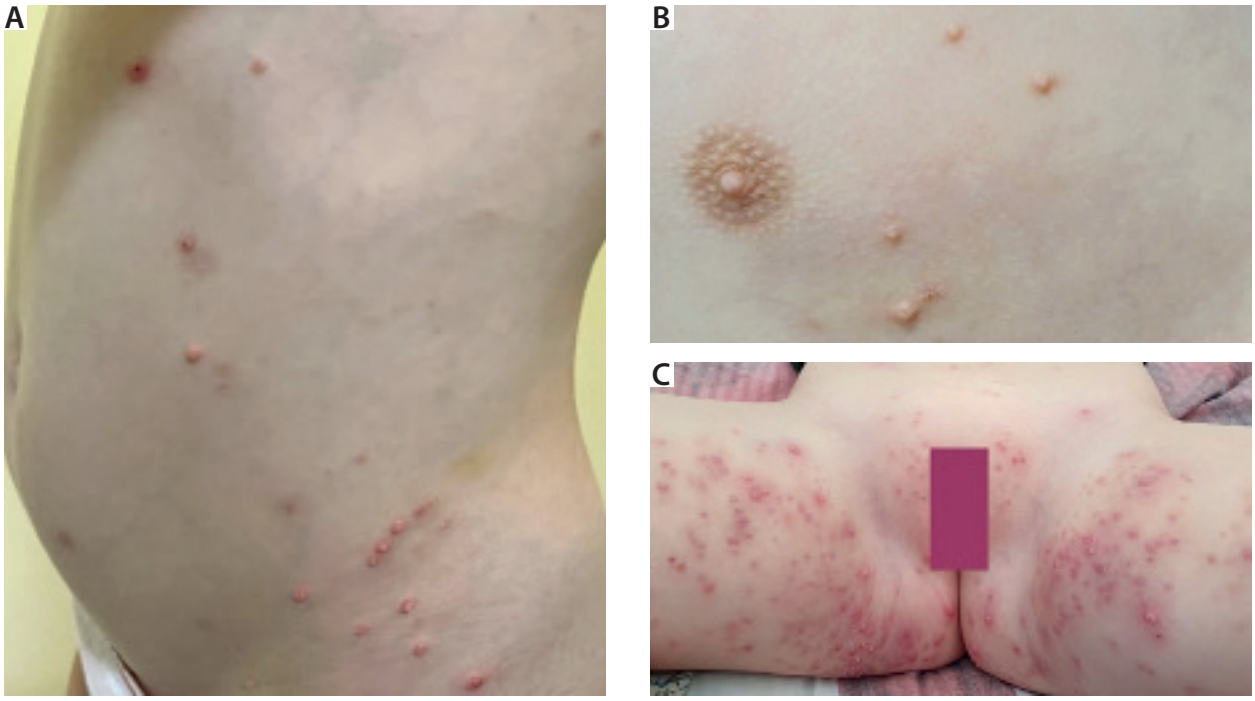

FIGURE 3. Clinical presentation of *molluscum contagiosum* virus infection showing dome-shaped, round, pinkish-purple skin lesions (**A, B**) and molluscum dermatitis (**C**)

