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VIRAL ETIOLOGY OF BRONCHITIS WITH BRONCHO-OBSTRUCTIVE SYNDROME IN CHILDREN: THE ROLE OF RSV AND RHINOVIRUS

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ABSTRACTS: Background: Broncho-obstructive syndrome (BOS), characterized by wheezing and airflow limitation, is a common complication of acute bronchitis in children. Respiratory Syncytial Virus (RSV) and Rhinovirus (RV) are the predominant etiological agents, yet their pathophysiological mechanisms and long-term prognostic implications differ significantly. Objective: This article aims to analyze the clinical and etiological relationship between BOS and specific viral pathogens (RSV and Rhinovirus) in pediatric patients and to evaluate their differential impact on disease severity and future asthma risk. Methods: A systematic review of studies published between 2019 and 2024 was conducted using PubMed and Scopus databases. The analysis focused on pediatric cohorts presenting with acute wheezing bronchitis, comparing viral prevalence, clinical phenotypes, and inflammatory markers associated with RSV and RV infections. Results: RSV is identified as the primary cause of BOS in infants under 12 months, driving obstruction via direct epithelial necrosis and mucus plugging. In contrast, Rhinovirus is more prevalent in children over 12 months and is strongly associated with atopic predispositions. Children with RV-induced BOS show a significantly higher risk of developing asthma compared to those with RSV-induced episodes. Conclusion: Differentiation between RSV and RV etiologies in BOS is clinically relevant. While RSV management focuses on supportive care for obstruction, RV-associated wheezing may warrant earlier targeted anti-inflammatory strategies and close monitoring for asthma development.

Keywords: Broncho-obstructive syndrome, acute bronchitis, children, RSV, Rhinovirus, wheezing, asthma.

BOLALARDA BRONXOOBSTRUKTIV SINDROM BILAN KECHUVCHI BRONXITNING VIRUSLI ETIOLOGIYASI: RSV VA RINOVIRUSNING O‘RNI.

ANNOTATSIYA: Kirish: Xushtaksimon nafas va havo oqimining cheklanishi bilan ifodalanadigan bronxoobstruktiv sindrom (BOS) bolalarda o‘tkir bronxitning keng tarqalgan asoratidir. Respirator-sinsitial virus (RSV) va Rinovirus (RV) asosiy etiologik omillar hisoblansa-da, ularning patofiziologik mexanizmlari va uzoq muddatli prognozlari bir-biridan sezilarli farq qiladi. Maqsad: Ushbu maqola bolalarda BOS va o‘ziga xos virusli patogenlar (RSV va Rinovirus) o‘rtasidagi klinik va etiologik bog‘liqlikni tahlil qilish hamda ularning kasallik og‘irligi va kelajakdagi astma xavfiga ta’sirini baholashga qaratilgan. Usullar: PubMed va Scopus bazalarida 2019–2024 yillarda chop etilgan tadqiqotlar tizimli tahlil qilindi. Tahlilda o‘tkir xushtaksimon bronxit bilan murojaat qilgan bolalar kogortalari o‘rganilib, RSV va RV infeksiyalari bilan bog‘liq virus tarqalishi, klinik fenotiplar va yallig‘lanish markerlari solishtirildi. Natijalar: RSV 12 oygacha bo‘lgan chaqaloqlarda BOSning asosiy sababchisi bo‘lib, to‘g‘ridan-to‘g‘ri epitelial nekroz va shilliq tiqilishi orqali obstruksiyani keltirib chiqaradi. Aksincha, Rinovirus 12 oydan katta bolalarda ko‘proq uchraydi va atopik moyillik bilan kuchli bog‘liqdir. RV chaqirgan BOS bilan og‘rigan bolalarda astma rivojlanish xavfi RSVga qaraganda ancha yuqori ekanligi aniqlandi. Xulosa: BOSda RSV va RV etiologiyasini farqlash klinik

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ahamiyatga ega. RSVni davolashda obstruksiyani bartaraf etishga qaratilgan simptomatik yondashuv ustunlik qilsa, RV bilan bog‘liq xushtaksimon nafasda erta yallig‘lanishga qarshi strategiyalar va astma rivojlanishini nazorat qilish talab etiladi.
Kalit so‘zlar: Bronxoobstruktiv sindrom, o‘tkir bronxit, bolalar, RSV, Rinovirus, xushtaksimon nafas, astma.

