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Asthma In Adults: Principles Of Diagnosis And Management

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Abstract

Asthma is a chronic respiratory condition that can onset in childhood or adulthood. The chronic nature of the condition can, over a period, lead to decreased lung function, which can cause morbidity and even fatality in some cases. Therefore, it is critical to assess the current diagnostic techniques and treatment modalities to reduce any adversities associated with asthma.

Aim: To objectively review the latest methodology for diagnosis and management of asthma in the adult population.

Materials and methods: This review is a comprehensive search of PUBMED from the year 2005 to 2025.

Conclusion: Asthma is a chronic condition that requires careful and timely diagnosis to prevent lifelong complications and frequent exacerbations. The condition should be conscientiously treated according to the patient's age, sex, history, and symptoms, along with avoidance of risk factors as much as possible.

Keywords: Asthma; Adults; Diagnosis; Management; Risk factors.

Introduction

Asthma is a commonly seen chronic condition that affects the bronchioles. It is characterized by symptoms that vary and often recur, obstruction of the air, and bronchospasms. The most common symptoms are wheezing, dyspnea, coughing, and tightness of the chest. [1] WHO reports that asthma affected nearly 262 million people in 2019, and has cost an estimated 455,000 deaths.[2] About 96% of deaths in lower-income countries are attributed lack of availability or high cost of inhaled medicines, especially inhaled corticosteroid (ICS) inhalers.[3]

Etiological causes

Asthma is caused by a variable combination of genetic and environmental factors. The interplay of a genetic susceptibility and an environment with factors suitable for precipitating the disease is believed

to be responsible.[4] Tan et al hypothesized that genetic potential and atopy are more attributable to the onset of asthma before the age of 12, while post 12 years of age, environmental factors are more dominantly responsible.[5]

Genetic Factors

It has been reported that people are more likely to develop if other close family members, such as a parent or sibling, also have asthma.[2] Elward et al reported that if one identical twin has asthma, the probability of the other twin developing asthma is nearly 25%.[6] Various genes have been implicated in asthmatic symptoms due to their relation to the immune system or role in modulating the inflammatory process. Some of these genes include IL-10, GSTM1, CTLA-4, SPINK5, LTC4S, and IL4R. However, despite the presence of genes being corroborated by several studies, the results of those studies have been variable among different populations.[7]

Martinez described that certain genetic variants only cause asthma in combination with certain specific environmental factors, such as a single-nucleotide polymorphism in the CD14 region, along with exposure to an endotoxin that can come from various environmental sources. In such cases, the risk of asthma is the combined product of the genetic predilection and the exposure to endotoxin. [4][8]

Environmental Factors

Environmental allergens and irritants, on exposure, increase the risk of asthma. These allergens include indoor and outdoor air pollution, house dust mites, molds, occupational chemical exposure, fumes, and dust.[2] These substances that cause asthma in exposed people are known as asthmagens.[9] Development of asthma and an increase in severity is associated with low air quality from environmental factors such as traffic pollution or high ozone levels.[10] Volatile organic compounds can be a trigger for asthma, with formaldehyde showing a positive association.[11]

Allergens

Inhalation of common indoor allergens such as dust mites, cockroaches, animal dander, and mould is associated with asthma.[12] Viral respiratory infectious agents such as respiratory syncytial virus and rhinovirus may be associated with increased risk of developing asthma, especially in pediatric populations.[1]

Hygiene Hypothesis

The hygiene hypothesis has been employed to explain the increased rates of asthma around the world is due to a direct and unintentional result of decreased exposure to non-pathogenic microbes during childhood. [13] The reduced exposure to these microbes, such as bacteria and viruses, is due to decreased family sizes along with increased cleanliness. This hypothesis is corroborated by the lower incidence rate of asthma in farms and households with pets.[14] Delivery via caesarean section is associated with increased rates of developing asthma due to a lack of acquisition of healthy bacterial colonization that the newborn would have acquired during passage through the birth canal.[15]

