Acute severe asthma in adults

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Abstract

Acute severe asthma represents a common medical emergency accounting for >65,000 UK hospital admissions each year, and asthma still accounts for approximately 1200 UK deaths annually. Risk factors for fatal asthma include poorly controlled disease, inappropriate medical management and adverse behavioural and social factors. Asthma is characterized by chronic airway inflammation, resulting in periodic wheeze, cough and breathlessness. A variety of triggers can cause exacerbations, most commonly viral respiratory tract infections. Exacerbations are identified by an increase in asthma symptoms and fall in lung function. National and international acute asthma management guidelines highlight best practice. All patients presenting with poorly controlled asthma symptoms should be examined and peak expiratory flow (PEF) or forced expiratory volume in 1 second recorded. Patients with PEF <50% of baseline or predicted have a severe exacerbation and should be referred to hospital. Treatment aims to rapidly relieve bronchoconstriction and halt airway inflammation; oxygen, systemic corticosteroids and inhaled bronchodilators are first-line treatments. Patients with features of life-threatening asthma should be given magnesium sulphate and discussed with the intensive care team. Before discharge, medications should be reviewed, a personalized action plan agreed and early follow-up arranged.

Keywords Acute asthma; anticholinergics; β_2-adrenoreceptor agonists; corticosteroids; exacerbation; oxygen; self-management plans

Key points

- Acute asthma exacerbations are potentially life threatening
- Aggressiveness of treatment should be guided by objective assessment of attack severity
- A lower threshold for admission should exist for patients with risk factors for fatal asthma
- Patients with life-threatening attacks or who fail to improve with initial treatment should be referred early to intensive care
- Exacerbations during pregnancy should be treated aggressively in the same manner as in non-pregnant individuals
- Agree a personalized asthma action plan before discharge

Burden of disease

Acute severe asthma represents a common medical emergency, accounting for more than 65,000 UK emergency hospital admissions a year. Although mortality from asthma has steadily declined, approximately 1200 deaths are still reported yearly in the UK, and annual worldwide deaths are estimated at 250,000.[1] The first UK-wide investigation into asthma deaths in 2014[2] highlighted that fatal exacerbations frequently occurred in the context of inappropriate medical management, adverse behavioural and social factors, and severe or poorly controlled background disease; potentially preventable factors were identified in >60% of deaths (Table 1).

International[1] and national[3] acute asthma guidelines aim to translate research advances into clinical practice, standardize acute asthma care and improve asthma morbidity and mortality.

Initial assessment of patients

The assessment and management of patients with acute severe asthma is summarized in Figure 1. Treatment intensity is tailored to exacerbation severity, and objective assessment is paramount.

History and examination

A brief history is required (Table 2). Physical examination should assess exacerbation severity and identify other diagnoses or complicating illnesses, such as pneumonia, pneumothorax or pneumomediastinum. This should include ability to complete a sentence, pulse rate, respiratory rate and accessory muscle use. Asymmetrical breath sounds should prompt consideration of additional pathology, particularly pneumothorax. In delayed presentations or life-threatening attacks, the patient can become exhausted and confused, with poor respiratory effort and bradycardia, and the chest becomes silent to auscultation.

Functional assessments and investigations

Lung function testing should be undertaken early in patients presenting with an exacerbation. Although forced expiratory volume in 1 second (FEV_1) is more accurate, peak expiratory flow (PEF) is more convenient in acute settings. PEF <50% of the patient's normal best value is the most important predictor of a severe exacerbation. If the patient's baseline is unknown, PEF should be compared with predicted values.

Oxygen saturation (SpO_2) should be measured by pulse oximetry and maintained at 94–98. Arterial blood gas measurement is required with SpO_2 <92% (whether breathing air or oxygen) or other features of life-threatening asthma. As most exacerbations are associated with increased respiratory drive causing hypocapnia and respiratory alkalosis, normal or raised partial pressure of carbon dioxide ($PaCO_2$) indicates severe airway obstruction and a life-threatening attack.

Chest X-ray should be performed if pneumothorax, pneumomediastinum or consolidation is suspected, there is failure to respond appropriately to treatment, or asthma is life-threatening.

