EFFECTIVE AEROSOL THERAPY IN CHRONIC RESPIRATORY DISEASE

Dr Matthew Ng Joo Ming

ABSTRACT

Inhaler therapy offers many advantages over systemic medications including less side effects and rapid onset of action. Currently there are three major types of inhalation devices: metered dose inhaler (MDI), dry powdered inhaler (DPI) and small volume nebuliser (SVN). A patient with COPD would likely to be on a MDI possibly with an aerochamber, along with one or more DPIs for long acting brochodilater therapy or inhaled corticosteroid therapy. Patients do not use their MDIs or DPIs well enough to benefit from the prescribed drugs. We can make aerosol therapy more effective for the patient with chronic respiratory disease by paying attention to the education and training of the patient in the proper use and to make sure that we as providers know how to use the inhalers correctly. Keeping the inhalers few will help the patient.

SFP2006; 32(4): 55-57

INTRODUCTION

Inhaler therapy is the mainstay of treatment in the management of patients with asthma and COPD. It offers many advantages over systemic medications including less side effects and rapid onset of action. The medications are delivered directly to the target organs. In the market there are many different delivery devices, the mechanism and how to use them can be daunting to both the patient and the provider. To add on to the confusion are many different attachment designed to aid the delivery of the medications. Lets look at the following anecdotal examples:

1. Mr Tan a 50-year old odd-jobber has adult onset asthma. He is on follow-up by his Family Physician. He was prescribed Ventolin MDI 2 puffs prn and Becotide 2 puffs three times a day. He has been compliant with his medication and comes to the clinic regularly for reviews and medications. He was referred to the tertiary hospital for frequent exacerbation of his asthma despite being on preventive medications. Asked to demonstrate his inhaler technique during follow-up at the specialist outpatient clinic, he just opened his mouth and spray the aerosol in!

2. Candidates sitting for the Graduate Diploma in Family Medicine are required to take a practical examination comprising of 10 OSCEs stations. Teaching inhaler technique was one of the questions set during one of the examination. The examiners noted with amazement at the number of variations demonstrated by the candidates.

MATTHEW NG JOO MING, Associate Consultant, Family Medicine and Continuing Care, Singapore General Hospital

TYPES OF DELIVERY DEVICES

Currently there are three major types of inhalation devices: metered dose inhaler (MDI), (Figure 1) dry powdered inhaler (DPI) (Figure 2) and small volume nebuliser (SVN) (Figure 3). Based on current therapeutic guidelines[1] a patient with COPD would likely to be on a MDI possibly with an aerochamber, along with one or more DPIs for long acting brochodilater therapy or inhaled corticosteroid therapy.

Figure 1: Metered Dose Inhalers

Figure 2: Dry Powder Inhalers

Figure 3: Small Volume Nebuliser (Courtesy of Julian Lim)

Several recent meta-analysis showed that any inhaler device type can be equally effective in treating patient provided the patient use it correctly and there is drug available in the device[2-4]. There is evidence to show that multiple inhaler type lead to confusion for the patient, resulting in errors of use. Patients with COPD are likely to be in their 60s with other comorbidities resulting in more errors.

PROBLEMS WITH INHALER USE

Fink and Rubin recently reviewed problem of inhaler use. They noted that 28-65% of patients do not use their MDIs or DPIs well enough to benefit from the prescribed drugs. They also noted that corresponding to poor patient use of inhalers, only 2 of 40 textbooks used in physician training include a list of simple steps for the proper use of the MDI[5]. These problems are listed in Table 1.

Table 1. Problems of inhaler use

Metered dose inhalers (MDI)	Dry powder inhalers (DPI)
Error in technique	Error in technique
Lack of dose counter	Dependence on user inspiratory flow
Lack medical provider knowledge	Reduce fine-particle dose in high ambient humility
Patient factor associated poor MDI use	Lack of provider knowledge

Source: Fink & Rubin, 2005

Metered dose inhaler (MDI)

The First MDI was introduced in 1956 by 3M laboratories as an alternative to the breakable glass bulb nebuliser in used at that time. It is a simple compact device requiring the patient to "press and breathe". Yet difficulty in the use of this simple device was recognized as early as 1965. Many studies subsequently from 1980s to the 1990s continue to confirm these, some of which are highlighted on the table above[7]. McFadden cataloged the frequency of patients' errors with MDIs, based on 12 studies, involving 955 subjects who committed 1536 errors[6]. The most frequent MDI error was failure to coordinate actuation with inhalation, followed by too short a breathe-hold.

Another practical problem noted in MDI is the lack of dose counter. Ideally a patient should count the number of actuation he has made to determine the number of doses left in the device. However this is often not the case and patient reported that they determine that the MDI is empty when there is no sound during actuation. MDI makes use of a propellant to drive the aerosol out of the canister and it can release an aerosol plume with little or no drug. Many patient also knew that they are suppose shake the canister before actuation to mixed the propellant and the drug but in practice less than half of patient did so.

Anecdote 2 above illustrates another interesting problem associated with MDI used: the lack of provider knowledge. A number of studies also showed a disturbing lack of knowledge of correct MDI use on the part of the healthcare professional[8].

Patient factors have also been studied as associated with or predictive of poor MDI technique. Mental cognitive status in older patients has emerged in several studies as predictive of the ability to use an MDI correctly[9].

