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Original Article

Severe Human Rhinovirus Lower Respiratory Tract Infections in Young Children

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ABSTRACT

Purpose: Human rhinovirus (HRV) infections can result in lower respiratory tract infections (LRTIs). We aimed to investigate the characteristics of severe HRV LRTI in young children.
Methods: Medical records were reviewed retrospectively in patients who were hospitalized for HRV LRTIs from 2016 to 2020 at the Samsung Medical Center in Seoul, Korea. Patients aged 90 days or older and younger than 5 years were included. Patients with co-infections with other respiratory pathogens were excluded. Severe HRV LRTI was defined as the following: the need for high-flow oxygenation, mechanical ventilation, or intensive care unit admission.
Results: A total of 115 cases were identified. The median age was 17 months (range, 3–56 months) and the median hospital days were 4 days (range, 2–31 days). Of the 115 cases, 18 patients (15.7%) developed severe HRV LRTI. The median age was younger in the severe group compared to the non-severe group (9.5 months vs. 19.0 months, P=0.001). Of 18 patients with severe HRV LRTI, 11 (61.1%) had underlying diseases – chronic lung diseases accounted for the largest proportion (63.6%). Six patients (33.3%) required mechanical ventilation. Of note, 7 previously healthy children were diagnosed with severe HRV LRTI. Of those 7 children, 4 of them were diagnosed with asthma later. When the 115 cases were divided into previously healthy (n=60) and underlying disease (n=55) groups, severe courses of HRV LRTI were observed in 11.7% and 20.0% of children, respectively (P=0.219).
Conclusions: HRV can cause severe LRTI even in previously healthy children as well as in children with comorbidities.

Keywords: Rhinovirus; Child; Respiratory tract infection; Intensive care units

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No potential conflict of interest relevant to this article was reported.

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INTRODUCTION

Human rhinovirus (HRV) is a small, non-enveloped 7.2-kb single-stranded positive-sense RNA virus that belongs to the family *Picornaviridae*, genus *Enterovirus*.[1] HRV is the most common pathogen causing respiratory virus infections (more than 50%) in both adult and children populations, and frequently causes otitis media and sinusitis.[2-4] HRV is further divided into 3 species as HRV-A, HRV-B, and HRV-C with more than 150 subtypes.[5] Due to its various subtypes, HRV can cause recurrent infections.[6]

Although most common, HRV has been neglected for several decades since it was considered to have low virulence and only caused upper respiratory tract infections. However, studies have reported that HRV infections are the cause of asthma exacerbation, chronic bronchitis, and serious lower respiratory tract infections (LRTIs), potentially requiring pediatric intensive care unit (PICU) admission.[4,7,12]

HRV is detected throughout the year but is more frequently observed in the spring and autumn seasons.[13] During the first 2 years of the coronavirus disease 2019 pandemic with strict social distancing, most of the respiratory viruses with distinct seasonality such as influenza and respiratory syncytial virus (RSV) disappeared in the community.[14,15] However, HRV continued to circulate and has become almost the only respiratory virus during this time.[16] The steady detection of HRV in social distancing settings has further highlighted its clinical significance.

There are abundant studies on respiratory viruses such as influenza, RSV, and adenovirus that are well-known to cause serious infections. However, few studies have focused on severe LRTIs caused by HRV in young children.[17] In this study, we analyzed the data on hospitalized pediatric patients due to HRV LTRIs to compare the groups depending on severity, multiple hospitalizations, and follow-up data in certain patients.

