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Research article

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Asthma in Children

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Abstract

Asthma is one of the most common chronic diseases of the airways, characterized by allergic inflammation in the airways, often as a result of exposure to allergens, cold air, tobacco smoke, exercise, or emotional stress. The most common asthma symptoms in children are: cough, shortness of breath with wheezing, chest pressure and shortness of breath. Asthma is an incurable disease, but its symptoms, which range from mild to life-threatening, can be controlled with medication and lifestyle, thus ensuring a full and normal life for the child.

Keywords: Asthma, Disease, Children, Management

Introduction

Asthma is a condition characterised by airway obstruction due to bronchial smooth muscle constriction and inflammation that is at least partly reversible [1]. Any asthmatic is susceptible to suffering from an exacerbation ('asthma attack'), which may be caused by allergic triggers (e.g. pollen, mould), respiratory infection, medications (e.g. NSAIDs or β-blockers) or lack of compliance with treatment.

A moderate asthma exacerbation describes asthmatics with increased symptoms and a peak expiratory flow rate (PEFR) of >50% than their best or predicted value. Acute severe asthma describes an individual with any of the following features:

a. PEFR 33%–50% best or predicted value
b. Respiratory rate ≥25/min
c. Heart rate ≥110/min
d. Inability to complete sentences in one full breath

Epidemiology, the science of the prevalence and determinants of disease, provides an assessment of disease frequency and burden of pediatric asthma [2]. In addition it allows researchers to explore associations of risk factors for childhood asthma and the study of disease progression as well as the effect of therapeutic interventions. The data gathered from epidemiological reports permits the calculations of the economic impact of the disease to an individual, family, and society. Disease prevention and reduction in the short-term and long-term consequences of untreated illness are fundamentals of pediatric care. The application of prevalence and cost of illness may be used to determine the resources that should be allocated to effectively limit the morbidity and mortality associated with pediatric asthma.

Asthma is a disorder affecting conducting airways in which inflammation interacts with structural changes to cause variable airflow limitation [3]. Conventional treatment of established asthma is highly effective in controlling symptoms and improving quality of life. With the possible exception of immunotherapy, however, no treatment has been shown to modify long-term outcomes and no cure has been identified. Most asthma has its origins in early life and the best predictors of continuation into adulthood are: early age of onset, sensitization to house dust mites (in environments where this is a prevalent allergen), reduced lung function, and increased bronchial hyperresponsiveness (BHR) in childhood. Under such circumstances attention must focus on an understanding of the early life origins of the disease in order to identify targets for primary prevention.

Symptoms [4]

- Presence/duration: cough, wheeze, shortness/labored/rapid breathing
- Home therapy: # & frequency of steroids, bronchodilator doses
- Previous attacks:
» Use of steroids
» ER/hospital/ICU care
» Intubation
- Best baseline peak expiratory flow (PEF)
- Trigger exposures

Diagnosis [4]

- Bronchiolitis
- Laryngotracheobronchitis (croup)
- Foreign body aspiration
- Vocal cord dysfunction
- Airway compression

- Anaphylaxis

In children, conditions that can also present with wheezing, cough, and increased sputum production include bronchiolitis, cystic fibrosis, croup, epiglottitis, bronchitis, and foreign-body aspiration [5]. Bronchiolitis has many similarities to asthma but presents as an acute illness and is not a chronic disease. Cystic fibrosis is a chronic disease that initially may be confused with asthma, but patients also develop GI symptoms, growth disturbances, recurrent sinus infections, and pneumonia. Croup, epiglottitis, bronchitis, and foreignbody aspiration are discrete episodes and not chronic diseases. In adults, the primary diseases confused with asthma are COPD (chronic obstructive pulmonary disease) and CHF (congestive heart failure). Both of these diseases usually have their onset in adulthood. A chest x-ray, ECG (electrocardiogram), spirometry, and other testing can help to distinguish between CHF and pulmonary disease.

