



Just the facts: How to diagnose and manage acute preschool asthma in the ED

Brett Burstein^{1,2} · Jennifer Turnbull¹

Received: 14 April 2022 / Accepted: 9 August 2022 / Published online: 1 September 2022
© The Author(s), under exclusive licence to Canadian Association of Emergency Physicians (CAEP)/ Association Canadienne de Médecine d'Urgence (ACMU) 2022

Keywords Asthma · Diagnosis · Management · Children

Clinical scenario

A 14-month-old girl presents to the emergency department (ED) with signs of respiratory distress and wheeze. The parents report that the child has had fever, cough and nasal congestion for 48 h, with difficulty breathing developing today. She has no significant medical history and immunizations are up to date.

Clinical questions

What is preschool asthma and how is it diagnosed in the ED?

A diagnosis of preschool asthma can be made in children aged 12-months to 5-years. Diagnosing asthma among preschoolers can be a challenge, particularly among those aged 12–24 months who can present with similar confounding respiratory syndromes (e.g. bronchiolitis), and who are still too young for formal diagnostic testing (e.g. pulmonary function testing). Despite this, it is important that preschool asthma be diagnosed and treated, as undiagnosed/uncontrolled asthma can be associated with frequent ED visits, treatment delays, irreversible airway remodeling, and increased morbidity [1].

Asthma should be considered in children ≥ 12 months who have [1]:

- (1) Clinical evidence of lower airway obstruction (wheeze);
- (2) Documented reversibility of airway obstruction following a therapeutic trial of short-acting β -agonists (SABA), demonstrated by a ≥ 3 -point decrease in the Pediatric Respiratory Assessment Measure (PRAM, Fig. 1);
- (3) No evidence of an alternative diagnosis (The differential diagnosis of lower airway obstruction is broad and includes but is not limited to bronchiolitis, foreign body aspiration and anaphylaxis. A personal/family history of atopy may raise the suspicion for asthma, but is not necessary for diagnosis.)

A clinical diagnosis of asthma is made when a child has experienced ≥ 2 episodes meeting these criteria [1]. Importantly, among children aged 12–24 months, asthma cannot be differentiated from bronchiolitis on history and physical exam alone, therefore initial asthma management can be therapeutic and diagnostic. For children 12–24 months old with respiratory tract infection symptoms, wheezing that is not reversible with a SABA trial is more consistent with a diagnosis of bronchiolitis.

Ancillary tests such as chest radiography or blood gases are not required to diagnosis asthma, but may be useful when there is diagnostic uncertainty or failure to improve with treatment [2]. Chest radiography frequently leads to over-diagnosis of pneumonia, but may help identify complications such as pneumothorax, or alternate diagnoses such as a foreign body [2].

The language used when communicating diagnosis with parents is important for education and adherence, and to avoid future treatment delays both at home and in the ED.

✉ Jennifer Turnbull
jennifer.turnbull.med@ssss.gouv.qc.ca

¹ Division of Pediatric Emergency Medicine, Department of Pediatrics, Montreal Children's Hospital, McGill University Health Centre, Montreal, QC, Canada

² Department of Epidemiology, Biostatistics and Occupational Health, McGill University, Montreal, QC, Canada

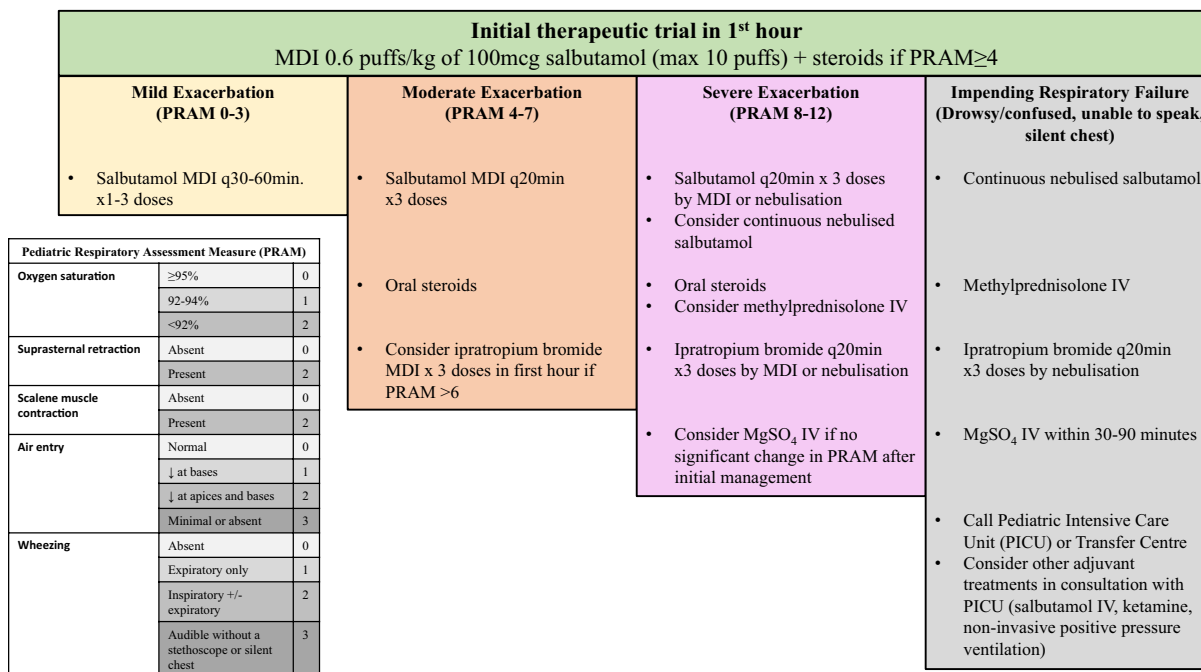


Fig. 1 Initial management of preschool asthma by severity PRAM score (inset). Source: data drawn from Trotter et al. [2]

A first episode meeting criteria should be communicated as “suspected asthma”, while a second episode should be clearly communicated as “asthma”. Up to 60% of children meeting this clinical diagnosis become asymptomatic by age 6 [1]. Those with persisting symptoms can be referred for formal testing.

