Nebulisers in General Practice

A nebuliser is a device that converts liquid into aerosol droplets suitable for inhalation\textsuperscript{[1]}. Nebulisers use oxygen, compressed air or ultrasonic power to break up medication solutions and deliver a therapeutic dose of aerosol particles directly to the lungs. The use of nebulisers in the community is declining\textsuperscript{[2]}. However, they may still be useful in certain clinical situations, and are preferred by some patients.

Nebuliser systems

A wide variety of nebulisers is available. Nebulisers can be driven by compressed gas (jet nebuliser) or by an ultrasonically vibrating crystal (ultrasonic nebuliser)\textsuperscript{[2]}. Conventional jet nebulisers waste a great deal of the drug during expiration and ultrasonic nebulisers are becoming more common\textsuperscript{[1]}.

In order to produce small enough particles from solution in 5-10 minutes, gas flow rates of at least 6 L/minute are usually necessary. Ultrasonic nebulisers use a rapidly vibrating piezoelectric crystal to produce aerosol particles. Ultrasonic nebuliser machines are often smaller and quieter.

Nebulisers are highly inefficient and many deliver only 10% of the prescribed drug dose to the lungs. Much of the drug is caught on the internal apparatus or wasted during exhalation. The efficiency of drug delivery depends on the type and volume of nebuliser chamber and the flow rate at which it is driven. Some chambers have reservoir and valve systems to increase efficiency of particle delivery during inspiration and reduce environmental losses during expiration. Breath-assisted open vent systems improve drug delivery but are dependent on the patient having an adequate expiratory flow.

Face masks and mouthpieces are equally effective for administration of aerosol particles but breathless patients may prefer face masks. Both nebulisers and spacers used for small children employ face masks. Face masks should be avoided or sealed very tightly when anticholinergic drugs are administered to patients with glaucoma. Face masks should ideally also be avoided for delivery of nebulised corticosteroids, to prevent contact with the surrounding facial skin and eyes\textsuperscript{[1]}.

Use of nebulisers in various clinical conditions

Nebulisers are used for emergency and domiciliary treatment of many respiratory diseases. Indications for nebuliser use include the management of exacerbations and long-term treatment of chronic obstructive pulmonary disease (COPD), management of cystic fibrosis, bronchiectasis, HIV/AIDS and symptomatic relief in palliative care. The British Guideline produced jointly by the British Thoracic Society (BTS) and Scottish Intercollegiate Guidelines Network (SIGN) on the management of asthma identifies a limited use for nebulisers in this condition\textsuperscript{[3]}.

Patients using nebulisers must be advised on how to self-treat and when to seek medical help.

Asthma\textsuperscript{[3]}

See also separate Which Device in Asthma article.

A Cochrane review found that nebuliser delivery produced outcomes that were not significantly better than metered-dose inhalers delivered by spacer in adults or children. Spacers may have some advantages compared to nebulisers for children with acute asthma\textsuperscript{[4]}.

There are few cases in which the British Guideline recommends nebuliser use. It initially states that there are insufficient data to make a recommendation about their use in life-threatening asthma. However, later the Guideline does recommend that the nebulised route (oxygen-driven) be used for the delivery of high-dose beta agonists in acute asthma with life-threatening features. If a nebuliser is used in the emergency situation, there are theoretical risks of oxygen desaturation whilst using air-driven compressors. Therefore, nebulisers should be oxygen-driven with a ‘high flow regulator’ fitted to the cylinder in order to provide the necessary flow rate of 6 L/minute.

COPD

Although patients with COPD are considered to have irreversible bronchoconstriction, most show some reversibility with high-dose bronchodilators. The nebulised aqueous vapour is also believed to alter viscosity of mucus and assist expectoration. Therefore, air-driven nebulisers are used frequently in the treatment of acute exacerbations and maintenance of COPD. However, there is no actual evidence of superiority of nebulisers over metered-dose inhalers for delivery of bronchodilator therapy in COPD.