MATERIALS AND METHODS

This is a retrospective study that included pediatric patients aged 90 days (3 months) or older and younger than 60 months who were hospitalized for LRTIs with confirmed HRV infections from January 2016 to December 2020. Because detection of respiratory virus polymerase chain reaction (PCR) not always suggest respiratory infections, we intended to distinguish the true HRV LRTI from shedding or bystanders through inclusion and exclusion criteria.[18]

1. Inclusion criteria

Patients with HRV LRTI were identified as those who were admitted for respiratory symptoms and diagnosed with acute bronchitis (J20.9, J20.6), acute bronchiolitis (J21.9, J21.88), or pneumonia (J18.9, J12.9) by International Classification of disease-10 (ICD-10) with the confirmed nasopharyngeal HRV by multiplex respiratory virus PCR (AdvancSur™, LG Chem, Seoul, Korea). If a patient was re-admitted for HRV LRTI with new respiratory symptoms and showed a positive HRV PCR test that was performed 21 days or more apart from the previous test, it was considered as a separate HRV LRTI admission, and counted as multiple hospitalization.[1]

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2. Exclusion criteria

Co-infection cases with other respiratory pathogens (virus or bacteria) were excluded. Co-infection was defined as positive for HRV by PCR and positive for at least one other respiratory pathogen by nucleic acid amplification tests, cultures, or serology tests. For *Mycoplasma pneumoniae* antibodies, patients with a single titer of 1:640 or higher, or a subsequent 4-fold increase were considered to have a positive result.[19] HRV detection after 48 hours of hospitalization were excluded considering nosocomial infection. Pediatric cancer patients, who had C00-D49 code of ICD-10, were also excluded.

Patients who were admitted to the PICU or received high-flow oxygenation therapy at the general ward were classified into the severe group. The remaining patients were grouped into the non-severe group. Information for clinical manifestations and outcomes was obtained by medical records. Comparisons between groups were made using the chi square test or Fisher's exact test, using STATA (Statacorp LLC, College Station, TX, USA) and GraphPad Prism 10 (GraphPad Software, San Diego, CA, USA). The diagnosis of asthma was based on clinical diagnosis by pulmonologists and allergists. This study was approved by the Samsung Medical Center Institutional Review Board (SMC 2022-04-067).

RESULTS

1. Patient characteristics

A total of 115 episodes of HRV LRTI hospitalization in 102 patients were identified. The median age at admission was 17 months (range, 3–56 months), 67.0% of the patients (77/115) were male, and patients who had underlying diseases accounted for 47.8% (55/115) of the episodes. The median hospital stay was 4 days (range, 2–31 days).

Among the 115 episodes, 18 episodes (15.7%) were classified into the severe group. **Table 1** shows the clinical characteristics of the severe and non-severe groups. The median age of the severe group was younger than the age of the non-severe group (9.5 vs. 19.0 months, P=0.001). Patients in the severe group underwent longer hospital stays compared to the non-severe group (8.5 days vs. 4 days, P<0.001). There was no difference in the proportion of the male gender (77.8% vs. 64.9%, P=0.415) or underlying diseases (61.1% vs. 45.4%, P=0.219) between the 2 groups.

2. Age distribution and severity

The age distribution of the patients was further examined in **Fig. 1**. Among the 115 episodes, two-thirds (80/115) of the patients were younger than 24 months of age. The proportion for

Table 1. Characteristics of the patients with severe or non-severe courses of human rhinovirus lower respiratory tract infections in young children

Variables	Total	Non-severe	Severe	*P*-value*
Admission	115 (100)	97 (84.3)	18 (15.7)	
Age (mon)	17 (3–56)	19.0 (3–56)	9.5 (4–32)	0.001
Male sex	67.0 (77/115)	65.0 (63/97)	77.8 (14/18)	0.415
Hospital day	4 (2–31)	4 (2–31)	8.5 (4–20)	<0.001
Underlying disease,† % (No.)	47.8 (55/115)	45.4 (44/97)	61.1 (11/18)	0.219

Values are presented as number (%) or (range) unless otherwise indicated.
*Between the non-severe group and severe group.
†Underlying disease: chronic lung disease, asthma, tracheolaryngomalacia, cardiac anomaly, neurologic disorder, syndromic disease or anomaly.