What is the initial management?

It is important that management in the ED is initiated early and tailored to severity and treatment response (Fig. 1). The mainstay of treatment for acute asthma is inhaled SABAs (e.g. 0.6 puffs/kg of 100 mcg salbutamol, max 10 puffs), with the addition of systemic steroids for moderate or severe episodes (PRAM ≥ 4). Early systemic steroids reduce hospitalizations, ED length of stay, and relapse following initial treatment [2]. There is currently no evidence for superiority of a specific oral steroid, dose or duration [3]. Compared to prednisolone, oral dexamethasone has equivalent efficacy and is associated with less vomiting, and fewer subsequent doses, which can improve adherence [3]. A simple and effective steroid regimen is oral dexamethasone at a dose of 0.6 mg/kg as part of a 1- or 2-day course [1]. Intravenous corticosteroids (e.g. methylprednisolone 1–2 mg/kg, max 125 mg) should be used for children with severe asthma unable to tolerate oral steroids or with impending respiratory failure [2].

There is evidence for use of inhaled short-acting anticholinergics (SAAC, i.e. ipratropium bromide) in moderate-to-severe asthma. Three doses of a SAAC (e.g. ipratropium bromide 4 puffs for < 30 kg, 8 puffs for > 30 kg) within the first treatment hour has been shown to reduce hospitalizations among children ≥ 3 yo [4]. There is no evidence for benefit beyond three doses [2].

What is the best medication delivery method?

Metered dose inhalers (MDI) with an age-appropriate spacing device provide efficient medication delivery [2, 4, 5]. ED treatment via MDI is associated with lower rates of admission when compared to treatment by nebulization [4, 5]. These benefits are most pronounced as severity increases, and among younger patients [4]. Owing in part to pragmatic factors, treatment by nebulization remains a reasonable option for severe acute asthma, to more easily deliver continuous salbutamol and facilitate the delivery of multiple medications in rapid succession (i.e. salbutamol and ipratropium bromide). For asthma with hypoxia (< 92%), oxygen can be delivered with medications either by nebulization, or by nasal prongs under the spacing device during MDI treatment [4, 5].

When should magnesium sulfate be used?

Magnesium sulfate should be used for moderate-to-severe acute asthma when, despite severity-specific initial treatment (Fig. 1), there has been no significant change in asthma severity score, or ongoing moderate-to-severe respiratory distress [2]. Studies of magnesium sulfate administered intravenously for children with moderate-to-severe exacerbations within 30–90 min, or following three initial SABA treatments have shown a reduction in hospitalizations, however ideal dosing has not been determined (range 40–75 mg/kg) [2].

What are ED discharge criteria?

Children are likely safe for discharge 1–2 h following the last SABA treatment if they have (1) no significant respiratory distress, good air entry, and an oxygen saturation of $\geq 92\%$ on room air (PRAM score of ≤ 3) [2]. Admission should be considered for children who remain oxygen-dependent despite maximal treatment and/or have a PRAM ≥ 4 at 4–6 h post-systemic steroid [2]. Transfer to a pediatric center or to the Pediatric Intensive Care Unit should be considered for ongoing severe symptoms after 1–2 h of treatment (status asthmaticus), or impending respiratory failure (altered level of consciousness, inability to speak in sentences, silent chest, pneumothorax).

At discharge, parents should be provided with a clear, ideally written, asthma action plan which includes a review of home medication administration technique, regular salbutamol until the exacerbation resolves (e.g. easy-to-remember

regimen of 4 puffs q4 h \times 4 days) then as needed, consideration of regular use inhaled corticosteroids, and clear instructions when to return to the ED [2].

Funding This work was unfunded. Dr. Burstein is the recipient of a career awards from the Quebec Health Research Fund (FRQ-S).

Declarations

Conflict of interest The authors have no conflicts of interest to disclose.

References

1. Ducharme FM, Dell SD, Radhakrishnan D, et al. Diagnosis and management of asthma in preschoolers: A Canadian Thoracic Society and Canadian Paediatric Society position paper. *Paediatr Child Health*. 2015;20(7):353–71.
2. Trottier ED, Chan K, Allain D, Chauvin-Kimoff L. Managing an acute asthma exacerbation in children. *Paediatr Child Health*. 2021;26(7):438–9.
3. Normansell R, Kew KM, Mansour G. Different oral corticosteroid regimens for acute asthma. *Cochrane Database Syst Rev*. 2016. [https://doi.org/10.1002/14651858.CD011801.pub2\(5\):p.CD011801](https://doi.org/10.1002/14651858.CD011801.pub2(5):p.CD011801).
4. Pollock M, Sinha IP, Hartling L, et al. Inhaled short-acting bronchodilators for managing emergency childhood asthma: an overview of reviews. *Allergy*. 2017;72(2):183–200.
5. Castro-Rodriguez JA, Rodrigo GJ. beta-agonists through metered-dose inhaler with valved holding chamber versus nebulizer for acute exacerbation of wheezing or asthma in children under 5 years of age: a systematic review with meta-analysis. *J Pediatr*. 2004;145(2):172–7.