Management of viral-induced wheezing in the preschool child

Wheezing is a common problem among preschool children (Bhatt, 2013), and its prevalence is rising in the UK (Kuehni et al, 2001). This has an inevitable impact on healthcare costs. Indeed, it is estimated that caring for this patient group costs around £53 million (Brand et al, 2008). This article informs general practice nurses (GPNs) about the condition, which can vary greatly in frequency and acuity, so that appropriate supportive management and follow-up can be offered when a child presents with this condition to the surgery. The patient story sets the scene of a typical wheezing preschool child, and raises the questions about whether to treat or not to treat; the concerns parents have about treatment, acute episodes and the overall management of preschool children with wheeze.

EPIDEMIOLOGY

Globally, the leading cause of paediatric ward and emergency consultations are viral-induced wheezing episodes in the one to five-year-old age group (Davies et al, 2008; Gill et al, 2013). So much so, that preschool wheeze in the UK is estimated to cost the National Health Service £53 million, with the greatest expenditure of £34 million within primary care (Stevens et al, 2003). Many of these children will be seen by general practice nurses (GPNs). Depending on their severity and frequency, wheezing episodes can also have a major impact on children and their families, due to the significant morbidity associated with acute episodes. Episodes can occur suddenly, be unpredictable and can, in some cases, be frequent and severe. This can disrupt some

KEY WORDS:

- Preschool wheeze
- Management
- Parent/carer education
- Guidelines
- Plan

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parents’ careers, as they regularly have to take time off work at short notice to look after their child when they are unwell. Autumn is the peak time of year for wheezy episodes, typically starting from September (Johnston et al, 2006).

It is estimated that at least one in three children experience at least one wheezing illness before the age of three (Taussig et al, 2003; Brand, 2008; Bloomberg, 2009). Wheeze does resolve in approximately three-quarters of children by the time they are five years old (Frank et al, 2008), but approximately one-third of preschool wheezers go on to develop asthma (Martinez et al, 1995).

Bearing in mind that the data from these studies were collected retrospectively and analysed over several years, this information does not help a clinician when a child presents with a wheeze, because it is very difficult to predict what the outcome will be by the time the child is six years old. Furthermore, although most children do resolve by the time they are six, it is important to recognise that a small proportion of these children will have long-term consequences from their repeated wheezy episodes in the form of chronic airway inflammation and symptoms that continue into adulthood, or may experience recurrence of symptoms following remission (Sears et al, 2003). This group are mostly individuals who have had frequent and severe wheezy episodes at preschool, irrespective of atopy (Gern et al, 2005; Goksör et al, 2015; Saglam, 2013). However, atopy and smoking are also known to increase the risk of prolonged symptoms into adulthood (Butland and Strachan, 2007).

DEFINITIONS, TYPES OF WHEEZE AND ASTHMA

It is generally recognised that recurrent wheeze is defined as having a minimum of three wheezing episodes per year. Wheeze is described as a continuous high-pitched sound with musical quality that comes from the chest during expiration (Brand et al, 2008). Ideally, wheezing should be confirmed by a trained clinician due to varying parental perceptions of wheeze, which can be quite different from a clinician’s and could be referring to any type of noisy breathing, such as upper airway congestion sounds or stridor (Elphick et al, 2000). Wheezing is caused by the passage of air through the walls of a narrowed airway, caused by bronchospasm, inflammation or secretions, to produce sounds which can be high or low pitched and heard anywhere in the chest during auscultation.