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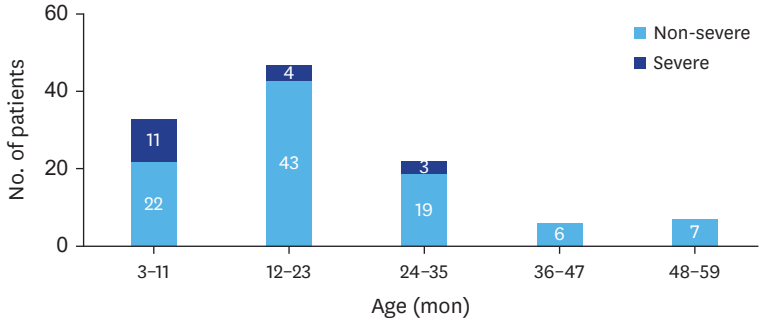

Fig. 1. Age distribution of the hospitalized children with human rhinovirus lower respiratory tract infection. Two-thirds of the hospitalized patients were under 24 months of age with increased rates of severe courses in the younger age group.

the severe group was higher in patients younger than 12 months of age compared to those 12 months or older (33.3% [11/33] vs. 8.4% [7/82], P<0.001). In children 36 months or older, none of them were classified in the severe group.

3. Underlying diseases and severity

Further analysis of groups with or without underlying disease is shown in **Fig. 2**. Among the 115 episodes, 55 episodes (47.8%) occurred in patients with underlying diseases. The proportion of severe courses was 11.7% (7/60) for previously healthy children and 20% (11/55) for patients with comorbidities. However, this finding was not statistically significant (P=0.219).

Among patients who were previously healthy, 5 patients were diagnosed with asthma later (after discharge from HRV LRTI). The median age of asthma diagnosis was 25 months (range, 14–34 months) and the median time interval from the HRV LRTI to asthma diagnosis was one month (range, 0.2–15 months).

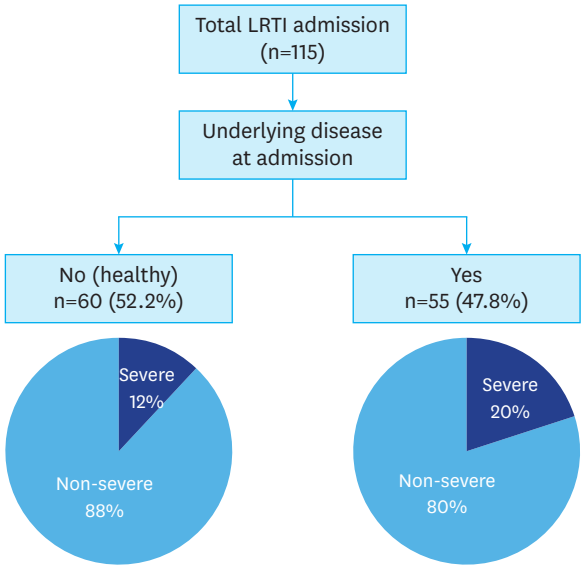

Fig. 2. Clinical course of HRV LRTI in patients with or without underlying diseases. More than 10% of HRV LRTI hospitalization led to severe courses, even in healthy children.
Abbreviations: LRTI, lower respiratory tract infection; HRV, human rhinovirus.

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4. Multiple hospitalizations and severity

Ten patients were hospitalized twice or more for HRV LRTI, with a median interval of 251 days (range, 21–497 days) between admissions. When these 10 patients were compared with the 93 patients who were hospitalized only once, the patients with multiple hospitalizations experienced a higher rate of severe courses (50.0% [5/10] vs. 14.1% [13/92], P=0.0142). All cases of severe courses occurred during the patients' initial admission for HRV LRTI. Among the patients with multiple hospitalizations, 6 had underlying diseases, 5 of which were chronic lung diseases. Four patients did not exhibit an underlying disease at the time of hospitalization, but 3 of them (75%) were diagnosed with asthma later during the follow-up period.

