Turkish Journal of Pediatric Disease

Original Article

The Impact of Human Parainfluenza Virus on Child Health: A Clinical Study

Furkan KALAYCI[1], Ece KARAKÖSE[1], Ayça ÇIRAK[1], Metin YİĞİT[1,2]

[1]Department of Child Health and Diseases, Ankara Bilkent City Hospital, Ankara, Türkiye
[2]Department of Child Health and Diseases, Yıldırım Beyazıt University, Ankara, Türkiye

ABSTRACT

Objective: This study aims to identify the clinical characteristics of Human Parainfluenza Virus (HPIV) infections in children, evaluate morbidity and mortality rates, and investigate the impact of chronic diseases on the course of these infections.

Material and Methods: The research was conducted retrospectively and cross-sectionally on children aged 0-18 who tested positive for HPIV in the respiratory viral panel at Ankara Bilkent City Hospital Children's Hospital between August 2019 and July 2023. Patients with multiple virus positivity were excluded from the study.

Results: The study included 160 patients, of whom 61.2% were male and 38.8% were female. The most common presenting symptoms were cough (66.3%) and fever (52.5%). Of the patients, 41.2% were treated as inpatients, and 19.6% received care in the intensive care unit. The need for invasive or noninvasive mechanical ventilation was observed in 10% of the patients. There was a statistically significant association between the presence of lung infiltration and chronic disease with hypoxia ($p < 0.001$).

Conclusion: While HPIV infections are generally mild, they can lead to significant morbidity and the need for intensive care in children with chronic diseases. These findings highlight the necessity for careful clinical evaluation and close monitoring of children with HPIV infections. The study's results may contribute to the management and treatment strategies for HPIV infections in the pediatric population.

Key Words: Child, Parainfluenza virus, Pneumonia, Upper respiratory tract infection

INTRODUCTION

Human Parainfluenza Virus (HPIV) is an enveloped, negative-sense, single-stranded RNA virus belonging to the Paramyxoviridae family (1). It was first isolated from children with croup in the late 1950s (2). Today, it has been shown to constitute a significant portion of lower respiratory tract infections in children (3).

HPIV infections typically present with symptoms of upper respiratory tract infections, including fever, cough, runny nose, and sore throat (4). However, HPIV can cause severe respiratory diseases in young children or those with comorbid conditions (5). It is reported as the second most common cause of respiratory tract infections in children under five years of age, after RSV viruses (5–7).

This study aimed to determine the clinical features, morbidity, and mortality of HPIV infections, with a particular focus on assessing the severity of outcomes in children with chronic diseases.

Conflict of Interest : On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethics Committee Approval : This study was conducted in accordance with the Helsinki Declaration Principles. The study was approved by Ankara Bilkent City Hospital, Ethics Committee No. 1 (24.04.2024/ 140).

Contribution of the Authors*: *KALAYCI F: Constructing the hypothesis or idea of research and/or article, Planning methodology to reach the conclusions, Taking responsibility in logical interpretation and conclusion of the results, Taking responsibility in necessary literature review for the study, Taking responsibility in the writing of the whole or important parts of the study. ***KARAKÖSE E:*** Taking responsibility in patient follow-up, collection of relevant biological materials, data management and reporting, execution of the experiments, Taking responsibility in necessary literature review for the study, Taking responsibility in the writing of the whole or important parts of the study. ***ÇIRAK A:*** Taking responsibility in patient follow-up, collection of relevant biological materials, data management and reporting, execution of the experiments, Taking responsibility in necessary literature review for the study, Taking responsibility in the writing of the whole or important parts of the study. ***YİĞİT M:*** Constructing the hypothesis or idea of research and/or article, Planning methodology to reach the conclusions, Organizing, supervising the course of progress and taking the responsibility of the research/study, Taking responsibility in logical interpretation and conclusion of the results, Taking responsibility in necessary literature review for the study, Taking responsibility in the writing of the whole or important parts of the study, Reviewing the article before submission scientifically besides spelling and grammar.

How to cite : Kalaycı F, Karaköse E, Çırak A and Yiğit M. The Impact of Human Parainfluenza Virus on Child Health: A Clinical Study. Turkish J Pediatr Dis. 2025;19(1):1-4.