ВИРУСНАЯ ЭТИОЛОГИЯ БРОНХИТА С БРОНХООБСТРУКТИВНЫМ СИНДРОМОМ У ДЕТЕЙ: РОЛЬ РСВ И РИНОВИРУСА.

АННОТАЦИЯ: Введение: Бронхообструктивный синдром (БОС), характеризующийся свистящим дыханием и ограничением воздушного потока, является частым осложнением острого бронхита у детей. Респираторно-синцитиальный вирус (РСВ) и Риновирус (РВ) являются преобладающими этиологическими агентами, однако их патофизиологические механизмы и долгосрочные прогностические последствия существенно различаются. Цель: Данная статья направлена на анализ клинической и этиологической связи между БОС и специфическими вирусными патогенами (РСВ и Риновирус) у детей, а также на оценку их дифференциального влияния на тяжесть заболевания и риск развития астмы. Методы: Был проведен систематический обзор исследований, опубликованных в период с 2019 по 2024 год в базах данных PubMed и Scopus. Анализ был сосредоточен на педиатрических когортах с острым обструктивным бронхитом, сравнивались распространенность вирусов, клинические фенотипы и маркеры воспаления при инфекциях РСВ и РВ. Результаты: РСВ определен как основная причина БОС у детей до 12 месяцев, вызывая обструкцию за счет прямого эпителиального некроза и закупорки слизью. Напротив, Риновирус чаще встречается у детей старше 12 месяцев и тесно связан с атопической предрасположенностью. У детей с БОС, вызванным РВ, риск развития астмы значительно выше по сравнению с эпизодами, вызванными РСВ. Заключение: Дифференциация этиологии РСВ и РВ при БОС имеет клиническое значение. В то время как лечение РСВ фокусируется на поддерживающей терапии, свистящее дыхание, ассоциированное с РВ, может потребовать более ранних противовоспалительных стратегий и тщательного мониторинга развития астмы.
Ключевые слова: Бронхообструктивный синдром, острый бронхит, дети, РСВ, Риновирус, свистящее дыхание, астма.

INTRODUCTION

Acute bronchitis accompanied by Broncho-obstructive Syndrome (BOS)—often clinically termed "wheezing bronchitis" or "obstructive bronchitis"—is one of the most frequent reasons for hospitalization in pediatric practice. The syndrome is defined by a constellation of symptoms including tachypnea, expiratory wheezing, prolonged expiration, and auxiliary muscle use, resulting from narrowing of the lower airways.

While anatomical and physiological features of the pediatric respiratory tract (narrow airways, compliant chest wall) predispose children to obstruction, viral infections are the primary triggers. Among the myriad of respiratory viruses, Respiratory Syncytial Virus (RSV) and Rhinovirus (RV) account for the vast majority of cases. However, recent evidence suggests that these two pathogens are not merely interchangeable triggers but represent distinct pathophysiological pathways with different implications for the child's future respiratory health, particularly concerning the development of bronchial asthma.

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LITERATURE REVIEW

The Burden of BOS BOS affects approximately 30-50% of children at least once before school age. The "march" from acute viral wheezing to chronic asthma is a subject of intense research.
RSV Pathogenesis RSV is the prototypical cause of bronchiolitis and obstructive bronchitis in infants. The mechanism of obstruction in RSV infection is primarily structural/cytopathic. RSV infects the ciliated epithelial cells of the bronchioles, causing syncytia formation, cell necrosis, and sloughing of debris into the lumen (Meissner, 2016). This, combined with copious mucus production and submucosal edema, mechanically blocks the small airways. The immune response is neutrophil-predominant.
Rhinovirus Pathogenesis Rhinovirus (RV), particularly species A and C, has emerged as a major cause of wheezing, especially in children older than one year. Unlike RSV, RV causes minimal cytolysis. Instead, it disrupts the epithelial barrier integrity and triggers the release of alarmins (e.g., IL-25, IL-33), which activate type 2 innate lymphoid cells (ILC2). This pathway leads to eosinophilic inflammation and bronchospasm, closely mimicking the pathophysiology of allergic asthma (Jackson et al., 2020).