5. Patients with severe courses

Out of the 115 hospitalizations, 18 patients (15.7%) with severe courses were further analyzed with findings shown in **Table 2**. Fifteen patients received PICU care, while 3 patients received high-flow oxygenation therapy at the general ward. Six patients (33.3%, 6/18) required a mechanical ventilator with no fatal cases.

Among these 18 patients, 11 patients had comorbidities. Seven patients (7/11, 63.6%) had underlying chronic lung diseases, most commonly bronchopulmonary dysplasia or bronchiolitis obliterans. Of note, there were 4 patients (4/18, 22.2%) without any underlying diseases at the time of hospitalization but were later diagnosed with asthma.

DISCUSSION

In this study, among the children hospitalized due to HRV LRTIs, approximately 15% of the children exhibited severe clinical courses including PICU care or high-flow oxygenation therapy. None of the children 36 months or older developed a severe course. Although there was no statistical significance, the tendency for a higher rate of having underlying diseases was observed to be almost double in the severe group. It is noteworthy that even in healthy children with HRV LRTI, 11.7% of them had severe clinical courses.

Table 2. Characteristics of the patients in the severe group (n=18)

Severe (n=18)	No. (%)
Ward	
Cared at PICU	15 (83.3%)
Cared at GW with high flow oxygenation	3 (16.7%)
Respiratory support (highest setting)	
Mechanical ventilation	6 (33.3%)
High-flow oxygenation	10 (55.6%)
Oxygen	2 (11.1%)
Prognosis	
Improved	18 (100%)
Deceased	0 (0%)
Underlying disease	
No	7 (38.9%)
Yes	11 (61.1%)
Chronic lung (BPD, BO)	7 (63.6%)
Laryngomalacia	1 (9.1%)
Cardiac anomaly	1 (9.1%)
Others*	2 (18.2%)

Abbreviations: PICU, pediatric intensive care unit; GW, general ward; BPD, bronchopulmonary dysplasia; BO, bronchiolitis obliterans.
*Hypoxic ischemic encephalopathy, Treacher-Collins syndrome.

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Since the observation that experimental HRV infections could cause LRTI symptoms, HRV has also been regarded as a pathogen that could cause LRTI in humans.[20] In addition, with the availability of multiplex respiratory virus PCR, HRV has become more readily identified as a cause for LRTI.[21,22] Several studies have reported the clinical significance of HRV in adults, which reported that HRV infections in adults were associated with the exacerbation of underlying lung diseases and even mortality, especially in elderly patients.[23,24] Another study reported that in-hospital mortality was comparable to that of influenza in patients with malignancies, HIV, immunosuppressant therapy, and transplantation.[25] In addition, there have been several studies conducted on HRV LRTI in hematopoietic cell transplant (HCT) recipients and its negative impact on HCT outcomes including increased mortality.[26-28] In immunocompetent adults, cases of severe respiratory symptoms due to HRV infections have been reported.[29,30]

In children, HRV began to receive attention as a possible LRTI pathogen in the 1980s and 1990s.[17,20,31] In retrospective studies from the United States and Canada, hospitalization and emergency department visits of children resulting from HRV infections were reported, increasing awareness of HRV LRTI.[17,31,32] There have been also reports on HRV LRTI in immunocompetent children.[33,34] It has been shown that even previously healthy children can be hospitalized due to HRV LRTI. A study from the United States demonstrated that among patients who were hospitalized due to HRV-only LRTI, patients without comorbidities accounted for 54.2% of the study population.[3] Similarly, in our study, 52.2% of the hospitalized patients due to HRV LRTI had no history of any comorbidities. Previous studies reported that among the children without underlying diseases hospitalized due to HRV LRTI, a significant proportion of patients developed a severe disease course. A study conducted in Turkey reported that 32.6% of 46 HRV LRTI hospitalized children without underlying diseases received PICU care.[34] In our study, 11.7% of 60 patients without underlying diseases exhibited severe courses (cared in the PICU or received high-flow oxygenation therapy in the general ward). Although there is some difference in the proportion of the severe groups between the 2 studies, both studies demonstrated that a significant proportion of healthy children (11.7–32.6%) had progression to a severe course during HRV LRTI hospitalization.