It is important to distinguish viral wheeze from bronchiolitis, which is defined differently in various parts of the world and could be referring to any type of wheeze seen in preschoolers. In the UK, Australia and Northern Europe, bronchiolitis is defined as the presence of an upper respiratory tract infection (URI) with coryza and cough that quickly develops into lower respiratory tract infection (RTI) symptoms, with feeding difficulties, respiratory distress and hypoxia in severe cases, and usually occurs in infants under one year of age. Widespread crepitations are heard rather than wheeze, although wheeze may also be present and symptoms do not respond to bronchodilators or oral corticosteroids (Bhatt and Smyth, 2011). It is common for

Kyle

In 2013, aged 18 months, Kyle was referred to the paediatric respiratory nurse clinic having had three wheezing episodes that were triggered by viral upper respiratory tract infections (URIs) in three months. Each episode was severe enough to warrant a hospital admission and was assessed as being severe as per the British Thoracic Society/Scottish Intercollegiate Guidelines Network guidelines (BTS/SIGN, 2014). During one of the episodes, Kyle’s oxygen saturations were 87% in air, and he was treated with combined salbutamol and atrovent nebulisers, oxygen, intravenous magnesium sulphate and oral prednisolone 20mgs once daily. He made a quick recovery and was discharged on beclomethasone dipropionate (BDP) 100mcg twice daily using a volumatic spacer and mask. Kyle did not have any personal history of eczema or atopy, nor was there any family history of atopic disease. During well periods, Kyle did not require bronchodilators for exertion or have any nocturnal symptoms.

During one clinic appointment, Kyle’s mother tearfully admitted that she was ‘at the end of her tether’. After receiving a warning at work about the amount of sick leave she had taken, she was now considering quitting her job as a teacher and wanted to take Kyle out of nursery as she felt that this was contributing to the frequency of his wheezy episodes. Another issue raised was that she felt reluctant to seek help at times, as she never saw the same doctor and some clinicians made her feel like an ‘over-anxious mother’. At times, when she brought Kyle in for a review at the start of one of his episodes, she felt ‘fobbed off’ by being told it was ‘only a cold’ and to continue with the inhalers, when she knew that she would be in the emergency department with Kyle later that evening. The family could never go out or plan a weekend away for fear of Kyle having another episode.

Gradually, as Kyle grew older, he improved and was managing better during subsequent viral URIs. After several months of treatment, Kyle’s parents had discontinued montelukast and reduced BDP to 50mcg once daily, as they were concerned that the medications were causing behavioural changes. Kyle had one further admission with wheeze and since then has been monitored every six months. He has been nearly one year off treatment and is now four years old.

Despite treatment he continued to have wheezy episodes and treatment was increased to 200mcg (BDP) twice daily and subsequently, following further admissions to the paediatric ward, montelukast 4mgs nocte was commenced.

In 2013, Kyle was admitted to the ward following an episode of severe lower respiratory infection, which was severe enough to warrant a hospital admission and was assessed as being severe as per the British Thoracic Society/Scottish Intercollegiate Guidelines Network guidelines (BTS/SIGN, 2014). During one of the episodes, Kyle’s oxygen saturations were 87% in air, and he was treated with combined salbutamol and atrovent nebulisers, oxygen, intravenous magnesium sulphate and oral prednisolone 20mgs once daily. He made a quick recovery and was discharged on beclomethasone dipropionate (BDP) 100mcg twice daily using a volumatic spacer and mask. Kyle did not have any personal history of eczema or atopy, nor was there any family history of atopic disease. During well periods, Kyle did not require bronchodilators for exertion or have any nocturnal symptoms.

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infants who have had an episode of bronchiolitis in infancy to have recurrent wheezy episodes, with subsequent viral infections (Bont et al, 2000; Lemanske et al, 2005), and this should be part of the clinical history-taking, although bronchiolitis as a condition is not discussed in this article.

Children under five years are susceptible to wheezy illnesses due to their size and the diameter of their narrow airways. Most children who wheeze do improve over time when they grow larger and their airways become more resilient. Because there are many types of wheezing patterns in preschoolers, the European Respiratory Society (ERS) Task Force (Brand, 2008; Table 1) categorised preschool wheeze as either ‘episodic viral wheeze’ (EVW) or ‘multi-trigger wheeze’ (MTW).

