

ASTHMA CONTROL

Asthma control: importance of compliance and inhaler technique assessments

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Abstract

Objectives: The available assessment tools to determine asthma control do not include components assessing factors that may directly affect control. Our aim was to evaluate the relationship between patient compliance, inhaler technique and the level of asthma control. **Methods:** Scores from the Asthma Control Test, individual inhaler device checklists and a novel questionnaire on the patient's medication regimen were used to measure control, inhaler technique and compliance, respectively, in patients with asthma attending Sultan Qaboos University Hospital, Muscat, Oman during a 3-month period. **Results:** All of the 218 patients were receiving inhaled steroids, either in combination with long-acting beta agonists (86.2%) or alone. Asthma control was good in 92 (42.2%) patients; with 38 males (50%) and 54 females (38%), respectively ($p = 0.059$). Compliance and inhaler technique were poor in 40.8% (89) and 18.3% (40) of the patients. 60% (36) of the patients with good and 59.4% (41) with partial compliance had good control while 83.1% (74) with poor compliance had poor control ($p < 0.001$). Of the 92 patients with good control, 86 (93.5%) exhibited good inhaler techniques. In contrast, 85% (34) of the patients with poor inhaler techniques demonstrated poor control (odds ratio [OR] = 5.3; 95% confidence interval [CI]: 2.05–14.8; $p < 0.001$). A total of 93.3% (56) with good and 89.9% (62) with partial compliance demonstrated good inhaler techniques ($p < 0.001$). In patients with good control, 35 (38%) exhibited both good inhaler techniques and compliance and 38 (41.3%) had a good technique and partial compliance. **Conclusion:** Patients with good inhaler techniques and compliance have better control of their asthma. Asthma control will remain suboptimal unless the reasons for this lack of control are identified, assessed and eliminated. We recommend that inhaler technique assessment and measurements of patient compliance with their prescribed treatments should be considered for inclusion in the current assessment tools.

Keywords

Asthma control, compliance, inhaler technique

History

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Introduction

The current evidence-based guidelines suggest that most patients with asthma can have complete control over the symptoms and can pursue regular activities without any restrictions. However, prospective studies from real-life scenarios have confirmed that a significant number of patients do not achieve this target [1–3]. It is often noted that a significant number of patients suffer from poorly controlled asthma despite being on the appropriate medication and upward titration of the treatment, as recommended in these guidelines. Inadequate access to healthcare, smoking, poor compliance, faulty inhaler use, a lack of specialist care and low literacy are a few of the factors associated with poor asthma control [4–6]. Many patients with difficult asthma have improper inhaler techniques and are poorly adherent to inhaled corticosteroid therapy [7–9]. Evidence indicates

that improving compliance and inhaler technique results in better asthma outcomes, including improved control and quality of life [6,10,11].

Currently, there are several instruments designed to measure asthma control which provide accurate information on the patient's status, the effectiveness of the treatment response and the short-term predictability of the clinical course [12]. However, these instruments do not include components to assess the factors that may directly affect control, such as the accuracy of their inhaler technique and compliance with asthma medications. The aims of this study were to evaluate the relationship of compliance and inhaler technique with the level of asthma control and to determine if these factors should be considered for inclusion in the current assessment tools.

Methods

All consecutive patients with asthma attending the adult pulmonary clinics of the Sultan Qaboos University Hospital, Muscat, Oman, during a 3-month period between March 2011 and May 2011 were prospectively evaluated. The study was

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approved by the Ethical Committee of the Sultan Qaboos University. The study group was comprised of patients who had been diagnosed with asthma at an earlier occasion and were subsequently being followed on a regular basis. A diagnosis of asthma was made by the physician on the basis of a typical history of wheezing, breathlessness, recurrent exacerbations, spirometric results, peak expiratory flow rate (PEFR) variability and a previous response to asthma medications. Only patients who were on inhaled corticosteroids, with or without long-acting beta agonists, for at least 6 months prior to recruitment were included. Patients with associated allergic rhinitis were also included in the study. Patients with other comorbidities, such as bronchiectasis, hypertension, diabetes, ischemic heart disease or any other illnesses, were not included. These patients were excluded as it was feared that the side effects of some of the medications prescribed for these conditions or their accompanying symptoms might negatively affect their Asthma Control Test (ACT) scores.