0000-0002-6702-8206 : KALAYCI F
0009-0009-0729-4105 : KARAKÖSE E
0009-0007-8844-3322 : ÇIRAK A
0000-0003-3536-4456 : YİĞİT M

Correspondence Address:
Furkan KALAYCI
Department of Child Health and Diseases,
Ankara Bilkent City Hospital, Ankara, Türkiye
E-posta: drfurkankalayci@gmail.com

Received : 21.05.2024
Accepted : 24.06.2024
DOI: 10.12956/tchd.1487615

MATERIALS and METHODS

Our study was designed as a retrospective, cross-sectional analysis. It included all children aged 0-18 years who presented to Ankara Bilkent City Hospital's Children's Hospital between August 2019 and July 2023 and tested positive for HPIV on the respiratory viral panel. Patients with simultaneous positivity for other viruses were excluded from the study.

Respiratory pathogens were identified using a multiplex real-time PCR assay (Rotor-Gene Q, QIAGEN, Germantown, MD). The admission dates and seasons, presenting complaints, history of chronic diseases, laboratory values, lung infiltrations, hypoxia status, need for hospitalization, hospitalization settings (ward or intensive care), and requirements for mechanical ventilation (invasive or non-invasive) of patients who tested positive for HPIV were retrospectively reviewed. Patients with missing clinical or laboratory data were excluded.

The study population was divided into three groups based on the presence of chronic diseases. The first group comprised individuals with primary or secondary immunodeficiencies, the second included those with chronic lung diseases, and the third consisted of patients without respiratory-affecting chronic diseases or those free from any chronic conditions.

Statistical analyses were conducted using Statistical analyses were conducted using IBM Statistical Package for the Social Sciences, version 23.0 (SPSS Inc., Armonk, NY, IBM Corp., USA). The Kolmogorov-Smirnov test and histograms were used to assess the normality of numerical and continuous variables. Normally distributed numerical data were expressed as means and Standard Deviation (SD), while non-normally distributed data were presented as medians and Interquartile Range (IQR). Categorical variables were expressed as percentages (%) and counts (n). Continuous variables with normal distributions between two groups were compared using the Student's T-test, whereas the Mann-Whitney U test was employed for those not fitting a normal distribution. The Kruskal-Wallis test was used to analyze continuous variables from multiple groups without a normal distribution. Categorical variables were analyzed using Pearson's chi-square or Fisher's Exact Test. When comparing more than one group, p-values were adjusted using the Bonferroni correction. Multivariate logistic regression analysis was utilized to identify risk factors for severe illness outcomes. The significance level was set at $p < 0.050$.

RESULTS

A total of 160 patients were included in the study, with 38.8% (n=62) being female and 61.2% (n=98) male. The median age of the participants was 3 years (IQR: 1-5). Hospital admissions peaked during the spring, accounting for 34.4% (n=55) of the cases, with similar distributions across other seasons. The most commonly reported symptoms were cough (66.3%) and fever (52.5%). Upon admission, 22.5% (n=36) of the patients had low oxygen saturation. Of the patients, 41.2% (n=66) required hospitalization, with 19.6% (n=13) of these treated in the intensive care unit. Mechanical ventilation or high-flow nasal cannula (HFNC) support was necessary for 10% (n=16) of the patients: four required intubation, seven used non-invasive mechanical ventilation, and five received HFNC treatment.

The study participants were categorized into three groups based on the presence of chronic diseases. The first group, consisting of patients with primary or secondary immunodeficiencies, made up 15% (n=24) of the study population; the second group, including those with chronic lung diseases, accounted for 15.6% (n=25); the third group, comprising individuals without respiratory-affecting chronic diseases or without any chronic conditions, represented 69.4% (n=111). Lung infiltration was observed in 33.1% (n=53) of the patients. Statistical analysis showed significant associations between both chronic diseases and lung infiltration with hypoxia ($p<0.001$ for both), and with the need for mechanical ventilation ($p<0.001$ for both).