Episodic wheezers are asymptomatic until they have a viral URTI. Whereas MTW occurs for reasons in addition to viral infections such as exercise, laughter or exposure to allergens, i.e. cats, dogs or pollens. Both types of wheeze may be described as ‘transient’ if resolved by the time the child is six years old. ‘Late-onset wheeze’ refers to symptoms that occur after three years of age and is defined as ‘persistent’. In 60% of cases, both types may resolve as the child gets older (Martinez, 1995), although it is believed that EVW has a better long-term prognosis than MTW (Brand et al, 2008).

The diagnosis of asthma tends to be avoided in preschool children, even though it is known to develop in early childhood especially with wheezing episodes triggered by viruses (Funginger et al, 1992).

There is much debate as to whether or not asthma should in fact be diagnosed in the under fives (Ducharme et al, 2015). Airway remodelling and irreversible damage to lung tissue has been detected in toddlers, and treatment started early in this group of children is beneficial to prevent ongoing airway changes and long-term consequences (Saglani et al, 2007).

Asthma is ideally diagnosed by objective measurement of air flow obstruction and reversibility using bronchodilators and corticosteroids (British Thoracic Society/Scottish Intercollegiate Guidelines Network [BTS/SIGN], 2014; Table 2). This requires lung function testing which is not usually available in primary or secondary care settings for children under five years old. Therefore, a confirmatory diagnosis of asthma is extremely difficult in the preschool age group, and is open to misinterpretation leading to either the overdiagnosis of asthma and inappropriately treating children with corticosteroids, or underdiagnosis, with inadequate treatment and long-term consequences (Ducharme et al, 2015).

When faced with a wheezy preschool child, it is virtually impossible to establish in the first instance whether or not the child has EVW, MTW, or is suffering from asthma, although this does become clearer over time. Response to treatment varies according to the cellular processes driving a viral illness, and may be either eosinophilic or neutrophilic, or a combination of both. Furthermore, an individual’s gene type combined with certain environmental factors, for example viruses, exposure to environmental tobacco smoke (ETS), or allergens are known to interact with the individual’s immune system, and can then influence wheeze patterns and symptoms which may change from one type to another as the child gets older, or may completely resolve (Bacharier et al, 2007; Spycher et al, 2010; Strippoli et al, 2011).

These issues present frequent challenges to clinicians trying to manage the differing types of wheeze, which all present with similar symptoms and mimic asthma. Currently, the preferred approach to treating wheeze in preschool children is based on the probability of asthma if no alternative diagnosis can explain the symptoms. Guidance suggests two options (BTS/SIGN 2014):

- If a low or intermediate probability of asthma is suspected, it is reasonable not to treat initially, although a bronchodilator with appropriate spacer could be supplied for relief of symptoms as and when needed. Follow-up should be arranged after a specified time period. Parents must be educated about the signs and symptoms they should be monitoring, and, if given a bronchodilator, should be

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**Table 1: Definitions of wheeze** (ERS Task Force; Brand et al, 2008)

<table>
<thead>
<tr>
<th>Type</th>
<th>Definition</th>
</tr>
</thead>
</table>
| Episodic (viral wheeze)| - Wheezing only during URTIs, or a ‘cold’  
                        | - No wheezing between episodes                                               |
| Multi-trigger wheeze  | - Wheezing during URTIs, and also triggered by exposure to allergens, cold damp air, irritants or exercise |
| Transient wheeze      | - Wheeze that occurs before the age of three and has resolved by the time the child is six years old  
                        | - May be episodic or multi-trigger                                           |
| Late-onset wheeze     | - Wheeze that occurs after three years old  
                        | - May be episodic or multi-trigger                                           |

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**Table 2: Risk factors for asthma (BTS/SIGN, 2014)**

- Frequent and severe episodes of wheeze in under-five-olds
- Coexisting atopic conditions, i.e. eczema, allergic rhinitis, food allergy
- Family history of atopy
- Symptoms occur in response to allergens, cold air, exercise and, apart from viral URTI
- Wheeze on auscultation
- Confirmed response to bronchodilator/or corticosteroids by clinician