Asthma control

Controlled asthma was defined as having normal pulmonary function, no symptoms of asthma, no exacerbations and no limitation of day-to-day activities [13]. Asthma control was assessed by the ACT scoring system, which consists of five questions with five optional answers for each question [14]. Each answer is subsequently assigned a score ranging from 1 to 5, with the total score ranging from 5 to 25. To this end, control was determined to be good if the total score was more than or equal to 20, and as poor if the total score was less than 20.

Inhaler technique

Patients were shown a variety of different inhaler devices and were asked to identify the device they were currently using. This was deemed essential so as to prevent the patients from having to demonstrate their inhaler technique on an unfamiliar device. Having selected their usual device, the patients were then asked to demonstrate how they customarily used their inhaler with the demonstration placebo devices. Each patient's inhaler technique was assessed using a checklist comparing their performance with the respective manufacturer instructions of each device [15,16]. The patient's technique was judged to be good if all the essential steps for correct inhaler use were performed accurately and poor if any of the required steps were missed out or performed inaccurately.

Compliance

The term compliance in the medical field denotes the adherence of a patient to a prescribed management plan designed to effectively treat an illness [17]. In this study, compliance was measured for controller treatment only. Patient compliance with the treatment, in the form of inhaled corticosteroids (ICS), with or without long-acting beta agonists (LABA), was assessed in three ways to ensure a proper documentation. First, the patients were required to visually identify their medication from the various displayed inhalers. The patients were then personally questioned on

their compliance with the identified medication using a specifically designed medication regimen questionnaire, which collected information regarding the dosage, frequency and regularity of use of the medication, as well as the number of unused inhalers they had stockpiled at home. This was later cross-checked with a review of the patient's medication prescription and collection history from the hospital's electronic patient records (EPR). Patients compliance was scored as: *good* if they were taking 100% of their daily requirements, missing the dose or frequency no more than twice a week; *partial* if they were taking more or less than their daily requirements, either in frequency or dose; and *poor* if they selected any of the other options, such as taking their medication only when needed or not taking their medication at all, as shown in Table 1.

Each patient was interviewed by a specialist respiratory therapist during a routine visit to the adult pulmonary clinics of the Sultan Qaboos University Hospital. The patient's information, treatment details and current medication prescriptions were collected from the EPR during the visit. Patients were then given in English and a validated Arabic version of the ACT [18]. The completed forms were kept with a nurse in the Outpatient Department until data entry. Compliance was checked using the pre-designed questionnaire by the rotating junior doctors or by medical students attending the clinic.

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS), Version 17 (IBM, Corp., Chicago, IL). Descriptive statistics of the study population and the relation between the dependent and independent variables were measured. Chi-squared test or Fisher's exact test were used to derive the relation and the *p* value. The odds ratio (OR) and 95% confidence interval (CI) were also calculated.

Results

A total of 218 patients aged 12–72 years old (median age = 39 years) were included in the study, with the majority (65.1%) of the patients being female. Among these patients, 73.9% had

Table 1. Assessment of compliance with prescribed controller treatment in asthma.