Spacer Device

A holding chamber or spacer (Figure 4) simplify the MDI inhalation and reduced oropharyngeal drug deposition. However it increases the cost to patient and defeats the purpose of having the MDI in the first place, which is its compact size. The electrostatic charge on the wall of the chamber reduces the dose of the medication delivered to the patient. Priming, or actuating the MDI 12-20 times into the holding chamber reduces the electrostatic charge but it is a wasteful of MDI doses.

Figure 4: Spacer Devices

Dry powder inhalers (DPI)

DPI was introduced in 1971 to overcome the problem of dose-breathe synchronizing inhalation of the MDI. It is breath-actuated and removed the hand-breath coordination associated with MDIs. However, there is evidence to show that similar numbers of experience asthma and COPD patients exhibit errors in using DPIs as in MDIs[10].

The number of devices available operates differently in loading and priming for use. This will lead to confusion especially in a patient who requires medication to be delivered in different devices. Humility is a concern with DPIs because of the potential for powder clumping and reduced dispersal of fine particle mass. The humility can be from the ambient air or directly from patient exhalation into the mouthpiece.

DPIs rely on patient inspiratory effort to lift drug powder from the metering chamber or capsule and to disaggregate the powder into particles small enough to reach the lungs. The DPIs in current use have inherent but different resistances, so the inspiratory flow needed to create the pressure drop necessary for optimal drug delivery differs among the various models. This raises the question of whether the COPD patient can perform adequate inhalation through the DPI, especially during an exacerbation because of severe airflow limitation.

Nebulisers

Of all the inhaler types nebulisers offer the simplest used to patients: proper use requires only normal tidal breathing, with no breath-hold and 60-90 inhalations to acquire the aerosol. The usual problems cited for nebuliser are not ones of patient use, but rather other disadvantages including size, possible need for compressor or gas source, external power source and lengthy time of treatment[11]. Further there is variability in the performance of different brands of nebulisers.

SOLUTION TO INHALER MISUSE

An ideal inhaler should possess three qualities: ease of use during an attack, knowing how many doses are left and overall ease of use. With each inhaler types and devices, there are classic problems that complicate patient use:

1. MDIs: disordination of actuation and inhalation; no dose counter
2. Holding chamber or spacer: additional bulk; additional cost
3. DPIs: differences in loading and priming among different models; need for patient inspiratory effort
4. Nebuliser: need for power source, bulky and lengthy time of treatment.

An inhaler that is easy to learn and use may alleviate recurring problems of lack of knowledge on the part of the patient and the provider. Simplified inhaler design and easy use may improve use in patients who have cognitive and physical impairment. Unless all manufacturers can agree on a "universal inhaler" type, which operates basically the same with any formulation, it looks like the interim measure to minimized misuse lies in the education, training of the patient and provider[12].

A recent study by Song et al showed that the error rate with MDI use among hospitalized patients with a mean age of 68 years was reduced from 6.72 (out of 15) errors per patient to 2.43, with only 5-10 minutes of education by a respiratory therapist instruction, which included encouragement to use a spacer[13]. In addition, the limitation on the number and types of inhaler device prescribed would also improve compliance and misuse.

CONCLUSIONS

We can make aerosol therapy more effective for the patient with chronic respiratory disease by paying attention to the education and training of the patient in the proper use and to make sure that we as providers know how to use the inhalers correctly. Keeping the inhalers few will help the patient.

REFERENCES

1. MOH clinical practice Guidelines: COPD November 2006.
2. Dolovich MB et al. Device selection and outcomes of aerosol therapy: evidence based guidelines. American College of Chest Physicians. Chest 2005;127(1):335-71.
3. Brocklebank D, Ram F et al. Comparison of the effectiveness of inhaler device in asthma and COPD: a systemic review of the literature. Health Technol Assess 2001;5(26):1-149.
4. Wright J, BrockbankD, Ram F. Inhaler devices for the treatment of asthma and COPD. Qual Saf Healthcare 2002;11(4):376-82.
5. Fink JB, Rubin BK. Problems with inhaler use: a call for improved clinician and patient education. Respir care 2005;50(10):1360-74; discussion 1374-5.
6. McFadden ER. Improper patient techniques with MDI: clinical consequences and solutions to misuse. J allergy Clin Immunol 1995; 96(2):278-83.
7. Orehek J, Gayrard P. Patient error in use of bronchodilator metered aerosols. Br Med J 1976;1(6001):76.
8. Interiano B, Guntupalli KK. Metered dose inhalers. Do healthcare providers know what to teach? Arch Intern Med 1993;153(1):81-5.
9. Allen SC, Ragab S. Ability to learn inhaler technique in relation to cognitive scores and tests of praxis in old age. Postgrad med J 2002: 78(915):37-9
10. Melani AS, Zanchetta D. Inhalation technique and variables associated with misuse of conventional metered dose inhalers or dry powder inhalers in experience adults. Ann Allergy Asthma Immunol 2004; 93(5): 439-46.
11. Seeto L, Lim S. Asthma and COPD. Inhalation therapy – clarity or confusion? Aust Fam Physician 2001;30(6):557-61.
12. Fink JB. Inhalers in asthma management: is demonstration the key to compliance? (editorial) Respir Care 2005;50(5):598-600.
Song WS, MullonJ, Regan NA. Instruction of hospitalized patients by respiratory therapist on MDI use leads to decrease in patient errors. Resp Care 2005;50(8):1040-5.