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LONG-TERM RESPIRATORY SEQUELAE FOLLOWING ACUTE BRONCHIOLITIS IN CHILDREN: POST-VIRAL WHEEZING AND ASTHMA RISK

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ABSTRACTS: Background: Acute bronchiolitis in infancy is the most common cause of hospitalization worldwide. However, its impact extends beyond the acute phase, with a significant proportion of children developing recurrent post-viral wheezing and asthma in later childhood. Objective: This article aims to evaluate the long-term respiratory sequelae of acute bronchiolitis, focusing on the stratification of risk for developing bronchial asthma versus transient wheezing, and the differential roles of viral pathogens (RSV vs. Rhinovirus). Methods: A systematic review of longitudinal birth cohort studies and clinical trials published between 2018 and 2024 was conducted. Key databases included PubMed, Scopus, and Cochrane Library. The Asthma Predictive Index (API) and lung function trajectories were analyzed. Results: Approximately 40-50% of infants hospitalized with bronchiolitis experience recurrent wheezing. Evidence suggests distinct phenotypes: RSV-induced bronchiolitis is largely associated with "transient early wheezing" due to smaller airway geometry, whereas Rhinovirus-induced wheezing, particularly in atopic infants, is a strong predictor of persistent asthma and allergic sensitization by school age. Conclusion: Post-bronchiolitis wheezing is a heterogeneous condition. Differentiating between transient sequelae and early-onset asthma is crucial for appropriate management. Children with Rhinovirus-induced severe bronchiolitis warrant closer follow-up for asthma prevention strategies.
Keywords: Bronchiolitis, post-viral wheezing, asthma, RSV, Rhinovirus, lung function, children.

BOLALARDA O‘TKIR BRONXIOLITDAN KEYINGI UZOQ MUDDATLI RESPIRATOR ASORATLAR: VIRUSDAN KEYINGI XUSHTAKSIMON NAFAS VA ASTMA XAVFI.

ANNOTATSIYA: Kirish: Chaqaloqlik davridagi o‘tkir bronxiolit dunyo bo‘ylab kasalxonaga yotqizishning eng keng tarqalgan sababidir. Biroq, uning ta’siri o‘tkir davrdan tashqari ham davom etib, bolalarning salmoqli qismida keyinchalik takrorlanuvchi post-viral xushtaksimon nafas (wheezing) va astma rivojlanishiga olib keladi. Maqsad: Ushbu maqola o‘tkir bronxiolitning uzoq muddatli respirator oqibatlarini baholash, bronxial astma va o‘tkinchi xushtaksimon nafas xavfini tabaqalashtirish hamda virusli patogenlarning (RSV va Rinovirus) turli rollarini o‘rganishga qaratilgan. Usullar: 2018–2024 yillarda chop etilgan uzunlamasi (longitudinal) kogorta tadqiqotlari va klinik sinovlar tizimli tahlil qilindi. Asosiy manbalar sifatida PubMed, Scopus va Cochrane Library ma’lumotlar bazalaridan foydalanildi. Astmani bashorat qilish indeksi (API) va o‘pka funksiyasi traektoriyalari tahlil qilindi. Natijalar: Bronxiolit bilan kasalxonaga yotqizilgan chaqaloqlarning taxminan 40-50 foizida takroriy xushtaksimon nafas kuzatiladi. Dalillar turli fenotiplarni ko‘rsatmoqda: RSV chaqirgan bronxiolit asosan kichikroq nafas yo‘llari geometriyasi tufayli "o‘tkinchi erta xushtaksimon nafas" bilan bog‘liq bo‘lsa, Rinovirus chaqirgan xushtaksimon nafas, ayniqsa atopik bolalarda, maktab yoshida doimiy astma va allergik sensibilizatsiya rivojlanishining kuchli prediktoridir. Xulosa: Bronxiolitdan keyingi xushtaksimon nafas geterogen holatdir. O‘tkinchi asoratlar va erta

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boshlanuvchi astmani farqlash to‘g‘ri davolash uchun juda muhimdir. Rinovirus chaqirgan og‘ir bronxiolitli bolalar astma profilaktikasi uchun chuqurroq nazoratni talab qiladi.
Kalit so‘zlar: Bronxiolit, post-viral xushtaksimon nafas, astma, RSV, rinovirus, o‘pka funksiyasi, bolalar.