Description	
1. Frequency	
a.	Regularly as prescribed, missing ≤ 2 times/week.
b.	Taking more than or less than the prescribed frequency.
c.	Any other regimen, e.g. only with symptoms/not taking it at all.
2. Dose	
a.	As prescribed, but may take lower or higher dose ≤ 2 times/week.
b.	Taking lower or higher doses > 2 times/week.
3. Compliance	
Good	Taking full daily requirement (frequency & dose) as prescribed, {1.a + 2.a}.
Partial	Taking more or less than daily requirement (frequency & dose) {1.a + 2.b or 1.b + 2.a}.
Poor	Taking only during symptoms or not taking at all {1.c}.

associated allergic rhinitis. All of the patients were receiving ICS, either in combination with LABA (86.2%) or alone. Asthma control was good in 42.2% (92) of the patients. Half of the male patients (38) were judged to have a good control of the disease compared to only 38% (54) of the female patients ($p=0.059$). No significant difference was found in the level of asthma control between patients who were on ICS alone or on ICS with LABA ($p=0.325$). Patients who had asthma alone or with associated allergic rhinitis also exhibited similar levels of asthma control ($p=0.141$).

Compliance and inhaler technique were poor in 40.8% (89) and 18.3% (40) of the patients, respectively (Table 2). There were no significant differences in compliance between genders ($p=0.234$). Good, partial and poor compliance were reported by 25 (32.9%), 19 (25%) and 32 (42.1%) male patients, and 35 (24.6%), 50 (35.2%) and 57 (40.1%) female patients, respectively. A total of 60% (36) of the patients with good and 59.4% (41) with partial compliance had good control of their asthma. A significant number of patients (83.1%; $n=74$) with poor compliance demonstrated poor control of their asthma ($p<0.001$). On comparing patients with good and poor compliance, the latter were found more likely to have poor asthma control (OR = 7.4; 95% CI: 3.5–15.8; $p<0.001$).

Table 2. Characteristics of patients along with levels of control, compliance and inhaler technique.

Characteristics	<i>n</i>	%
Gender		
Male	76	34.9
Female	142	65.1
Diagnosis		
Asthma	57	26.1
Asthma + Allergic Rhinitis	161	73.9
Control		
Good	92	42.2
Poor	126	57.8
Compliance		
Good	60	27.5
Partial	69	31.7
Poor	89	40.8
Technique		
Good	178	81.7
Poor	40	18.3

Inhaler technique was good in 66 (86.8%) male patients and 112 (78.9%) female patients ($p=0.101$). Of the 92 patients with good control, 93.5% (86) showed good inhaler techniques. Similarly, 85% (34) of the patients with poor inhaler technique had poor control of their asthma. Moreover, 93.3% (56) with good and 89.9% (62) with partial compliance had a good technique ($p<0.001$). The likelihood of having uncontrolled asthma was significantly higher in those with poor inhaler techniques (OR = 5.3; 95% CI: 2.05–14.8; $p<0.001$).

In patients with good asthma control, 38% (35) displayed good inhaler technique as well as compliance and 41.3% (38) had a good technique and partial compliance (Figure 1). Only 16.7% (21) of the patients with poor control of their asthma demonstrated a good inhaler technique and compliance. It was noted that, in patients with poor control, 73% (92) had good technique. Forty percent (24) of the patients with good compliance and 40.6% (28) with partial compliance had poor control of the disease.

Discussion

Correct inhaler technique and good patient compliance with the treatment plan is important in controlling the symptoms of asthma. In this study, it was observed that patients were more likely to be compliant with their medication regimens if they also were cognisant of and exercised correct inhaler techniques. Nevertheless, other factors are likely to be involved in the control of asthma, as the results of this study show that a significant number of patients who were satisfactorily compliant with their medication regimes and who were using their inhalers correctly nonetheless had poor control over their disease.