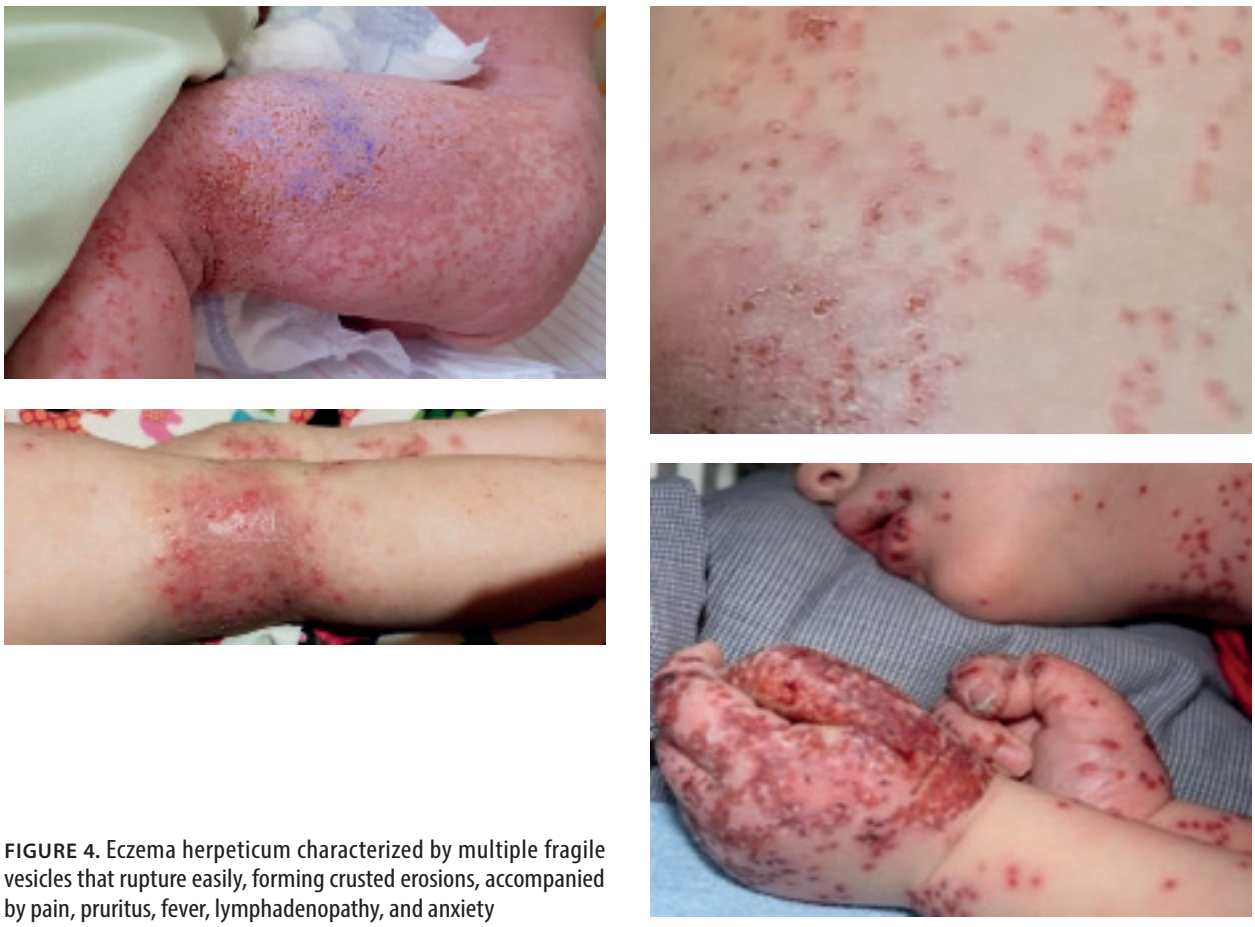

FIGURE 4. Eczema herpeticum characterized by multiple fragile vesicles that rupture easily, forming crusted erosions, accompanied by pain, pruritus, fever, lymphadenopathy, and anxiety