Factors influencing hypoxia included fever (OR=0.257, 95% CI 0.76-0.87, p=0.029), cough (OR= 7.66, 95% CI 1.32-44.22, p=0.023), lung infiltration (OR= 0.12, 95% CI 0.03-0.48, p=0.003), and the presence of chronic diseases (OR= 0.27, 95% CI 0.08-0.9, p=0.033).

Blood tests were conducted on 54% (n=87) of the patients, revealing leukopenia in 3% (n=5) and leukocytosis in 13% (n=22). C-reactive protein (CRP) levels were positive in 20% (n=18) and negative in 80% (n=69) of the cases. Three patients died from complications associated with HPIV; two of these had immunodeficiency, and one had chronic lung disease.

DISCUSSION

HPIV infections typically present with mild symptoms in children; however, the presence of chronic diseases can significantly increase morbidity and mortality. Our study aimed to delineate the clinical features of HPIV infections and identify factors that contribute to a poorer prognosis. The insights gained provide valuable guidance for managing and treating the disease in pediatric patients.

HPIV infections are predominantly observed in the spring and late winter seasons (8,9). Our findings align with general patterns described in the literature, where PIV-3 infections often reach epidemic levels in the summer, while other subtypes peak from autumn to spring (10). PIV-4 infections are more frequent in late summer and autumn (11,12). The reasons for these seasonal variations in subtypes are not fully understood but may relate to regional rainfall patterns, possibly influencing the genetic structure of the viruses (10). Since our study did not differentiate between subtypes, we cannot comment on specific subtype-related outcomes.

In both children and adults, chronic diseases such as immunodeficiency, chronic lung disease, and heart failure are associated with more severe HPIV infections (13,14).

Studies have reported severe pneumonia in children with severe combined immunodeficiency syndrome (SCID) and the progression from upper respiratory infections to pneumonia and respiratory failure in transplant patients (15,16). Our study corroborates these findings, demonstrating a significant association between chronic diseases and increased needs for hypoxia management and ventilatory support. It is crucial to rigorously assess children with chronic conditions, given their elevated risk for serious morbidity and mortality.

In a study on hospitalized patients diagnosed with HPIV infection, cough was the most common reason for admission, affecting 82.2% of cases (17). Another study reported that fever was the most frequent cause of emergency admissions, followed by cough (18). Swamy et al. (16) noted that cough was present in all patient admissions. These findings indicate that fever and cough are the most common symptoms. Similarly, our study found that fever and cough were the most prevalent symptoms. The variation in results across different studies may be due to the differing priorities of symptoms that prompt different populations to seek hospital care. Moreover, the absence of prominent symptoms in the early stages of infection could result in a lower reported frequency of fever.

Lower respiratory tract infections are frequently associated with HPIV infections. In a study involving 743 patients, of whom 69 were diagnosed with HPIV, the incidence of lung infiltration was reported to be 15.94% (n=11) (19). Another study observed that 9.6% (n=21) of patients exhibited lung infiltration, 7.7% (n=17) required admission to the intensive care unit, and 3.2% (n=7) needed mechanical ventilation (20). Similar rates were observed in our study. It is recommended that chest radiography be performed in selected children diagnosed with HPIV, as those showing lung infiltration on chest radiographs may require intensive care admission and respiratory support.

CONCLUSION

While HPIV infections are commonly associated with croup, they can also lead to severe lower respiratory tract infections. Hospitalized patients may necessitate intensive care and mechanical ventilation, either invasive or non-invasive. The presence of chronic diseases and lung infiltrations adversely affects patient prognosis. Therefore, careful monitoring is imperative for children with HPIV infection presenting with fever and cough, especially those with radiographic evidence of lung infiltration or a history of chronic illness, as they may develop a need for intensive care or mechanical ventilation during their illness course.

Limitations:

The main limitations of our study include its single-center, retrospective design. Factors such as access to healthcare facilities, particularly in rural areas, and delays in seeking care due to socioeconomic reasons could significantly influence the clinical course observed. Multi-center and prospective studies are essential to obtain a more comprehensive understanding of HPIV infections and their outcomes.