A prospective study from the United States analyzed the HRV species and reported that HRV-A and HRV-C were associated with acute respiratory infection hospitalization and serious illness outcomes in children less than 5 years of age.[35] Another study from Australia for children admitted to the PICU for acute respiratory illnesses reported that HRV-C was the most common HRV species followed by HRV-A.[10] Our study is limited since we did not perform additional sequencing studies on the viruses.

HRV infections are a well-known cause of acute exacerbations in patients with asthma.[36] HRV-infected respiratory epithelium cells can promote the release of Th2 cytokines by Th2 cells and type 2 innate lymphoid cells.[37] HRV-C species have been reported to be most related to acute exacerbations of acute asthma.[38,39] HRV infections in asthma patients require more attention since acute asthma exacerbations can be life-threatening. Of note, in our study, 4 out of the 7 (57%) previously healthy children with severe courses of HRV LRTI were later diagnosed with asthma. Therefore, when patients without underlying diseases require respiratory support for HRV LRTI, careful follow-ups should be considered even after recovery. Additional investigations including checking the patient's and family members' medical histories and consulting with an allergist are needed.[7,11]

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Patients who were hospitalized multiple times for HRV LRTI may have been infected with different subtypes of the rhinovirus each time they were hospitalized.[40] In our study, 10 patients underwent multiple hospitalizations due to HRV LRTI and half of them experienced a severe course during hospitalization. It was noteworthy that 3 out of 4 patients (75%) underwent multiple hospitalizations for HRV LRTI without underlying diseases and developed asthma later. Therefore, close follow-ups and monitoring may be required when a healthy child is repeatedly admitted for HRV LRTI.

Our study has limitations. Due to the small sample size, statistical significance could not be demonstrated even though the proportion of patients with comorbidities was almost twice as high in the severe group compared to the non-severe group. It has been suggested that the clinical manifestations of HRV infections vary depending on the species.[6] However, because of the retrospective nature of the study, we did not perform the sequencing to analyze the viral factors.

In conclusion, although HRV is the most common and is well-known to cause mild upper respiratory symptoms, the potential of worsening clinical courses should be considered whenever children under 5 years of age are hospitalized for LRTIs.

REFERENCES

1. Greenberg SB. Respiratory consequences of rhinovirus infection. Arch Intern Med 2003;163:278-84.
PUBMED | CROSSREF
2. Vandini S, Biagi C, Fischer M, Lanari M. Impact of rhinovirus infections in children. Viruses 2019;11:521.
PUBMED | CROSSREF
3. Chu HY, Englund JA, Strelitz B, Lacombe K, Jones C, Follmer K, et al. Rhinovirus disease in children seeking care in a tertiary pediatric emergency department. J Pediatric Infect Dis Soc 2016;5:29-38.
PUBMED | CROSSREF
4. Peltola V, Jartti T, Putto-Laurila A, Mertsola J, Vainionpää R, Waris M, et al. Rhinovirus infections in children: a retrospective and prospective hospital-based study. J Med Virol 2009;81:1831-8.
PUBMED | CROSSREF
5. Stobart CC, Nosek JM, Moore ML. Rhinovirus biology, antigenic diversity, and advancements in the design of a human rhinovirus vaccine. Front Microbiol 2017;8:2412.
PUBMED | CROSSREF
6. Erkkola R, Turunen R, Räisänen K, Waris M, Vuorinen T, Laine M, et al. Rhinovirus C is associated with severe wheezing and febrile respiratory illness in young children. Pediatr Infect Dis J 2020;39:283-6.
PUBMED | CROSSREF
7. Ortega H, Nickle D, Carter L. Rhinovirus and asthma: challenges and opportunities. Rev Med Virol 2021;31:e2193.
PUBMED | CROSSREF
8. Ljubin-Sternak S, Meštrović T, Ivković-Jureković I, Kolarić B, Slović A, Forčić D, et al. The emerging role of rhinoviruses in lower respiratory tract infections in children - clinical and molecular epidemiological study from Croatia, 2017–2019. Front Microbiol 2019;10:2737.
PUBMED | CROSSREF
9. Hartiala M, Lahti E, Forsström V, Vuorinen T, Ruuskanen O, Peltola V. Characteristics of hospitalized rhinovirus-associated community-acquired pneumonia in children, Finland, 2003–2014. Front Med (Lausanne) 2019;6:235.
PUBMED | CROSSREF
10. Cox DW, Khoo SK, Zhang G, Lindsay K, Keil AD, Knight G, et al. Rhinovirus is the most common virus and rhinovirus-C is the most common species in paediatric intensive care respiratory admissions. Eur Respir J 2018;52:1800207.
PUBMED | CROSSREF

