Abstract. – Background and objectives: Poor inhalation technique may impact both asthma control and compliance in patients with asthma. The SYSTER survey is therefore aimed at assessing the influence of starting or switching an existing therapy to a breath-actuated pressurized metered dose inhaler (pMDI, Autohaler®) on these parameters.

Materials and Methods: 709 French general practitioners (GP) enrolled 2588 asthmatic patients in whom therapy with the breath-actuated pMDI was either initiated, or a switch from an existing inhalation device to the said inhaler was deemed necessary. Asthma control was assessed at inclusion and after 4 weeks of treatment with the Juniper Asthma Control Questionnaire (ACQ). In addition, patient adherence was estimated according to the self-reported Morisky scale.

Results: 1510 patients (mean age 39 years, standard deviation 18 years; 53% male) completed follow-up after 4 weeks. The main reasons for inhaler change were poor asthma control (49%) and poor coordination (40%). After 4 weeks of therapy with the breath-actuated pMDI, asthma control significantly improved from 2.35±1.05 to 1.32±0.93 in the ACQ (p<0.0001). Also, self-reported patient adherence improved from 2.11±1.43 to 1.57±1.53 on the Morisky scale (p<0.0001).

Discussion: These results suggest that by focusing on the inhalation devices, asthma control and compliance with treatment are improved.

Key Words:
Asthma, Autohaler, Asthma control, Compliance, Inhalation technique.

Introduction
Chronic diseases usually imply long-term treatment, sometimes for life, and poor compliance is often observed, especially in asthma.

The inhalative route of therapy itself constitutes a challenge in such a disease. Inadequate inhalation technique has been documented both for metered dose inhalers (MDI) and dry powder inhalers (DPI), leading to a decrease of the dose delivered to the target organ and poor asthma control. Despite the availability of efficient treatment options, poor asthma control is still very common, with inadequate inhalation technique being one of several reasons. The Autohaler® (Teva Santé, France) is a breath-actuated pressurized inhaler which removes the need for coordination of actuation and inhalation – a problem many patients face. The patient simply needs to remove the mouthpiece cover, lift a priming lever and inhale through the mouthpiece. Unlike DPI, the delivered dose is independent of the inspiratory airflow. It also allows a dose intake feedback which is likely to improve the patient’s confidence in the system. These features should facilitate the treatment. The present prospective epidemiologic survey was designed to describe the clinical profile of asthmatic patients in whom general practitioners (GPs) initiated treatment with an Autohaler® inhalation device (ID) or in whom they deemed it necessary to change the existing inhalation system, as well as to evaluate the impact of this decision on asthma control and treatment compliance. GPs were also asked about their usual practice regarding minimal education on inhalation technique, i.e. demonstrating and checking the technique.

Materials and Methods
Study Design and Subjects
French GPs were contacted by mail and asked to participate in the unpaid survey. Each GP who...
agreed to participate was to include the first 4 asthma patients for whom he/she prescribed therapy with the Autohaler inhalation device, either for treatment initiation or for the substitution of a former ID. In order not to change the experimental conditions and to maintain a real-life setting, the only non-inclusion criterion to be applied was the concomitant participation in another epidemiological survey or in a clinical study. Three documents were used for data collection:

1. A set of 2 anonymous self-assessment questionnaires in which patients were asked to report their asthma control using the Juniper Asthma Control Questionnaire (ACQ), their satisfaction with their ID on a visual analog scale (VAS) and compliance with asthma treatment on the Morisky scale. The Morisky scale is a self-reported medication-taking score based on four questions about forgetting the medicine, being careless at times about taking it, stopping it when feeling better or worse. The questionnaires were completed on the day of the visit to the GP’s practice and were repeated one month later at home. They were then sent anonymously to the data handling Center in a pre-stamped envelope.

2. A cohort form to be completed by the GP, describing the GP’s and each patient’s demographic characteristics, asthma history, previous asthma treatment, and reasons for changing to the self-actuated pressurized inhaler.

3. A questionnaire to be completed by the GP, describing on the one hand the main characteristics of their practice in order to assess their representativity of French GPs and on the other hand their opinion on patients’ attitudes towards ID substitution or initiation, respectively, as well as their approach to education regarding inhalation technique.

Statistics
Descriptive statistics were performed as follows: mean, standard deviation, median and range were calculated for quantitative parameters, numbers and percentages for qualitative parameters. Quantitative variables were compared using an analysis of variance (ANOVA) and qualitative variables using the chi-square test, or Fisher’s exact test in the event of too small a sample.