Medical conditions

Atopy is a triad of atopic eczema, allergic rhinitis, and asthma.[16] Atopic disease is the strongest risk factor for the development of asthma, with a higher rate of development in individuals with either eczema or hay fever.[1][17] Asthma is more common in individuals with certain types of urticaria.[1] Holtjer et al reported a strong association between higher BMI and increased risk of asthma.[18] It is believed that the buildup of fat leads to decreased respiratory function, along with the pro-inflammatory nature of the adipose tissue.[19] Mendy et al reported that in adults, asthma is associated with diabetes and hypertension[20] Medications are also known to trigger asthma in susceptible patients. This includes beta blockers such as propranolol, ACE inhibitors, aspirin, and NSAIDS.[21][22] Lai et al also reported that maternal consumption of acid-suppressive drugs during the prenatal period can increase the risk of asthma in the offspring.[23]

Exacerbation

Also known as an asthma flare-up or asthma attack, It is an acute or sub-acute worsening in symptoms and lung function, compared with the person's usual condition. It can be triggered by upper respiratory tract infections that are viral in nature, exposure to pollen or pollution, or poor adherence to ICS treatment. These exacerbations can also be seen without any risk factors.[24] Scelo et al reported that individuals with allergic rhinitis, nasal polyposis, and chronic rhinosinusitis experience more exacerbations per year, compared to those without such conditions. Anxiety and depression are categorized as asthma-mimicking or asthma-aggravating comorbidities due to worse symptom control, reduced medication adherence, and reduced asthma-related quality of life. Asthma-COPD-related overlap also leads to more frequent exacerbations.[25] Severe exacerbations can often be fatal but can be reduced by taking ICS-containing treatment.[24]

Pathophysiology

Asthma is caused by increased contractibility of smooth muscle surrounding the conducting zone of airways- bronchi and bronchioles, due to chronic inflammation. This leads to the classic symptoms of wheezing and bouts of narrowing of airways, along with other factors. The narrowing is reversible in nature, with or without the aid of medicines.[17] Changes are observed in the airway, which can include eosinophilia and thickening of the lamina reticularis. There may be hypertrophy of smooth muscles along with hyperplasia of mucous glands. The other components of the immune system that are also involved include T-lymphocytes, macrophages, neutrophils, cytokines, chemokines, histamine, and leukotrienes.[26] Other microscopic features include Charcot-Leyden crystals and Curschmann's spirals.[25]

Diagnosis

Signs and symptoms

The condition is characterized by recurring episodes of wheezing, dyspnea, chest tightness, and coughing.[26] These symptoms can range from mild to severe, from frequent to infrequent. When the symptoms of asthma are triggered, the air flow to the lungs is reduced, leading to difficulty in breathing out due to bronchoconstriction, the airways become thicker, and the mucus increases. There is an overall reduction in the expiratory airway, especially in patients with untreated asthma.[24]

Clinical Diagnosis

Diagnosis of asthma is based on clinical standards.[29] According to the GINA guidelines, asthma has two defining features: history of typical respiratory symptoms that are variable, that can be variable in frequency and severity, and variability in expiratory airflow. The physical examination is normal, but wheezing can be heard, especially on forced expiration. Spirometry is employed to confirm the diagnosis.[24]

Spirometry

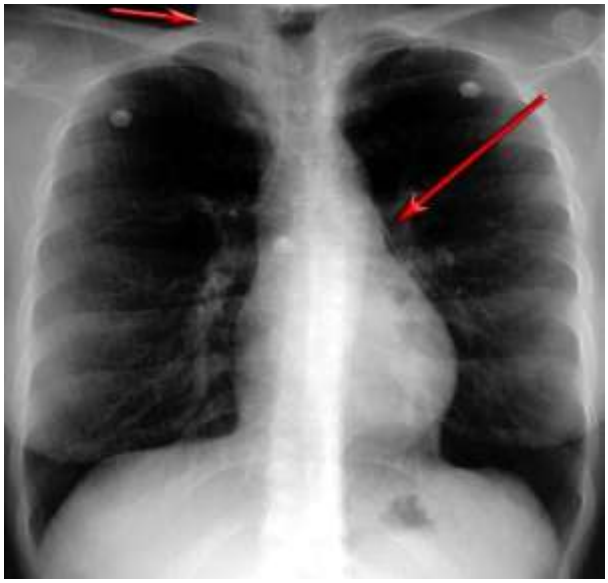
Spirometry is recommended for the diagnosis and management of asthma.[29] Following administration of bronchodilators such as salbutamol, if the FEV_1 improves more than 12% and increases by at least 200 milliliters, it is supportive of an asthma diagnosis.[26] Spirometry is to be performed every one to two years to monitor asthma control.[1]