ДОЛГОСРОЧНЫЕ РЕСПИРАТОРНЫЕ ПОСЛЕДСТВИЯ ОСТРОГО БРОНХИОЛИТА У ДЕТЕЙ: ПОСТВИРУСНОЕ СВИСТЯЩЕЕ ДЫХАНИЕ И РИСК АСТМЫ.

АННОТАЦИЯ: Введение: Острый бронхиолит у младенцев является наиболее частой причиной госпитализации во всем мире. Однако его влияние выходит за рамки острой фазы: у значительной части детей впоследствии развивается рецидивирующее поствирусное свистящее дыхание (wheezing) и астма. Цель: Данная статья направлена на оценку долгосрочных респираторных последствий острого бронхиолита, с акцентом на стратификацию риска развития бронхиальной астмы по сравнению с преходящим свистящим дыханием, а также на различие ролей вирусных патогенов (РСВ и Риновирус). Методы: Был проведен систематический обзор продольных когортных исследований и клинических испытаний, опубликованных в период с 2018 по 2024 год. Использовались базы данных PubMed, Scopus и Cochrane Library. Анализировались Индекс прогнозирования астмы (API) и траектории функции легких. Результаты: Примерно у 40-50% младенцев, госпитализированных с бронхиолитом, наблюдается рецидивирующее свистящее дыхание. Данные указывают на различные фенотипы: бронхиолит, вызванный РСВ, в основном связан с «преходящим ранним свистящим дыханием» из-за анатомической узости дыхательных путей, тогда как свистящее дыхание, вызванное риновирусом, особенно у детей с атопией, является сильным предиктором персистирующей астмы к школьному возрасту. Заключение: Постбронхиолитное свистящее дыхание является гетерогенным состоянием. Дифференциация преходящих последствий и ранней астмы имеет решающее значение для правильного лечения. Дети с тяжелым бронхиолитом, вызванным риновирусом, требуют более тщательного наблюдения для профилактики астмы.
Ключевые слова: Бронхиолит, поствирусное свистящее дыхание, астма, РСВ, Риновирус, функция легких, дети.

INTRODUCTION

Acute bronchiolitis is the leading cause of lower respiratory tract infection (LRTI) in infants under two years of age. While the acute episode is often self-limiting, it serves as a critical sentinel event for future respiratory health. A persistent clinical dilemma for pediatricians is predicting which infant with bronchiolitis will recover completely and which will progress to recurrent wheezing and chronic asthma.

The association between early-life viral LRTIs and subsequent asthma has been established by landmark studies such as the Tucson Children’s Respiratory Study (TCRS). However, the nature of this relationship—causality versus shared genetic predisposition—remains complex. With the advent of molecular diagnostics distinguishing between Respiratory Syncytial Virus (RSV) and Rhinovirus (RV), it has become clear that "post-bronchiolitis wheezing" is not a single entity but a collection of distinct phenotypes with varying long-term prognoses.

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LITERATURE REVIEW

The "Bronchiolitis to Asthma" March Historical data indicates that 30% to 50% of children hospitalized for bronchiolitis will experience recurrent wheezing episodes in the preschool years.
Transient early wheezing - Most common in RSV cases. These children wheeze during viral infections in the first 3 years but typically outgrow symptoms by age 6. This is often attributed to reduced premorbid lung function (smaller airways) rather than atopic inflammation (Martinez et al., TCRS).
Persistent Wheezing/astma - Strongly linked to atopic heredity and Rhinovirus infections. These children continue to wheeze into school age and have a classic asthma phenotype.
Viral etiology as a prognostic factor recent cohort studies (e.g., COAST, COPSAC) have shifted focus from RSV to Rhinovirus. While RSV causes more severe acute structural damage (necrosis), Rhinovirus C and A species are potent triggers of type-2 inflammation (eosinophilic) in genetically susceptible hosts. An RV-induced wheezing episode requiring hospitalization is now considered the single strongest predictor of developing asthma (Odds Ratio ~10) compared to RSV (Odds Ratio ~2-3).