https://doi.org/10.14776/piv.2023.30.e17

11. Stone CA Jr, Miller EK. Understanding the association of human rhinovirus with asthma. Clin Vaccine Immunol 2015;23:6-10.
PUBMED | CROSSREF

12. Miller EK, Lu X, Erdman DD, Poehling KA, Zhu Y, Griffin MR, et al. Rhinovirus-associated hospitalizations in young children. J Infect Dis 2007;195:773-81.
PUBMED | CROSSREF

13. Moriyama M, Hugentobler WJ, Iwasaki A. Seasonality of respiratory viral infections. Annu Rev Virol 2020;7:83-101.
PUBMED | CROSSREF

14. Kim JH, Kim HY, Lee M, Ahn JG, Baek JY, Kim MY, et al. Respiratory syncytial virus outbreak without influenza in the second year of the coronavirus disease 2019 pandemic: a national sentinel surveillance in Korea, 2021–2022 season. J Korean Med Sci 2022;37:e258.
PUBMED | CROSSREF

15. Park JY, Kim HI, Kim JH, Park S, Hwang YI, Jang SH, et al. Changes in respiratory virus infection trends during the COVID-19 pandemic in South Korea: the effectiveness of public health measures. Korean J Intern Med 2021;36:1157-68.
PUBMED | CROSSREF

16. Takashita E, Kawakami C, Momoki T, Saikusa M, Shimizu K, Ozawa H, et al. Increased risk of rhinovirus infection in children during the coronavirus disease-19 pandemic. Influenza Other Respi Viruses 2021;15:488-94.
PUBMED | CROSSREF

17. Kim JO, Hodinka RL. Serious respiratory illness associated with rhinovirus infection in a pediatric population. Clin Diagn Virol 1998;10:57-65.
PUBMED | CROSSREF

18. Kuribayashi M, Otake S, Kamiyoshi N, Naito S, Yamamoto Y, Shirai K, et al. Clinical influence of multiplex polymerase chain reaction routine uses in urgent pediatric admissions. Pediatr Int 2023;65:e15525.
PUBMED | CROSSREF

19. Kim NH, Lee JA, Eun BW, Shin SH, Chung EH, Park KW, et al. Comparison of polymerase chain reaction and the indirect particle agglutination antibody test for the diagnosis of *Mycoplasma pneumoniae* pneumonia in children during two outbreaks. Pediatr Infect Dis J 2007;26:897-903.
PUBMED | CROSSREF

20. Halperin SA, Eggleston PA, Hendley JO, Suratt PM, Gröschel DH, Gwaltney JM Jr. Pathogenesis of lower respiratory tract symptoms in experimental rhinovirus infection. Am Rev Respir Dis 1983;128:806-10.
PUBMED