**Table 3: Virus**

- Rhinovirus human RV A and RV B
- Respiratory syncytial virus (RSV)
- Coronavirus
- Brinfluenza
- Adenovirus
Long-term conditions: viral-induced wheezing in the preschool child

Table 4: Care pathway for wheezy child over one year of age, adapted from guidance used in secondary care

<table>
<thead>
<tr>
<th>Observations pre-bronchodilator, child 1–5 years old</th>
<th>Mild</th>
<th>Moderate/severe, refer to paediatrics ED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate</td>
<td>&lt;140 per minute</td>
<td>&gt;140 per minute</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>&lt;40 per minute</td>
<td>&gt;40 per minute</td>
</tr>
<tr>
<td>Recession</td>
<td>None or mild</td>
<td>Moderate/severe</td>
</tr>
<tr>
<td>Effort of breathing</td>
<td>Normal</td>
<td>Working hard</td>
</tr>
<tr>
<td>Oxygen saturations</td>
<td>&gt;94% in air</td>
<td>&gt;92% pink/&lt;92% severe</td>
</tr>
<tr>
<td>Colour</td>
<td>Pink</td>
<td>Pale</td>
</tr>
<tr>
<td>Speech</td>
<td>Speaking in full sentences/able to feed</td>
<td>Breathless/unable to speak</td>
</tr>
<tr>
<td>Level of consciousness</td>
<td>Alert</td>
<td>Alert/agitated</td>
</tr>
<tr>
<td>Treatment for mild wheeze, child 1–5 years old</td>
<td>Dose (mild)</td>
<td>Dose (moderate/severe)</td>
</tr>
<tr>
<td>Salbutamol via metered dose inhaler (MDI) and suitable spacer with mask</td>
<td>2–4 puffs every four hours</td>
<td>18 puffs every 20 minutes — give prednisolone 20mg (three days). Reassess after 20 minutes, if not improved refer to paediatric emergency department (ED) *</td>
</tr>
<tr>
<td>Consider prednisolone</td>
<td>20mg once daily, three days</td>
<td>Give prednisolone</td>
</tr>
</tbody>
</table>

Table 3 lists the viruses responsible for viral-induced wheeze. Rhinovirus (RV) and respiratory syncytial virus (RSV) are the most common. Rhinovirus and RSV infections have been linked to a higher risk of persistent wheeze, with RSV infections associated with recurrent episode wheezing episodes that may continue throughout early childhood. However, infections with rhinovirus have been associated with more long-term consequences (Bont et al, 2000), such as the development of asthma thought to be caused by damage to lung tissue and airway remodelling during and after recurrent infections (Jackson, 2010).

SOME CHILDREN ARE MORE VULNERABLE TO WHEEZY ILLNESSES

In addition to atopic children, there are other groups who have been shown to be more susceptible to wheezing illnesses. These are pre-term and low birthweight infants, due to their size and vulnerability to infections (Reisman et al, 1993).

Children of mothers who smoked during pregnancy and those exposed to ETS are at 70% increased risk of wheezing illnesses. This is the single most common risk factor for the development of persistent wheeze (Strachan and Cook, 1997). Parents should be informed about the risks to their child when exposed to ETS and should receive smoking cessation advice as part of the child’s overall treatment plan.

ASSESSMENT AND TREATMENT OF ACUTE WHEEZY EPISODES

Despite the publication of guidelines to aid clinical decisions (BTS/SIGN, 2014), the information regarding management of wheeze appears to be open to interpretation and has either led to variations in practice across primary, secondary and tertiary care settings (Lyttle et al, 2015), or, as found in the ‘National Review of Asthma Deaths’ (NRAD; RCP, 2014), the guidelines are not followed at all (BTS/SIGN, 2014). In the author’s clinical experience, advice is particularly lacking on the management of acute wheeze in preschool children.