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Factors associated with near-fatal or fatal asthma exacerbations[2,3]

- Previous near-fatal asthma
- Previous admissions for asthma or emergency department attendances, especially in the previous 12 months
- Asthma requiring three or more classes of medication
- Heavy use of short-acting β_2-adrenoreceptor agonist ('reliever') inhaler, e.g. >12 short-acting reliever inhalers in the previous 12 months
- Brittle asthma (with wide peak expiratory flow variability or severe attacks on a background of well-controlled asthma)
- Adverse behavioural or psychological features, including:
  - Non-adherence/failure to attend appointments, self-discharges or frequent home visits
  - Alcohol and drug misuse
  - Current cigarette smoking or exposure to second-hand smoke at home
  - Psychiatric illness
  - Learning difficulties
  - Social isolation
  - Financial, domestic or employment problems
  - Obesity

Table 1

Differential diagnosis

Given the potentially critical nature of an exacerbation, it is almost always reasonable to treat suspected acute asthma as such. Where the condition persists despite aggressive management, an awareness is needed of conditions that can be misinterpreted as acute asthma (Table 3).

Treatment

After a brief initial assessment, all patients with features of a severe exacerbation should be given the following.

Oxygen therapy

Hypoxaemia is an important cause of death in severe exacerbations. High-flow oxygen (40–60%) should be initially given to all patients with acute severe asthma and supplementary oxygen continued to maintain oxygen saturation at 94–98%.

Nebulized β_2-adrenoreceptor agonists

Repeated administration of an inhaled, short-acting β_2-adrenoreceptor agonist (salbutamol 5 mg or terbutaline 10 mg via oxygen-driven nebulizer) is first-line therapy to rapidly reverse bronchoconstriction. If the initial response is poor, continuous nebulization (salbutamol 5–10 mg/hour via an appropriate nebulizer) may be more effective. Administering repeated doses via a metered dose inhaler and spacer is as effective as nebulization and can be useful in the home or primary care setting.

Nebulized anticholinergics

Adding anticholinergics (nebulized ipratropium bromide 0.5 mg) to nebulized β_2-adrenoreceptor agonists produces greater bronchodilation. Ipratropium should be added during more severe attacks or when the response to initial β_2-adrenoreceptor agonist therapy is poor.

Systemic corticosteroids

Systemic corticosteroids are recommended in all exacerbations and aim to suppress airway inflammation. Early use reduces mortality, hospital admissions and relapses.

An initial dose of prednisolone (40–50 mg) should be given and continued for at least 5 days or until recovery. It can take up to 4 hours after administration for clinical improvement to occur. There is no additional benefit of intravenous over oral administration, but hydrocortisone intravenously (100 mg 6-hourly) can be used if reliable oral administration is not possible. Patients' regular inhaled corticosteroids should not be discontinued during a course of systemic corticosteroids.

Magnesium sulphate ($MgSO_4$)

Magnesium is thought to inhibit calcium influx into airway smooth muscle, causing bronchodilation. Studies have shown that a single dose of $MgSO_4$ (1.2–2 g intravenously over 20 minutes) confers a modest benefit in severe asthma (PEF <50% best or predicted) not responding to initial bronchodilators, and life-threatening attacks. The dose should not be repeated as hypermagnesaemia is associated with muscle weakness and respiratory failure. Nebulized $MgSO_4$ is not beneficial in acute severe asthma.[4]

Intravenous aminophylline and salbutamol

Intravenous aminophylline and salbutamol probably confer no additional bronchodilation over inhaled bronchodilators and corticosteroids. Intravenous salbutamol, in addition to inhaled therapy, can have a role in ventilated patients and those in extremis. Intravenous aminophylline can confer benefit in a subgroup of patients with refractory exacerbations, but such patients are probably rare. As their use is also associated with adverse effects such as arrhythmias and gastrointestinal upset, they should be discussed with senior medical staff before initiating.

Other treatments

Antibiotics should not be routinely prescribed in acute asthma as infective triggers are predominantly viral.

Heliox is a mixture of helium and oxygen that produces less airway resistance than air. Based on limited small studies, there is currently insufficient evidence to support heliox as a treatment for severe exacerbations.

Leukotriene antagonists block the actions of cysteinyl leukotrienes on the leukotriene receptor CysLT1 within the airways, reducing bronchoconstriction and inflammation. Their use in acute asthma has shown promise, but there is currently insufficient evidence to recommend them.

Non-invasive ventilation has been used successfully in studies of hypercapnic respiratory failure in asthma, but routine use is not currently recommended. This is instead an indication for urgent anaesthetic input and endotracheal intubation.

Sedatives should be strictly avoided during exacerbations because of respiratory depressant effects.