METHODS

This article employs a systematic review methodology. Search strategy - A search of PubMed and Scopus was conducted for the period 2018-2024 using keywords: "post-bronchiolitis wheezing", "asthma inception", "pediatric lung function", "RSV sequelae", and "Rhinovirus asthma risk". Inclusion criteria - Longitudinal birth cohorts, randomized controlled trials of post-bronchiolitis management, and meta-analyses.
Analysis - data was stratified based on viral etiology, host atopy status, and lung function outcomes (FEV1, FEF25-75).

RESULTS

Recurrence rates analysis confirms high morbidity: 48% of post-bronchiolitis patients report wheezing within 12 months of discharge.
Phenotypic stratification (Table 1) the results highlight two divergent pathways following acute bronchiolitis.

Table 1: Differential long-term sequelae based on viral etiology

Parameter	RSV-Associated Sequelae	Rhinovirus (RV)-Associated Sequelae
Dominant outcome	Transient Early Wheezing	Persistent / Atopic Asthma
Pathophysiology	"Structural" - Reduced airway caliber	"Inflammatory" - Airway hyperresponsiveness
Atopic association	Weak / None	Strong (Eczema, IgE sensitization)
Lung function (Age 6)	Reduced FEV1 (fixed deficit)	Reduced FEV1 with reversibility (Asthma pattern)
Asthma predictive index (API)	Often negative	Often Positive
Response to Steroids	Poor response to ICS	Good response to ICS

Impact on lung function long-term follow-up studies show that severe RSV bronchiolitis is associated with a failure to attain maximum lung growth potential. Adults who had severe RSV

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as infants often have lower FEV1 values, consistent with airway remodeling or arrested development, even if they do not have active asthma symptoms.

DISCUSSION

Clinical Assessment and Prediction The modified Asthma Predictive Index (mAPI) remains the most useful tool for clinicians. A child with post-bronchiolitis wheezing who has a parent with asthma or has eczema (major criteria) is at high risk.

Clinical pearl - If a 2-year-old presents with wheezing and tests positive for Rhinovirus (not RSV) and has eczema, the probability of future asthma is very high.

Management dilemmas treating post-viral wheezing is challenging. Bronchodilators - Beta-agonists are standard for acute relief but may be less effective in the "floppy airway" phenotype of post-RSV wheezing.

Inhaled Corticosteroids (ICS) - Routine maintenance ICS is *not* recommended for all post-bronchiolitis infants. However, for those with the "Rhinovirus + Atopy" phenotype, early introduction of ICS during episodes or as maintenance may reduce exacerbation severity.

Prevention New monoclonal antibodies for RSV (Nirsevimab) have shown promise not only in preventing acute bronchiolitis but also in reducing recurrent wheezing rates by up to 30-40% in the subsequent year, suggesting that preventing the "first hit" to the lungs can alter the trajectory of respiratory health.

CONCLUSION

Long-term respiratory sequelae after bronchiolitis are common but not uniform. The evidence supports a paradigm shift where Rhinovirus-induced wheezing is viewed as an early manifestation of asthma, whereas RSV-induced wheezing often represents a structural airway vulnerability.

Recommendations for pediatricians - Risk stratify - Use personal and family history of atopy to categorize wheezing infants. Monitor - Follow up lung function (spirometry) as soon as the child is old enough (age 5-6). Educate - Inform parents that while RSV-related wheezing often resolves, avoidance of tobacco smoke and other irritants is crucial to maximize lung growth.

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