### Reminder

When prescribing bronchodilators or any inhaler, it is essential that parents know how to administer the medicine appropriately using a spacer device that is suitable for the child.

advised to record the frequency it is required, when it is needed, and its effect on symptoms. It is most important that parents are given an action plan for the management of acute symptoms, so that they are educated about deteriorating symptoms and the necessary actions to take (BTS/SIGN, 2014; Royal College of Physicians [RCP], 2014).

- If symptoms, and personal and family history factors suggest a high probability of asthma, a trial of treatment according to the stepwise approach (BTS/SIGN, 2014) can be initiated. The child should be followed-up within 2–3 months. Likewise, it is important to ensure that parents fully understand the treatment being given and that it is for a trial. They should also be advised to monitor symptoms and bronchodilator use, and given an action plan for acute episodes. If there is no response after 2–3 months, reconsider treatment options and refer to a specialist for alternative diagnosis.

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### Practice points

- If the child does not tolerate the spacer at first, it is important to counsel parents to persevere and be gently persistent.
- The dose is more effective if the child is settled and not breathing in gasps if they are crying.

### Resource

An excellent resource for inhaler technique can be found on the Asthma UK website: www.asthma.org.uk/advice-using-inhalers
because there is so much conflicting evidence regarding diagnosis of wheeze type and the benefits of treatment. However, guidelines recommend categorising acute symptoms based on severity and treating accordingly (BTS/SIGN, 2014). It is reasonable to follow these guidelines for the treatment of an acute episode, however, the child should be closely monitored for their response to treatment.

Table 4 provides an adaptation of guidance used in a secondary care setting as a care pathway for the wheezy child over one year of age. However, this is included for illustration only, and individual clinical areas should define and agree their own local evidence-based procedures that follow national guidelines, i.e. BTS/SIGN, 2014.

CLINICAL HISTORY

In addition to physical assessment, the following considerations may assist clinical management. In most cases of viral wheeze there are usually no symptoms other than present wheeze in the clinical history (Bush et al, 2014; Table 5).

Bronchodilators

A child who is responding to treatment and settles on salbutamol given at four-hourly intervals should be advised to continue with this treatment for the duration of the URTI. It is important to ensure that the parent/carer is informed about the signs and symptoms of a worsening condition and should be shown how to check for chest recessions and changes in the child’s behaviour. In the author’s clinical experience, preschool children can be very deceptive when they are having an acute episode because their systems are able to compensate up to a critical point for their respiratory difficulties, but can quickly deteriorate. Despite appearing to look well and playful, examination of chest

Table 5: Clinical history

| Confirm presence of wheeze with auscultation |
| Nature and duration of wheeze |
| Is it constant or intermittent? |
| Are there other respiratory symptoms? |
| Factors that exacerbate wheeze and symptoms |
| Previous episodes of wheeze/severity; bronchiolitis |
| Medications |
| Number of previous courses of treatment, i.e. prednisolone or antibiotics |
| Response to treatment |
| Exposure to tobacco, damp, pets |
| Personal atopic history of child and current allergies |
| Family history of atopy |

If your child is:
• Having severe difficulty in breathing
• Has blue lips
• Is pale, drowsy or weak
Dial 999 immediately
State severe/life-threatening asthma
Give one puff of blue reliever inhaler via spacer every 30 seconds until ambulance arrives

If your child is:
• Breathless, and is working hard to breathe/using tummy muscles to breathe
• Unable to complete a sentence/take fluids and is getting tired
Dial 999 immediately
State severe/life-threatening asthma
Give one puff of blue reliever inhaler via spacer every 30 seconds until ambulance arrives

If your child is:
• Wheezing and breathless and the reliever inhaler is required more than the two puffs every four hours
Immediately contact your GP to make an appointment to be seen that day
Use the GP out-of-hours service, or go to the all-day health centre if you are unable to get an appointment

If your child has any of the following:
• Mild cough/wheeze
• Requires the reliever inhaler no more than two puffs every four hours
• Not breathing quickly
• Able to continue day-to-day activities
Continue four-hourly reliever inhaler
Contact your GP if there is no improvement

FIGURE 1.
Wheezy child action plan (adapted from Wirral University Teaching Hospital NHS Foundation Trust).
movements can show significant chest recurrences and breathlessness. There may also be subtle changes in the child’s behaviour that the parent may pick up, and some children become hyperactive as a result of the effects of bronchodilators.