METHODS

This study utilizes a comparative analytical approach based on a review of current medical literature and clinical guidelines.
Data sources - Relevant articles were sourced from PubMed, Cochrane Library, and Google Scholar (2019-2024). Key comparisons - The analysis focused on: 1) Age distribution of RSV vs. RV induced BOS. 2) Clinical severity scores. 3) Biomarkers (Blood eosinophils, IgE). Recurrence rates and asthma diagnosis at follow-up.

RESULTS

Prevalence by Age Analysis shows a distinct age-related dichotomy. RSV is the causative agent in 60-75% of BOS cases in infants <12 months, usually peaking during winter months. Rhinovirus becomes the dominant pathogen (up to 50-60%) in toddlers (1-3 years) and school-aged children, often with peaks in spring and early autumn.
Clinical and phenotypic differences Table 1 summarizes the key distinctions found in the review between the two viral etiologies.

Table 1: Comparative characteristics of BOS etiology: RSV vs. Rhinovirus

Feature	RSV-induced BOS	Rhinovirus (RV)-induced BOS
Primary age group	Infants (< 1 year)	Toddlers and preschoolers (> 1 year)
Mechanism of obstruction	Mucus plugging + cellular debris (Necrosis)	Smooth muscle spasm + Airway edema
Risk factors	Prematurity, Congenital heart disease	Atopy (Eczema), parental asthma
Response to Bronchodilators	Often poor or inconsistent	Frequently positive (Reversible obstruction)
Laboratory findings	Neutrophilic leukocytosis	Often Eosinophilia (>3-4%)
Long-term asthma risk	Moderate (associated with	High (Strong predictor of

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	"Transient Wheezing")	persistent asthma)
Seasonality	Late Autumn - Winter	Spring - Early Autumn

Impact on asthma development children hospitalized with RV-induced BOS have a significantly higher odds ratio (OR ~4.0-10.0) for developing asthma by age 6 compared to those with RSV-induced BOS. This is particularly true for children sensitized to aeroallergens (aeroallergen sensitization).

DISCUSSION

The differentiation between RSV and RV induced bronchitis with BOS is crucial for personalized management.

Diagnostic challenges - Clinically, both present with wheezing. However, a history of eczema or a family history of asthma in a wheezing toddler points strongly towards an RV etiology. Rapid PCR testing can confirm the diagnosis but is not always available in resource-limited settings.

Therapeutic implications - The poor response of RSV-induced obstruction to beta-agonists (like salbutamol) is explained by the fact that the obstruction is due to debris, not smooth muscle spasm. Conversely, RV-induced BOS, which involves airway hyperreactivity, often responds well to bronchodilators and may require systemic or inhaled corticosteroids (ICS) to dampen the type 2 inflammatory response.

Prognosis - Pediatricians should view RV-induced wheezing not just as an acute infection but as a "stress test" for the airways, revealing a susceptibility to asthma. These children require closer follow-up.

CONCLUSION

Broncho-obstructive syndrome in children is a heterogeneous entity driven largely by viral pathogens. Current evidence underscores that RSV and Rhinovirus represent two distinct endotypes of wheezing:

RSV causes obstruction primarily through viral-mediated tissue damage and mucus, affecting mostly infants, with a variable link to long-term disease.

Rhinovirus triggers obstruction through inflammatory pathways linked to atopy, affecting older children, and serves as a potent marker for future asthma risk.

Clinical Recommendation: In managing a child with acute bronchitis and BOS, the clinician should assess risk factors (age, atopy). For recurrent RV-associated wheezing, early introduction of controller therapy (e.g., intermittent or daily ICS) may be considered to mitigate exacerbations, whereas RSV management should remain supportive.

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