The diagnosis of asthma is primarily based on symptoms and clinical examination, which are often sufficient for clinical diagnosis, and laboratory and pulmonary function tests are used to confirm the diagnosis or to determine the degree of the disease [6]. There is no single diagnostic test for the diagnosis of asthma, so the condition is often difficult to diagnose, especially in young children. Specifically, pulmonary function cannot be measured in this age group, and the disease often manifests only as recurrent episodes of coughing and /or wheezing, which may resemble the symptoms of some other diseases. As asthma often occurs before the age of five and may start before the age of three, early diagnosis, follow-up and effective treatment are also essential in these patients.

Bronchiolitis

Bronchiolitis is a respiratory disease caused by a respiratory infection that affects tiny air channels, bronchioles, which lead to the lungs [7]. When the canal inflammation occurs, they overturn and fill the mucus, thereby aggravating the breathing of the baby. The disease most commonly affects infants and young children, because their tiny air channels can easily clog up, which is not the case with older children and adults. Bronchiolitis usually occurs during the first two years of age with the highest incidence rate between three and six months of age. It occurs more often in boys, children who are not breastfeeding and children who live in overcrowded conditions. Kindergartens' stay, and exposure to cigarette smoke may also increase the possibility that babies develop bronchiolitis.

Bronchiolitis is a clinical syndrome that comprises a group of presumed viral lung infections in children [8]. Although many cases are thought to be due to RSV, a substantial percentage of clinically indistinguishablecases test negative. As bronchiolitis is not a uniform disease, treatment responses are variable and the literature is varied with regard to treatment recommendations. Options include steroids, beta-agonists, and nebulized epinephrine. The effectiveness of steroids is thought to be highest in cases where the child has underlying reactive airway disease (usually bronchopulmonary dysplasia or asthma). For a child with allergies and eczema, steroids may be effective therapy if he or she has bronchiolitis. The dosing of the steroids is the same as for asthma: 2mg/kg/day once daily (or divided into two equal doses) for 5 days. Betaagonists seem to work for some children and not for others. A trial of two or three nebulized albuterol treatments may be undertaken in the ED. If effective, treatment may be continued as an outpatient using an inhaler with a spacer and mask or as an inpatient with a nebulizer. If ineffective, further treatments are not usually helpful. The use of nebulized epinephrine is currently controversial. Clinical experience suggests that some children respond well to nebulized epinephrine (at least transiently) while others do not.

Stress

Traumatic stress is characterized by responses of intense fear and stress to traumatic events [9]. While these responses are normal and healthy for survival and coping at the time of the event and often for a short time after, their persistence can become maladaptive and disruptive. Common symptoms include an onset and/or intensifying of sleep problems, intrusive thoughts, flashbacks, avoidance, hypervigilance, and general mood dysregulation. Some children experience somatic complaints, or unexplained physical complaints, such as headaches, stomachaches, chest pain, or weight change. Substance use and suicidality can also co-occur and are of great concern.

Traumatic stress can be comorbid with other disorders, particularly preexisting conditions. However, traumatic stress can also go undiagnosed or be misdiagnosed as other conditions with similar symptom profiles. As examples, children with prominent trauma symptoms of arousal and hypervigilance might be confused for having attention-deficit/hyperactivity disorder (ADHD) or anxiety; youth with significant trauma symptoms of avoidance, negative affect, mood dysregulation, and suicidal intent might be solely identified for depression; or children who have panic attacks in response to trauma reminders might be misdiagnosed with anxiety or a panic disorder. Of particular note for medical professionals, traumatic stress symptoms can also present as physical health concerns that are actually somatic complaints. A few studies have documented a relationship between trauma exposure and health concerns such as asthma, allergies, gastrointestinal issues, and headaches. However, in relation to trauma, stomachaches or headaches can come from stress, poor sleep, changes to routine, or avoidance. Chest pain or symptoms of asthma, such as shortness of breath, can come from trauma-induced stress, panic attacks, and anxiety. Weight change can come from emotional coping, stress, and body image or connectivity issues post-trauma. Because of possible similar symptom profiles with other health and mental health conditions, it is important for medical professionals to be trauma informed. This is not to say that someone with ADHD, depression, anxiety, irritable bowels, asthma, or weight change cannot also have traumatic stress comorbid to these conditions, but the under-detection of trauma exposure and the misand underdiagnosis of traumatic stress is concerning. Correctly identifying trauma can help the medical professional understand the etiology of the child's symptoms as well as indicate appropriate trauma-specific evidencebased treatment. A trauma-informed medical professional realizes the importance of responding to trauma and recognizes its symptoms. A simple application of this knowledge directs trauma-informed medical professionals to screen for trauma or rule it out before making diagnostic, treatment, and referral decisions for health and mental health conditions with similar symptom profiles.