REFERENCES

1. Branche AR, Falsey AR. Respiratory Viral Infections: Parainfluenza Virus Infection. Semin Respir Crit Care Med 2016;37:538-54.
2. Henrickson KJ. Parainfluenza Viruses. Clin Microbiol Rev 2003;16:242.
3. Calvo C, García-García ML, Ambrona P, Rico M, Pozo F, Del Mar Molinero M, et al. The burden of infections by parainfluenza virus in hospitalized children in Spain. Pediatr Infect Dis J 2011;30:792–4.
4. Chemaly RF, Hanmod SS, Rathod DB, Ghantoji SS, Jiang Y, Doshi A, et al. The characteristics and outcomes of parainfluenza virus infections in 200 patients with leukemia or recipients of hematopoietic stem cell transplantation. Blood 2012;119:2738–45.
5. Sato M, Wright PF. Current status of vaccines for parainfluenza virus infections. Pediatr Infect Dis J 2008;27: S123-5.
6. Wolf DG, Greenberg D, Kalkstein D, Shemer-Avni Y, Givon-Lavi N, Saleh N, et al. Comparison of human metapneumovirus, respiratory syncytial virus and influenza A virus lower respiratory tract infections in hospitalized young children. Pediatr Infect Dis J 2006;25:320–4.
7. Weinberg GA. Parainfluenza viruses: an underappreciated cause of pediatric respiratory morbidity. Pediatr Infect Dis J 2006;25:447–8.
8. Howard LM, Edwards KM, Zhu Y, Williams DJ, Self WH, Jain S, et al. Parainfluenza Virus Types 1–3 Infections Among Children and Adults Hospitalized With Community-acquired Pneumonia. Clin Infect Dis 2021;73:e4433.
9. Neumann G, Kawaoka Y. Seasonality of influenza and other respiratory viruses. EMBO Mol Med 2022;14: e15352.
10. Fé MMM, Monteiro AJ, Moura FEA. Parainfluenza virus infections in a tropical city: clinical and epidemiological aspects. Braz J Infect Dis 2008;12:192–7.
11. Maykowski P, Smithgall M, Zachariah P, Oberhardt M, Vargas C, Reed C, et al. Seasonality and clinical impact of human parainfluenza viruses. Influenza Other Respir Viruses 2018;12:706-16.
12. Wu W, Tang YW. Emerging Molecular Assays for Detection and Characterization of Respiratory Viruses. Clin Lab Med 2009;29:673-93.
13. Russell E, Ison MG. Parainfluenza Virus in the Hospitalized Adult. Clin Infect Dis 2017;65:1570–6.
14. Alimi Y, Lim WS, Lansbury L, Leonardi-Bee J, Nguyen-Van-Tam JS. Systematic review of respiratory viral pathogens identified in adults with community-acquired pneumonia in Europe. J Clin Virol 2017;95:26-35.
15. Jarvis WR, Middleton PJ, Gelfand EW. Parainfluenza pneumonia in severe combined immunodeficiency disease. J Pediatr 1979;94:423–5.
16. Apalsch AM, Green M, Ledesma-Medina J, Nour B, Wald ER. Parainfluenza and influenza virus infections in pediatric organ transplant recipients. Clin Infect Dis 1995;20:394–9.
17. Pecchini R, Berezin EN, Souza MC, de Andrade Vaz-de-Lima L, Sato N, Salgado M, et al. Parainfluenza virus as a cause of acute respiratory infection in hospitalized children. Braz J Infect Dis 2015;19:358-62.

18. Vega-Briceño LE, Pulgar BD, Potin SM, Ferres GM, Sánchez DI. Clinical and epidemiological manifestations of parainfluenza infection in hospitalized children. Rev Chilena Infectol 2007;24:377–83.
19. Swamy MA, Malhotra B, Reddy PVJ, Kumar N, Tiwari JK, Gupta ML. Distribution and Trends of Human Parainfluenza Viruses in Hospitalised Children. Indian J Pediatr 2016;83:1109-13.
20. Howard LM, Rankin DA, Spieker AJ, Gu W, Haddadin Z, Probst V, et al. Clinical features of parainfluenza infections among young children hospitalized for acute respiratory illness in Amman, Jordan. BMC Infect Dis 2021;21:323.