Radiography

Chest Radiographic Imaging

Chest X-ray is the most commonly used imaging method for the evaluation of asthma patients, especially in the case of exacerbation.[30] Bronchial thickening, hyperinflation, and focal atelectasis, though, are suggestive of asthma; chest radiography during exacerbation can demonstrate normal radiography, thus reducing the sensitivity of the method. Similar radiographic features can be seen in other conditions, such as chronic bronchitis and viral bronchopneumonia.[31]

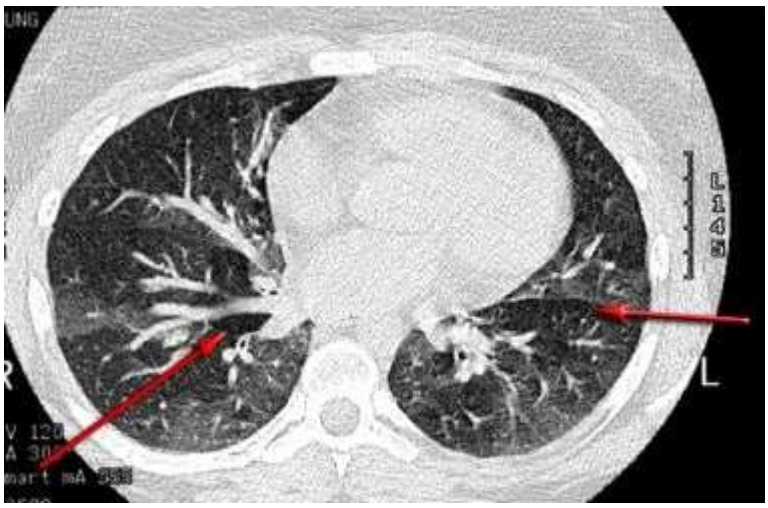
Figure 1: Plain Chest Radiography showing pneumomediastinum in bronchial asthma in posteroanterior view.[31]



Computed Tomography

A second line examination is high-resolution computed tomography (HRCT). It is beneficial in patients with chronic or recurring symptoms and in patients with complications such as bronchopulmonary aspergillosis and bronchiectasis.[32] It is a more sensitive method of diagnosis as it is better able to gauge the morphological changes associated with asthma, but it is expensive and increases the radiation exposure to the patients.[31]

Figure 2: High-resolution CT depicting mosaic pattern of lung attenuation in a patient with asthma during expiration [31]



Magnetic Resonance Imaging

Regional distribution of ventilation defects in asthma can be visualised across the lung using hyperpolarized gas in MRI.[33] However, hyperpolarized MRI comes with limitations such as the limited availability of a specialized mixture of gases, which is only available for research purposes, and the need for breath holding for 20 seconds by the patients, which can be difficult for patients with severe asthma.[34]

Methacholine Challenge

The methacholine challenge consists of using a substance that causes airway narrowing in predisposed individuals, which is given in increasing concentrations. If the test shows negative, the individual does not have asthma. In case of a positive test, it is not specific to the disease.[26]

Biomarkers

In patients with typical asthma symptoms, in case spirometry or PEF is unavailable, or testing is negative, elevated FeNO (adults/adolescents: >50ppb; children >35ppb) or blood eosinophils that are above the national/regional reference range can be used to support the diagnosis for Type 2 asthma. But as these biomarkers vary substantially and thus a lower reported level is not negative for asthma.[24]

Differential Diagnosis

The diagnosis for asthma should be made clinically while taking in consideration of family history, symptoms, and investigations.[35]

Table 1: Differential diagnosis for asthma [35]

CLINICAL CLUE	POSSIBLE DIAGNOSIS
Perinatal and family history	
Symptoms present from birth or perinatal lung problem	Cystic fibrosis; chronic lung disease of prematurity; ciliary dyskinesia; developmental lung anomaly
Family history of unusual chest disease	Cystic fibrosis; neuromuscular disorder
Symptoms and signs	
Persistent moist cough	Cystic fibrosis; bronchiectasis; protracted bacterial bronchitis; recurrent aspiration; host defence disorder; ciliary dyskinesia
Breathlessness with light-headedness and peripheral tingling	Dysfunctional breathing, panic attacks
Inspiratory stridor	Tracheal or laryngeal disorder
Failure to thrive	Cystic fibrosis; host defence disorder; gastro-oesophageal reflux
Investigations	
Focal or persistent radiological changes	Developmental lung anomaly; cystic fibrosis; postinfective disorder; recurrent aspiration; inhaled foreign body; bronchiectasis; tuberculosis
Without airflow obstruction	
Predominant cough without lung function abnormalities	Chronic cough syndromes; pertussis
Prominent dizziness, light-headedness, peripheral tingling	Dysfunctional breathing
Recurrent severe ‘asthma attacks’ without objective confirmatory evidence	Vocal cord dysfunction
Predominant nasal symptoms without lung function abnormalities	Rhinitis
Orthopnoea, paroxysmal nocturnal dyspnoea, peripheral oedema, preexisting cardiac disease	Cardiac failure