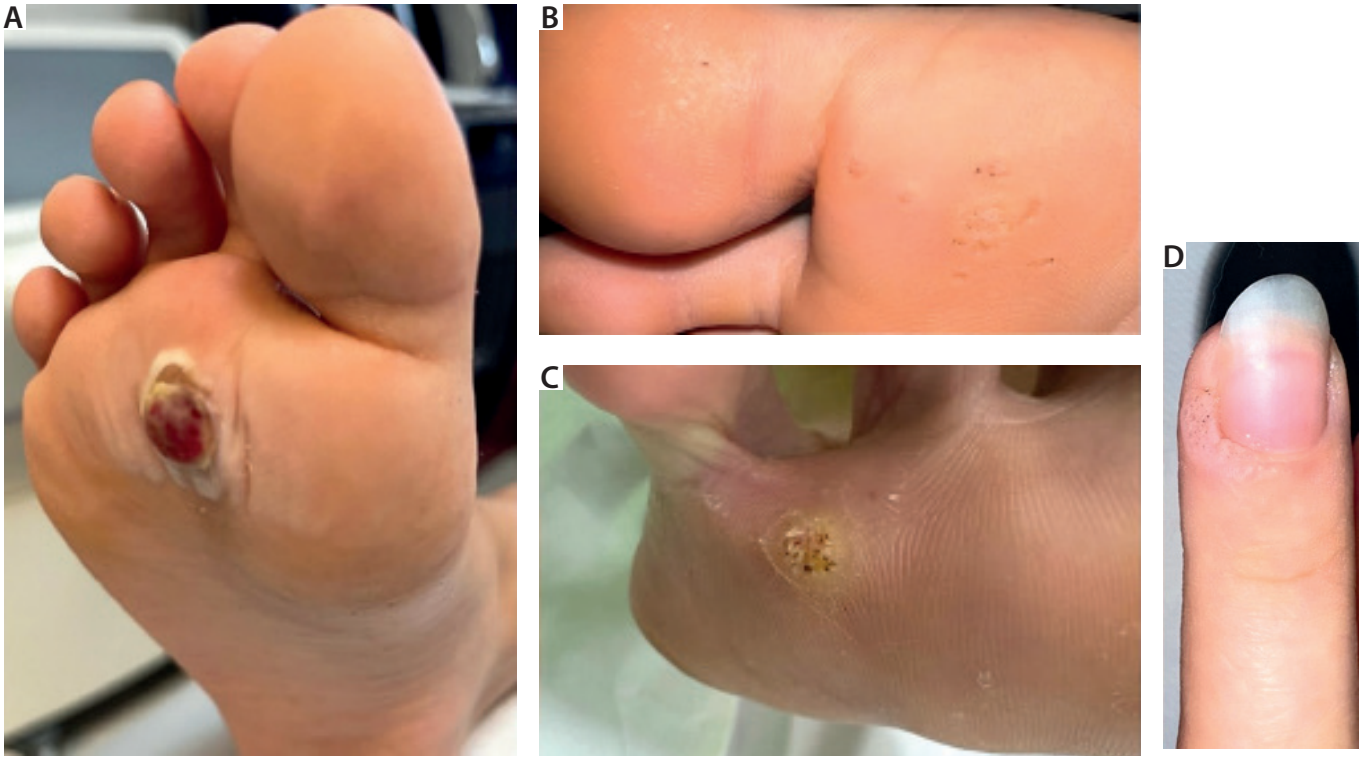

FIGURE 5. Cutaneous verrucae caused by human papillomavirus infection on the foot (**A–C**) and finger (**D**)

a higher prevalence observed among males during early childhood [10]. In contrast, females are more frequently affected during adolescence and adulthood [11]. In our study, a slight predominance of females over males was observed. The largest proportion of patients belonged to the youngest age group (1–6 years), consistent with the well-established tendency of AD to primarily affect younger children. However, it is important to note that AD can persist or even newly develop in older pediatric patients [12].

Atopic dermatitis has been classified into two clinical variants – summer and winter types [13]. A pilot study by Zhang *et al.* [14] suggested that patients with AD born in summer experience greater disease severity and pruritus during the summer months. Previous studies have corroborated that medical consultations for AD peak during summer, particularly in July and August [2]. In our study, a statistically significant increase in hospitalizations was observed in June compared with other months. This finding may reflect seasonal exacerbations of AD, which in turn could contribute to a higher incidence of viral skin infections among affected patients.

Pediatric patients with AD are particularly susceptible to cutaneous infections [15]. Although bacterial infections are more common in this group [16], viral etiologies remain an important differential consideration. Our study characterized four viral skin infections occurring in pediatric patients with AD.

Molluscum contagiosum, caused by the MCV, is a highly contagious poxvirus infection that frequently affects children [17]. *Molluscum contagiosum* virus infection typically presents as benign, dome-shaped papules, transmitted through direct contact or autoinoculation. Diagnosis is primarily clinical, and treatment is often pursued for cosmetic or preventive reasons, especially to reduce transmission within families. A frequent complication is molluscum dermatitis, which presents as pruritic eczematous inflammation adjacent to molluscum contagiosum lesions [1].