The cornerstone of the pharmacological management of asthma is inhalational therapy. In stable patients, metered-dose inhalers and dry powder inhalers are the most commonly used systems of delivery, while in an acute attack physicians rely on administering the drugs via nebulisation. The improper inhalation of these drugs can negatively affect their pulmonary deposition [19]. Therefore, in situations where the drugs do not reach the target area, or when they are not taken as prescribed, it is unsurprising that there should be a poor treatment response. Melani et al. [9] reported that the mishandling of inhalers was common in real-life

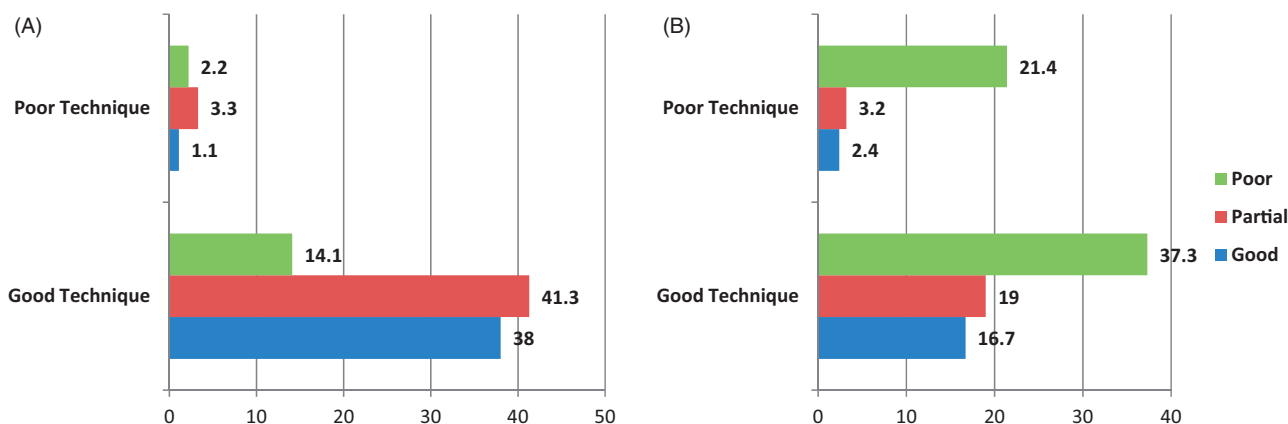


Figure 1. Figure showing the percentage of the patients having good, partial or poor compliance in patients with good and poor inhaler technique; in patients with good (A) and poor (B) control.

situations and that this was associated with poor clinical control and an increase in unscheduled health care visits. Similarly, Gamble et al. [7] observed that a significant proportion of patients with difficult asthma did not adhere satisfactorily to the prescribed inhaled and oral corticosteroid therapy.

Patient-related factors, including critical errors in device manipulation and poor compliance, have been reported to have a negative impact on asthma control [20]. In spite of the introduction of more user-friendly devices, faulty inhaler use among asthmatic patients remains a major issue all over the world. In the United States, 28–68% of patients do not use their inhalers correctly [21]. In a large study of 4078 patients, the misuse of pressurised metered-dose inhalers, mostly due to poor coordination, was found to be very frequent and associated with poorer asthma control [8]. Likewise, a study from Brazil documents that an appropriate inhalation technique is associated with the control of asthmatic symptoms [22]. However, Cárdenas et al. [23] argue that more evidence is required in order to state with certainty that inhaler technique is associated with asthma control. In our study, it was found that 93% of the patients with controlled asthma displayed good inhaler techniques. Furthermore, results showed that 85% of the patients with poor techniques suffered from poorly controlled asthma.

As mentioned earlier, compliance signifies the adherence of a patient to a prescribed management plan. This will necessarily include three specific components: (1) acceptance of the recommendation or management plan; (2) observance of the prescription and (3) persistence in following said treatment plan [24]. The suboptimal adherence of asthmatic patients to their medication is well-known. The poor compliance of patients to their prescribed therapy often leads to increased mortality and morbidity [25–29]. Although some of these patients may generally overuse emergency services, they may hesitate when it comes to taking their preventer medications regularly. Worldwide, patient compliance with asthma treatments are poor, with large variations between countries [30]. The WHO estimates that patient adherence to asthma treatments is approximately 50%, for both adults and children [31]. It is possible that this study noted good compliance in only 27.5% of the patients, whereas good and partial compliance together were seen in 59.2%, due to the strict criteria employed, which did not allow much freedom on the part of the patients. A very recent and excellent review discusses the various types of adherence problems, the factors which may lead to poor patient adherence, the impact of this on the disease and the community as a whole, as well as the potential solutions [24]. Improving patient compliance can result in superior asthma control and an improved quality of life for the patient [6,10]. In this study, 83% of patients with poor compliance also exhibited poor control of their asthma. In both of the groups of patients with good or partial compliance, nearly 60% had good control of the disease.