21. Gruteke P, Glas AS, Dierdorp M, Vreede WB, Pilon JW, Bruisten SM. Practical implementation of a multiplex PCR for acute respiratory tract infections in children. J Clin Microbiol 2004;42:5596-603.
PUBMED | CROSSREF

22. Kim SR, Ki CS, Lee NY. Rapid detection and identification of 12 respiratory viruses using a dual priming oligonucleotide system-based multiplex PCR assay. J Virol Methods 2009;156:111-6.
PUBMED | CROSSREF

23. Atmar RL. Uncommon(ly considered) manifestations of infection with rhinovirus, agent of the common cold. Clin Infect Dis 2005;41:266-7.
PUBMED | CROSSREF

24. Longtin J, Winter AL, Heng D, Marchand-Austin A, Eshaghi A, Patel S, et al. Severe human rhinovirus outbreak associated with fatalities in a long-term care facility in Ontario, Canada. J Am Geriatr Soc 2010;58:2036-8.
PUBMED | CROSSREF

25. Kraft CS, Jacob JT, Sears MH, Burd EM, Caliendo AM, Lyon GM. Severity of human rhinovirus infection in immunocompromised adults is similar to that of 2009 H1N1 influenza. J Clin Microbiol 2012;50:1061-3.
PUBMED | CROSSREF

26. Milano F, Campbell AP, Guthrie KA, Kuypers J, Englund JA, Corey L, et al. Human rhinovirus and coronavirus detection among allogeneic hematopoietic stem cell transplantation recipients. Blood 2010;115:2088-94.
PUBMED | CROSSREF

27. Seo S, Waghmare A, Scott EM, Xie H, Kuypers JM, Hackman RC, et al. Human rhinovirus detection in the lower respiratory tract of hematopoietic cell transplant recipients: association with mortality. Haematologica 2017;102:1120-30.
PUBMED | CROSSREF

28. Kim YJ, Waghmare A, Xie H, Holmberg L, Pergam SA, Jerome KR, et al. Respiratory viruses in hematopoietic cell transplant candidates: impact of preexisting lower tract disease on outcomes. Blood Adv 2022;6:5307-16.
PUBMED | CROSSREF

29. Kim K, Song YH, Park JH, Park HK, Kim SY, Jung H, et al. Rhinovirus associated severe respiratory failure in immunocompetent adult patient. Tuberc Respir Dis (Seoul) 2014;77:132-5.
PUBMED | CROSSREF

30. Ngu S, Pervaiz S, Avula A, Chalhoub M. Rhinovirus-induced rapidly progressing acute respiratory distress syndrome in an immunocompetent host. Cureus 2019;11:e3997.
PUBMED | CROSSREF

31. McMillan JA, Weiner LB, Higgins AM, Macknight K. Rhinovirus infection associated with serious illness among pediatric patients. Pediatr Infect Dis J 1993;12:321-5.
PUBMED | CROSSREF

32. Asner SA, Petrich A, Hamid JS, Mertz D, Richardson SE, Smieja M. Clinical severity of rhinovirus/enterovirus compared to other respiratory viruses in children. Influenza Other Respi Viruses 2014;8:436-42.
PUBMED | CROSSREF

33. Louie JK, Roy-Burman A, Guardia-Labar L, Boston EJ, Kiang D, Padilla T, et al. Rhinovirus associated with severe lower respiratory tract infections in children. Pediatr Infect Dis J 2009;28:337-9.
PUBMED | CROSSREF

34. Ekinci Sert S, Karagol C, Gungor A, Gulhan B. Comparison of clinical, demographic features, and costs in respiratory syncytial virus, rhinovirus, and viral co-infections in children hospitalized with viral infections of the lower respiratory tract. Jpn J Infect Dis 2022;75:164-8.
PUBMED | CROSSREF

35. Iwane MK, Prill MM, Lu X, Miller EK, Edwards KM, Hall CB, et al. Human rhinovirus species associated with hospitalizations for acute respiratory illness in young US children. J Infect Dis 2011;204:1702-10.
PUBMED | CROSSREF