With airflow obstruction	
Significant smoking history (ie, >20 packyears), age of onset >35 years	COPD
Chronic productive cough in the absence of wheeze or breathlessness	Bronchiectasis*; inhaled foreign body*; obliterative bronchiolitis; large airway stenosis
New onset in smoker, systemic symptoms, weight loss, haemoptysis	Lung cancer*; sarcoidosis*

* May also be associated with non-obstructive spirometry

Brittle Asthma

It is a severe form of asthma that, in spite of the use of heavy doses of corticosteroids, is characterised by a wide margin of variability of peak expiratory flow (PEF). These patients can have very serious attacks that can often be fatal. The disease can be classified as Type 1 with maintained PEF variability despite therapy and a female predilection, and Type 2, which can be characterized by acute/sudden attacks that can be very severe.[36]

Management

The management of asthma involves controlling the symptoms, managing the risk factors, preventing exacerbations and loss of lung function, and reducing any associated mortality.

Managing Risk Factors

Treatment of the risk factors, along with the management of the comorbidities, can help to reduce asthma exacerbations. The strategies recommended by GINA guidelines include: guided self-management, use of treatment regimens that include the use of ICS, avoidance of tobacco smoke, management of confirmed food allergy, referral to specialist centers, along with school-based programs that aim at skills to manage asthma.[24]

Non-pharmacological management

Though the SIGN guidelines state that the effectiveness of non-pharmacological management is difficult to maintain and call for more well-controlled interventional studies, they classify the preventive methods into two: primary and secondary. Primary prevention is the interventions that are introduced before the onset of the disease, designed to reduce the incidence. Secondary prevention is introduced after the onset and aims to reduce its severity. The prevention strategies include: food allergen avoidance, breastfeeding, modified infant milk formulae, nutritional supplementation – fish oils, weight reduction in overweight and obese patients, avoidance of tobacco smoke and other air pollutants.[35] Alternative methods such as breathing exercises, herbal and traditional Chinese medicine, homeopathy, hypnosis and relaxation therapies, and physical training can be recommended, but the effectiveness of some of these is not corroborated by sufficient studies.[35]

Pharmacological management

The 2025 GINA guidelines do not recommend monotherapy with SABA for adults and adolescents. Instead, they recommend the use of ICS-containing treatment modalities. Low-dose ICS-containing treatment should be started initially in adults and adolescents. The preferred treatment, also known as anti-inflammatory reliever (AIR) therapy, involves the use of ICS-formoterol in place of SABA.[24]

Two-track approaches can be used for the treatment of adults and adolescents. Track 1, which is recommended by GINA, utilises low-dose ICS-formoterol as reliever therapy, while track 2 consists of SABA as a reliever or a combination of ICS-SABA. The preference for track 1 is due to evidence corroborating its effectiveness in reducing exacerbations.[24]

Table 2: Treatment track for Asthma [24]

CLINICAL FEATURES	TRACK 1	TRACK 2
Infrequent asthma symptoms	Low dose ICS-formoterol as needed	Low dose ICS with SABA taken as needed
Asthma symptoms <3-5 days/week, with the lung function being either normal or mildly reduced	Low dose ICS-formoterol as needed	Regular daily dose of low-dose ICS, SABA in addition as needed
Asthma symptoms most days, waking due to asthma once a week or more, or low lung function	Low dose ICS-formoterol maintenance and reliever therapy (MART)	Regular daily low-dose ICS-LABA +SABA/ICS-SABA as needed
Daily asthma symptoms most days, waking at night due to asthma once a week or more, with low lung function, or current smokers	Medium-dose ICS-formoterol MART	Regular daily medium-dose ICS-LABA +SABA/ICS-SABA as needed Regular high-dose ICS+ SABA as needed
During acute asthma exacerbation	Treat exacerbation Start medium-dose ICS-formoterol MART	Treat exacerbation Start regular medium-dose ICS-LABA + SABA as needed