Oral corticosteroids (OCS)

There is conflicting evidence about the use of OCS to treat EVW. Although OCS are known to be highly effective on managing MTW and asthma exacerbations, the evidence is mounting against the use of OCS for EVW. Various trials have shown that the treatment is not always effective when compared to placebo (Csonka et al, 2003; Panickar et al, 2009).

However, the evidence is conflicting. The trial by Csonka et al (2003) found that the length of hospital stay was shortened with OCS along with less use of bronchodilator, whereas Panickar et al (2009) found no reduction in hospital stay compared to placebo. Comparing the evidence from these particular studies is difficult because each study used different inclusion criteria and symptom severity varied between participants. Furthermore, the doses of prednisolone were different. The Csonka et al study used prednisolone at 20mg once daily for three days, while Panickar et al used doses per kgs. All these factors can potentially affect the results leaving interpretation of the studies difficult.

The decision whether or not to treat a child with OCS should be based on the individual, the severity and frequency of their symptoms and their previous response to treatment if it has been given. The ‘National Asthma Guidelines’ (BTS/SIGN, 2014) recommended that children between the ages of one and five with moderate-to-severe wheeze requiring admission to hospital should be given oral prednisolone 20mg once daily for three days. Caution should be taken with children who have been prescribed multiple courses of OCS due to concerns about bone mineral density and adrenal suppression. Prednisolone is not always recommended for children who are well enough to remain at home. It should be reserved for severe symptoms that warrant a hospital admission (Brand et al, 2014; BTS/SIGN, 2014).

Antibiotics

These are not recommended to treat wheezing bearing in mind that 95% of wheezy respiratory illnesses in preschool children are due to viral infections (Allander et al, 2007).

Action Plan

Similar to the care of a child with asthma, all parents should be educated about their child’s treatment, and how, when and why it should be taken. A written action plan must be given with directions of how to recognise and manage situations when their child’s symptoms become worse. Parents need to be educated about how many puffs of bronchodilator are acceptable at home during acute episodes and when to seek a medical review. When used correctly, the use of a metered dose inhaler (MDI) and spacer during wheezy episodes can prevent unnecessary emergency department visits. However, excessive bronchodilator use, especially without a clinical assessment, can lead to prolonged episodes, or severe/life-threatening events as the child becomes increasingly hypoxic.

In the author’s clinical opinion, a wheezy child action plan, similar to that in Figure 1, should be given to parents on discharge from hospital, or at clinic appointments. It can also be used in schools, preschools and nurseries.

CONCLUSION

Wheezeing in children under six years old is common, but does need careful management to prevent hospital admissions and ensure that the child receives the appropriate treatment, depending on their individual situation. It is also important to consider the impact that the illness can have on families, such as Kyle’s (see patient story), and ensure that parents are both completely informed about the management of wheeze and are fully supported with access to prompt advice and reassurance when they need it.
young (preschool) children increasing in prevalence? *Lancet* 357: 1821–5


**Key points**

- Wheezing episodes can occur suddenly, be unpredictable and can, in some cases, be frequent and severe.

- The preferred approach to treating wheeze in preschool children should be based on the probability of asthma if no alternative diagnosis can explain symptoms.

- All parents should be educated about their child’s treatment and how, when and why it should be taken. Written action plans should be given.

**Wheezing** is a common problem among preschool children, with its prevalence rising in the UK.
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