Disease

Many illnesses are stratified according to severity because prog-

nosis and treatment vary based on the severity [10]. If neither the prognosis nor the treatment was affected by the stage of the disease process, it would not make much sense to subcategorize something as mild or severe. As an example, mild intermittent asthma poses less danger than does severe persistent asthma (particularly if the patient has been intubated for asthma in the past). Accordingly, with mild intermittent asthma, the management would be intermittent short-acting β-agonist therapy while watching for any worsening of the disease into more serious categories (more severe disease). In contrast, a patient with severe persistent asthma would generally require shortacting β-agonist medications as well as long-acting β-agonists, inhaled steroids, and potentially oral steroids.

Group A β-hemolytic streptococcal pharyngeal infection ("strep throat") is associated with complications including poststreptococcal glomerulonephritis and rheumatic fever. The presence of group A β-hemolytic streptococcus confers an increased risk of problems, but neither the prognosis nor the treatment is affected by "more" group A β-hemolytic streptococcus or "less" group A β-hemolytic streptococcus.

Asthma is a chronic, reversible (in most cases) obstructive airway disease characterized by inflammation and mucosal edema, increased sensitivity of the airways, and airway obstruction (bronchospasm and in some children, excessive, thick mucus) [11]. Increased inflammation causes increased sensitivity of the airways and is the most common feature of asthma.

Asthma is characterized by reversible hyperresponsiveness, obstruction, and inflammation of the lower airways [12]. About 13% of children are affected and, despite recent therapeutic advances, morbidity continues to be substantial, especially among inner-city residents. Common triggers include irritants (cigarette smoke), viral infections, weather changes, allergens (dust, animals), exercise, cold air, and emotional stress. Children with a history of bronchopulmonary dysplasia (BPD) or other acute lung injury (smoke inhalation, hydrocarbon ingestion, near-drowning) are at increased risk for hyperactive airways or asthma. The greatest risk of mortality is in children who have a history of respiratory failure or hypoxic seizures, are under-treated (at home or after a medical visit), or delay seeking medical attention.

Asthma is a chronic disease with significant morbidity and mortality [13]. It is a complex disease with a genetic component as well as an environmental component. According to the National Heath Interview Survey, over 10 million U.S. children under age 18 (14%) have ever been diagnosed with asthma and 7 million children still have asthma (10%). A prevalence study from Canada showed that 13% of asthmatic children used CAM, and the most common forms used were vitamins, homeopathy, and acupuncture.

A patient with a moderate to severe asthma exacerbation often has decreased air movement with diffuse wheezing (classically expiratory, but may be both inspiratory and expiratory), a prolonged expiratory phase, tachypnea, dyspnea, accessory muscle use, and coughing [14]. In status asthmaticus, the respiratory examination can be misleading, as the patient may have no wheez - ing because of lack of air movement ("tight" chest), so that the subsequent onset of wheezing may indicate improved air movement and a response to therapy. Tachycardia is common and can be secondary to respiratory distress, dehydration, or a side effect from the use of short-acting β2-agonists (SABAs) (albuterol, levalbuterol). If the patient presents with or develops fever, focus the examination on an evaluation for bacterial versus viral etiologies, although musical wheezing is generally not consistent with a classical bacterial process. Unilateral wheezing may indicate a foreign body or airway mass.

Assessment

Chest has hyperresonance on percussion [11]. Breath sounds are loud and coarse, with sonorous crackles throughout the lung fields. Prolonged expiration is noted. Coarse rhonchi may be heard, as well as generalized inspiratory and expiratory wheezing. As obstruction increases, wheezing becomes more high pitched. With minimal obstruction, wheezing may be mild, heard only on end expiration with auscultation, or absent. Breath sounds and crackles may become inaudible with severe obstruction or bronchospasm. Posturing occurs to facilitate breathing. Pulsus paradoxus (an abnormally large decrease in systolic blood pressure and pulse wave amplitude during inspiration) also may be noted because of lung hyperinflation.