The National Institute for Health and Care Excellence (NICE) recommends that when using nebulisers in COPD the following should be considered\textsuperscript{[1]}:

- Handheld devices are usually best, with a spacer if appropriate.
- Consider a nebuliser for people with distressing or disabling breathlessness despite maximum therapy with inhalers.
• Assess the individual and/or carer’s ability to use the nebuliser before prescribing and arrange appropriate support and maintenance of equipment.
• Continue nebuliser treatment only if there is an improvement in symptoms, daily living activities, exercise capacity or lung function.
• Cognitive function and praxis are more important than age in determining the ability of an older patient to use handheld inhalers or nebulisers.
• Patients experiencing difficulties using handheld inhalers may also have difficulty using nebulisers.
• Nebulised therapy should not continue to be prescribed without assessing and confirming that one or more of the following occurs:
  - A reduction in symptoms.
  - An increase in the ability to undertake activities of daily living.
  - An increase in exercise capacity.
  - An improvement in lung function.

• Nebulised therapy should not be prescribed without an assessment of the patient’s and/or carer’s ability to use it.
• Patients should be offered a choice between a face mask and a mouthpiece to administer their nebulised therapy, unless the drug specifically requires a mouthpiece (for example, anticholinergic drugs).
• Both nebulisers and handheld inhalers can be used to administer inhaled therapy during exacerbations of COPD.
• If a patient is hypercapnoeic or acidic the nebuliser should be driven by compressed air, not oxygen (to avoid worsening hypercapnoea). If oxygen therapy is needed it should be administered simultaneously by nasal cannulae. The driving gas for nebulised therapy should always be specified in the prescription.

It has been shown that patients poorly understand the principles of nebuliser treatment and are unaware when compressors frequently malfunction. Patients benefit greatly from improved nebuliser education, written instructions and technical support, which can be provided by nurse-led domiciliary services [6].

Cystic fibrosis, bronchiectasis, AIDS-associated infections and terminal disease
Nebuliser systems are used to deliver medications to control the symptoms and the progression of lung disease in people with cystic fibrosis. Many types of nebuliser systems are available [6]. Nebulisers are used to deliver bronchodilators, corticosteroids and dornase alfa to the lungs of patients with cystic fibrosis [7].

• Bronchodilator therapy not only improves airway obstruction but also increases mucociliary clearance of viscous secretions.
• High-dose corticosteroids are used to minimise airway inflammation in the treatment of bronchial hyperactivity and to reduce the rate of decline of respiratory function.
• Inhalation of the enzyme dornase alfa reduces sputum viscosity and improves clinical outcomes of people with cystic fibrosis [8].
• Regular nebulised antipseudomonal treatment also improves lung function and reduces the frequency of exacerbations of infection in people with cystic fibrosis [9].

Regular, long-term nebulised gentamicin is of significant benefit in non-cystic fibrosis bronchiectasis [10].

Nebulised pentamidine cannot be recommended for prophylaxis of Pneumocystis jirovecii pneumonia, as efficacy data are insufficient [11].

Many nebulised drugs are employed in palliative care but few indications are based on published evidence. However, regular nebulised normal saline helps to loosen tenacious secretions, may reduce breathlessness and is unlikely to do harm. There is also anecdotal evidence to support the use of nebulised opioids in patients with dyspnoea related to cancer but this has not been supported in clinical trials [12].

Practical issues
A patient’s ability to use equipment correctly must be assessed before recommending nebulised therapy. The actual nebulisers and compressors are not prescribable on the NHS [2]. It is important to select a nebuliser chamber and a compressor which are compatible. Access to equipment, servicing, advice and support must also be organised [1].

Cleaning
• Nebulisers should be cleaned daily in regular usage and after each use in intermittent use.
• The mask, mouthpiece and chamber should be disconnected, disassembled and washed in a warm detergent and water solution. The components should be left to dry overnight.
• Before reuse, the nebuliser should be run for a few seconds before adding medications.

Maintenance
• Disposable components such as the mouthpiece, mask, tubing and nebuliser chamber should be changed every three to four months.
• Compressors require annual servicing by manufacturer or local service provider.

Breakdown
• Patients must have a written plan describing whom to contact in the case of emergency, such as a respiratory or practice nurse.
If nebuliser times are slow, the equipment should be cleaned and treatment tried again. If it remains slow, a spare nebuliser should be used.

Further reading & references

1. Chronic obstructive pulmonary disease; NICE Clinical Guideline (June 2010)
2. Rees J; Methods of delivering drugs. BMJ. 2005 Sep 3;331(7515):504-6.
3. British Guideline on the management of asthma; Scottish Intercollegiate Guidelines Network - SIGN (2016)
11. Guidelines for the Prevention and Treatment of Opportunistic Infections in HIV-Infected Adults and Adolescents; AIDSInfo
12. How your doctor can help with breathlessness; CancerHelp UK

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