Other treatment options for adults and adolescents include:[24]

Table 3: Alternate treatment modalities for asthmatic patients [24]

TREATMENT MODALITY	CLINICAL NOTE
Specific allergen immunotherapy	• Can be used in caste of house dust mite allergy which is not well controlled by ICS • Sublingual immunotherapy not recommended if FEV_1 is ≤ 70%.
Long-acting muscarinic antagonists (LAMA)	• Add-n LAMA reduces risk of exacerbations while improving lung function; but shows no clinically important reductions in symptoms like dyspnea • Before adding LAMA for patients with exacerbations, medium dose ICS or MART should be considered
Leukotriene receptor antagonists	• These include montelukast, pranlukast, zafirlukast • Less effective than daily ICS, especially in preventing exacerbations

Managing severe asthma

In case, despite the use of Step 4 treatment, the patient has uncontrolled symptoms and/or exacerbations, the causes should be assessed, and the treatment should be optimized. Sputum eosinophil count should be measured if the test is available. The following treatment modalities can be considered:[24]

Table 4: Management modalities for severe asthma [24]

TREATMENT MODALITY	CLINICAL NOTE

High-dose ICS-LABA	• Can be considered • High risk of adverse effects such as adrenal suppression
Long-acting muscarinic antagonists	• Can be used in addition to ICS-LABA treatment
Biologics	Options include: • Anti-immunoglobulin E (subcutaneous omalizumab)- severe allergic asthma • Anti-interleukin 5 (reslizumab, mepolizumab, benralizumab) – severe eosinophilic asthma • Anti-interleukin 4 receptor alpha (dupilumab)- severe eosinophilic asthma/ Type 2 airway inflammation asthma/ patients who need maintenance oral corticosteroids
Maintenance oral corticosteroids	• Last resort • Lowest possible dose is used because of serious side-effects

Management of exacerbations

Compared to the patient's usual status, acute or subacute worsening of symptoms and lung function of the patient is referred to as an exacerbation. These exacerbations can be due to viral upper respiratory tract infection, exposure to pollen or pollution, or poor adherence to ICS treatments. Exacerbations can also occur without any of the risk factors. [24]

Table 5: Management of asthma exacerbation [24]

MANAGEMENT	CLINICAL NOTE
For patients using low-dose ICS-formoterol reliever (adults/adolescents using Track 1 treatment)	• Advise extra doses of ICS-formoterol inhaler for symptom relief • Seek medical care if symptoms are worsening or no improvement after 2-3 days or if more than maximum number of daily doses are needed
For patients using ICS-SABA reliever (adults/adolescents using Track 2 treatment)	• Advise extra doses of ICS-SABA • Seek medical care if condition is rapidly deteriorating or not improving after 2-3 days, or if ICS-SABA is needed more than 6 times daily
For patients using SABA reliever (adults/adolescents using Track 2 treatment)	• Use SABA for symptom relief, increase ICS-containing maintenance if it is prescribed for 1-2 weeks

Other points for consideration are to assess for alternative causes for breathlessness, use of bronchodilator therapy (salbutamol is commonly used) with controlled flow oxygen, oral corticosteroid therapy (prednisolone), titration of oxygen, and avoidance of sedative use. [24]

Complications

Various other conditions can complicate asthma in patients. These include: atelectasis, pneumonia, mucoid impaction of airways, pneumothorax, pneumomediastinum, eosinophilic lung disease allergic bronchopulmonary aspergillosis, bronchocenteric granulomatosis, chronic eosinophilic pneumonia, and syndrome of inappropriate antidiuretic hormone secretion (SIADH). [36]

Conclusion

Asthma is a chronic condition that requires careful and timely diagnosis to prevent lifelong complications and frequent exacerbations. The condition should be conscientiously treated according to the patient's age, sex, history, and symptoms, along with avoidance of risk factors as much as possible.

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Author contributions

The first author wrote the original text of the document. Each author must give their final approval before the manuscript is sent to a journal for publication. The literature review, editing, and creation of the table and figures were all completed by each co-author.

Conflict of Interest

The authors declare no conflict of interest, financial or otherwise.

Ethical Approval

Not Applicable

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