Children with chronic asthma may develop a barrel chest with depressed diaphragm, elevated shoulders, and increased use of accessory muscles of respiration. If symptoms are untreated or treated unsuccessfully, an acute asthma attack may progress to status asthmaticus, a severe unrelenting attack. Status asthmaticus is an acute, severe, and prolonged asthma attack in which respiratory distress continues despite vigorous therapeutic measures and may result in death.

Management

Children with asthma should have their medical management optimized [15]. All medications, both oral and inhaled, should be continued up to and including the day of surgery. Oral medications may be taken with clear fluids up to two hours before the induction of anesthesia. Patients with particularly severe asthma may benefit from short-term corticosteroid therapy for several days before surgery. Therapy should be planned with the pulmonologist.

Surgery should generally be postponed for children with an acute exacerbation of asthma or those who have an acute URI superimposed on chronic asthma. Asthmatic children are at increased risk of bronchospasm during general endotracheal anesthesia. The incidence of bronchospasm in asthmatic patients during anesthesia is between 8.4 and 71.0 per 1000, compared with 0.2 and 8.0 per 1000 in the general population. This incidence is further increased during acute exacerbations. Any child who has reactive airway disease is at increased risk of bronchospasm under anesthesia even in the absence of wheezing. For this reason, children who take inhalers on an as needed or occasional basis should implement prophylactic therapy 48 hours in advance of the surgery or procedure date. If there has not been an adverse airway event, treatment with a bronchodilator is not necessary

Airway Manangement

Though the principles of airway management in adults and chil-

dren are the same, a number of agerelated differences must be accounted for when managing the pediatric airway [16].

Physiologically, pediatric patients have a higher rate of O2 consumption and smaller functional residual capacity; therefore, they tend to desaturate more rapidly than adults. Compared with adults, children tend to have a shortened period of protection from hypoxia following pre-oxygenation, and infants and small children may require BVM (bag-valve-mask) ventilation during RSI (Rapid sequence intubation) to avoid hypoxia. Airway equipment selection is also based on the child's weight and length. A child's ETT (endotracheal tube) size can be estimated by the size of their external naris, the diameter of their little finger, or the formula ETT size 4 (age in years/4). The depth of ETT placement may be remembered as approximately three times ETT size or (age in years/2) 12.

Prevention

Asthma is a disorder of breathing characterized by widespread narrowing of airways within the lung. The main symptom is shortness of breath [17]. Although asthma can be potentially life threatening, medications can lead to symptom relief and prevention of future symptoms/asthma attacks. Due to these preventative measures the majority of research has focussed on changing children's health behaviors, such as adherence to medication. However some researchers have focussed on the importance of psychosocial factors that can impact the physical health of children with asthma. Adolescent boys with high allostatic load (assessed as a biomarker of chronic stress) were more susceptible to asthma (incident onset or continued prevalence) than in boys with low allostatic load. Similarly, socioeconomic status (SES) has been cited as an important factor in determining the success of a psychosocial intervention.

Social support has been found to have a mediating as well as a direct effect on health outcomes. For example, whilst poor maternal mental health has been linked to atopic and non-atopic wheezing, positive perception of social support acts as a protective factor. Family interaction and social support have also been found to be beneficial in other atopic conditions such as allergies. Family functionality, defined as adaptability and cohesion, has been linked to recovery from allergies in children aged between 18 months and 3 years. Furthermore, the combined effect of underlying chronic family stress and acute stress events have been reported to induce asthma symptoms in children aged 9–18 years.

Conclusion

The diagnosis of asthma in childre is primarily based on symptoms and clinical examination, which are often sufficient for a clinical diagnosis. There is no single diagnostic test for the diagnosis of asthma, so the condition is often difficult to diagnose, especially in young children. Namely, lung functions cannot be measured in this age group, and the disease often manifests itself only as recurrent episodes of coughing and/or wheezing, which may resemble the symptoms of some other diseases. As asthma often occurs before the age of five (and may begin earlier), early diagnosis, monitoring, and effective treatment are also important in these patients.

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