Atopic dermatitis is a recognized risk factor for MCV infection, with studies reporting a high prevalence of AD among affected children. These patients tend to develop more extensive eruptions and more pronounced inflammatory reactions due to impaired skin barrier function and altered immune responses, although findings across studies remain partially inconsistent. Management should be individualized, and referral to a pediatric dermatologist – potentially with dermoscopic evaluation – is advisable in uncertain cases [18]. Curettage remains the most widely used treatment, providing high satisfaction rates [19]. Alternative therapies such as cryotherapy, topical trichloroacetic acid, or laser ablation may also be considered, though they are generally not first-line approaches.

Human papillomavirus infection is another common viral condition, responsible for cutaneous verrucae (common warts), particularly on the soles of the feet [20]. Although HPV affects approximately 10% of the general population [21, 22], it was the least frequently identified viral infection in our cohort – likely because such cases are typically managed in outpatient settings rather than requiring hospitalization. Diagnosis is clinical, and as spontaneous regression frequently occurs, treatment de-

cisions should be individualized [23]. First-line therapies include cryotherapy and topical salicylic acid; however, these may be difficult to tolerate in children due to pain or blister formation. Alternative options, such as topical 5% imiquimod or monochloroacetic acid for plantar warts, may be used in selected pediatric patients [22].

Enterovirus infections most commonly manifest as hand-foot-mouth disease, characterized by oral enanthema and papulovesicular eruptions on the hands and feet, which usually resolve spontaneously within several days [24]. In certain cases – especially those associated with Coxsackievirus A6 or A16 – a more widespread presentation termed eczema coxsackium may develop. Although enteroviruses are highly contagious, eczema coxsackium is typically self-limited and not life-threatening, unlike EH [1]. Evidence regarding the relationship between AD and enterovirus infections remains conflicting and warrants further study [25–28].

Herpes simplex virus infections may present as localized lesions of the oral (HSV-1) or genital (HSV-2) regions or as disseminated eruptions. While most HSV infections are mild, EH represents a dermatological emergency requiring hospitalization. In our study, only a few HSV-positive patients developed EH, and all received systemic acyclovir, consistent with current treatment standards. Eczema herpeticum is characterized by a disseminated vesiculopustular eruption on an erythematous base, often evolving into erosions within 2–7 days. The diagnosis is primarily clinical, and distinguishing EH from eczema coxsackium is critical. Intravenous acyclovir is the first-line therapy, and immunosuppressive agents such as methotrexate should be withheld, while systemic corticosteroid doses should be reduced during active infection if feasible [29]. None of the patients in our cohort were receiving systemic therapy for AD at the time of infection; thus, treatment modification was not required. Bacterial superinfection, most commonly due to Staphylococcus aureus, may complicate the clinical course of EH. Moran *et al.* [30] demonstrated an association between S. aureus skin infections and a prior history of EH, suggesting that minimizing bacterial colonization in AD patients may reduce EH risk.

The main strength of our study is that it draws attention to the occurrence of viral skin infections in pediatric patients with atopic dermatitis, which are often underrecognized in clinical practice. By analyzing real-world hospital data, we provide a comprehensive overview of the most common viral etiologies, their clinical features, and management strategies. Additionally, the inclusion of seasonal trends offers valuable epidemiological insight into potential triggers of disease exacerbation. Nevertheless, several limitations of this study should be acknowledged. First, the sample size was relatively small and limited to four primary viral etiologies. Second, the COVID-19 pandemic likely influenced the observed incidence of viral infections through reduced exposure and isolation measures. Finally, disease severity indices such as EASI or SCORAD, as well as data on AD duration, were not consistently recorded at the time of infection, precluding assessment of correlations between infection and disease activity. Future studies should incorporate standardized severity assessments during episodes of viral infection to allow for a more comprehensive understanding of these relationships.

CONCLUSIONS

Molluscum contagiosum was the most prevalent viral skin infection among pediatric patients with AD, with curettage serving as the mainstay of treatment. *Herpes simplex* virus infections, including severe cases of EH, required systemic antiviral therapy with acyclovir. Antibiotic therapy was administered only in cases complicated by bacterial coinfection, highlighting the importance of accurate etiologic diagnosis and individualized management. These findings emphasize the need for clinicians to maintain vigilance for viral pathogens in children with AD and to implement tailored therapeutic approaches accordingly.

DISCLOSURES

1. Institutional review board statement: Not applicable.
2. Assistance with the article: None.
3. Financial support and sponsorship: None.
4. Conflicts of interest: None.

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