36. Corne JM, Marshall C, Smith S, Schreiber J, Sanderson G, Holgate ST, et al. Frequency, severity, and duration of rhinovirus infections in asthmatic and non-asthmatic individuals: a longitudinal cohort study. Lancet 2002;359:831-4.
PUBMED | CROSSREF

37. Jackson DJ, Gern JE. Rhinovirus infections and their roles in asthma: etiology and exacerbations. J Allergy Clin Immunol Pract 2022;10:673-81.
PUBMED | CROSSREF

38. Su YT, Lin YT, Yang CC, Tsai SS, Wang JY, Huang YL, et al. High correlation between human rhinovirus type C and children with asthma exacerbations in Taiwan. J Microbiol Immunol Infect 2020;53:561-8.
PUBMED | CROSSREF

39. Rajput C, Han M, Ishikawa T, Lei J, Goldsmith AM, Jazaeri S, et al. Rhinovirus C infection induces type 2 innate lymphoid cell expansion and eosinophilic airway inflammation. Front Immunol 2021;12:649520.
PUBMED | CROSSREF

40. van der Zalm MM, Wilbrink B, van Ewijk BE, Overduin P, Wolfs TF, van der Ent CK. Highly frequent infections with human rhinovirus in healthy young children: a longitudinal cohort study. J Clin Virol 2011;52:317-20.
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요약

목적: 리노바이러스의 감염은 하기도 감염을 일으키기도 한다. 본 연구에서는 리노바이러스에 의한 중증 하기도 감염을 보이는 소아환자의 특성을 알아보고자 하였다.

방법: 2016년부터 2020년까지 삼성서울병원 소아청소년과에 리노바이러스 하기도감염으로 입원한 환자의 의무기록을 후향적으로 분석하였다. 입원 시 연령이 생후90일 이상, 5세 미만인 소아 환자를 대상으로 하였다. 다른 호흡기 병원체와의 동시 감염이 확인된 환자는 제외하였다. 리노바이러스에 의한 중증 하기도감염은 고유량 산소요법 치료가 필요한 경우, 기계 호흡이 필요한 경우 또는 중환자실 입원하는 경우로 정의하였다.

결과: 해당 기간 동안 총 115건의 리노바이러스 하기도 감염 입원이 확인되었다. 연령 중앙값은 17개월 (범위, 3–56개월)이었으며, 입원 일수 중앙값은 4일 (범위, 2–31일) 이었다. 115 건 중 18건의 입원 (15.7%)은 중증 리노바이러스 하기도 감염 그룹으로 분류되었다. 중증 경과 그룹 환자의 연령 중앙값은 그렇지 않은 그룹에 비해 연령 중앙값이 낮았다 (9.5 개월 vs. 19.0 개월, P=0.001). 18명의 중증 리노바이러스 하기도 감염 그룹 환자 중 11명 (61.1%)는 기저질환을 가지고 있었으며, 만성 폐질환이 가장 많은 비율을 차지하였다 (63.6%). 여섯 명의 환자는 (33.3%) 기계 호흡을 필요로 하였다. 일곱 명의 기저질환이 없는 환자도 중증 리노바이러스 하기도 감염 그룹에 포함되어 있었다. 이들 일곱 명의 환자 중 네 명은 추후에 천식으로 진단되었다. 115건의 입원을 기저질환이 없는 환자군 (n=60)과 기저질환이 있는 환자군 (n=55)으로 나누어 분석하였을 때, 리노바이러스에 의한 중증 하기도 감염을 보이는 비율은 각각 11.7% 와 20.0% 였다 (P=0.219).

결론: 리노바이러스 감염은 중증 하기도감염의 원인이 될 수 있으며, 기저질환자 뿐 아니라 건강한 소아에서도 중증 하기도감염을 일으킬 수 있다.

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