Methods that can be used to assess compliance include patient self-reports, canister weighing/pill counts, prescription refills, drug assays and electronic monitoring [24,32–35]. Although methods of self-reporting and prescription refills are only 60% and 70% accurate, respectively, they are nevertheless useful in providing a practical and inexpensive

means of measuring compliance. Many instruments, such as Morisky self report score [36], the Asthma Compliance Questionnaire [37], the Brief Medication Questionnaire [38], locally developed questionnaires or modified versions of compliance questionnaires for other diseases [20,38], have been used before. In this study, we devised a questionnaire which collected data regarding the medication's dose; frequency, regularity and duration of use, and the number of unused inhalers stockpiled at home. The questionnaire also gathered information concerning prescription refills, which allowed the information provided by the patient to be cross-checked and therefore permitted the verification of each patient's compliance category. The table showing the compliance scoring system was very useful in measuring patient adherence. In addition, we believe that displaying the various available inhalers is important when such studies are done, as this allows the patient to correctly identify their device and medication. It is important to identify reasons behind a patient's poor compliance, as these factors may be beyond their control. Sometimes, the reasons for a patient's seeming lack of compliance may be quite simple and easily resolved. For instance, some of our patients categorised with partial or poor compliance were not regular with their medication; in actuality, this was due to the fact that they had not been dispensed enough of their medication to last until their next appointment.

Many studies have shown that asthma controls among many patients are below expectations [3,39,40]. Studies from Europe and North America record a control rate of 24–35% [41–43]. In contrast, asthma control was good in 42% of the patients in this study. Many factors, such as disease severity, smoking status, associated gastroesophageal reflux, occupational and environmental factors can also influence the outcome, among others. Some of the patients with good technique and compliance nonetheless demonstrated poor control of their symptoms, despite receiving appropriate medications as per the international guidelines. This could have been due to under treatment on an individual basis or perhaps because the patients had unidentified or coexisting trigger factors. Other possible reasons for poor control were not investigated. Interestingly, it was observed that the patients with correct inhaler techniques were more likely to adhere to their advised treatments. There are several tools to measure asthma control which can provide overall information on the patient's asthmatic status [12]. They do not include assessments of inhaler technique or measurements of compliance. However, this study demonstrates that these factors do influence the control achieved by the patient, and it is therefore worthwhile to include assessments of these factors in routine evaluations of patients with asthma.

The strengths of this study are that each patient was interviewed by a single person, the strict compliance criteria used and the fact that the patients visually identified their individual medications. A major limitation of this study was that other factors that could have contributed to poor asthma control were not assessed, such as potential under treatment or the existence of coexisting trigger factors. Patients with common comorbid conditions were also not included in the study and so the relationship between the number of medications prescribed and compliance could not be

addressed. Therefore, caution should be exercised in generalising the results of this study to other populations.

Conclusion

This study highlights the impact of inhaler technique and patient compliance on the level of asthma control, with patients with correct inhaler techniques and good compliance demonstrating superior levels of control. These results suggest the need to explore the role of other factors contributing to poor asthma control. Level of control will continue to be suboptimal among patients with asthma unless the reasons for this deficit are identified, assessed and eliminated. We recommend that assessments of inhaler technique and measurements of patient compliance with their prescribed treatments should be considered for inclusion in the current assessment tools.

Declaration of interest

The authors of this article declare no conflicts of interest, including specific financial interests, relationships, and/or affiliations relevant to the subject matter or materials included in this manuscript.

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