The socio-demographic characteristics of the GPs who participated in the study were first described and compared with those of the overall French GP population. Patient demographics and asthma history were analyzed from the cohort questionnaire and data about treatment compliance, asthma control and patient opinion of the ID were analyzed from the anonymous self-assessment questionnaires. A correlation was sought between the evolution of compliance (Morisky score) and asthma control (ACQ) and between evolution of compliance (Morisky score) and patient satisfaction with the ID (VAS).

Results
Among the 1106 GPs who initially agreed to participate in the study, 709 (64%) were active and included 2588 patients. 1510 patients fulfilled all inclusion criteria and follow-up requirements, thus defining the study population.

Patient Characteristics
The mean age of the patients who completed and returned both questionnaires (n = 1510) was 38.8 ± 18.4 years (6 to 88 years), 53% of whom were male and had suffered from asthma for 13.5 ± 10.7 years (0 to 73 years). Their demographic characteristics, asthma control (ACQ 2.35 ± 1.05 versus 2.29 ± 1.09, not significant.) and compliance (Morisky score 1.81 ± 1.21 versus 1.99 ± 1.19, not significant.) did not differ greatly from those of patients who did not answer the second questionnaire (n = 1078). One patient out of 4 of the study population had previously been admitted to hospital because of asthma and 1 out of 9 had attended an emergency unit because of asthma during the past 12 months (mean number of visits 1.7 ± 1.2). Almost half of the patients had undergone one or more short courses of oral corticoids (mean number of courses 2.0 ± 1.3). Twenty-seven percent of them were smokers and 27% ex-smokers. Almost all patients (95%) were already being treated for asthma, and 15% of the treated patients were using at least two different devices. Existing treatments in the preceding month and ID systems are presented in Table I and Table II. The main reason for changing the ID was poor asthma control, as shown in Figure 1. As expected, the mean ACQ score was higher in patients who were switched to the Autohaler® due to poor asthma control (2.8 ± 0.9 versus 2.0 ± 1.0, p<0.0001).
Improved asthma control with breath-actuated pMDI: the SYSTER survey

Evolution of Asthma Control, Treatment Compliance and Patient Satisfaction After One Month of Treatment With Autohaler®

A significant improvement in asthma control and compliance was observed after one month of treatment with Autohaler® (Figures 2 and 3). The mean ACQ score decreased from 2.35 ± 1.05 to 1.32 ± 0.93 (p<0.0001), while the proportion of patients with an ACQ score lower than 2 increased from 34% to 76%. The mean Morisky score decreased from 2.11 ± 1.43 to 1.57 ± 1.53 (p<0.0001). Patient response was independent of sex and of the former ID but was influenced by age, with a better outcome in younger patients (p<0.001 for the ACQ score and p<0.01 for the Morisky score). Evolution of compliance was not influenced by the prior duration of asthma, but evolution of asthma control was better in patients in whom the duration was shorter (p<0.05). Patient satisfaction with Autohaler® was significantly higher than satisfaction with the ID previously used (Figure 4). The mean VAS score increased from 51 ± 19 to 75 ± 14 (p<0.0001), irrespective of the previous ID. A significant correlation was shown between the evolution of asthma

Table I. Ongoing treatments for asthma.

<table>
<thead>
<tr>
<th>Type of medication</th>
<th>Number of patients</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-acting bronchodilator</td>
<td>869</td>
<td>61%</td>
</tr>
<tr>
<td>Inhaled corticoids</td>
<td>646</td>
<td>46%</td>
</tr>
<tr>
<td>Fixed combination</td>
<td>471</td>
<td>33%</td>
</tr>
<tr>
<td>Long-acting bronchodilator</td>
<td>227</td>
<td>16%</td>
</tr>
<tr>
<td>Antileucotriens</td>
<td>223</td>
<td>16%</td>
</tr>
<tr>
<td>Oral corticoids</td>
<td>53</td>
<td>4%</td>
</tr>
<tr>
<td>Other</td>
<td>47</td>
<td>3%</td>
</tr>
</tbody>
</table>

Table II. Inhalation device(s) used.

<table>
<thead>
<tr>
<th>Type of inhalation device</th>
<th>Number of patients</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metered dose inhaler</td>
<td>824</td>
<td>59%</td>
</tr>
<tr>
<td>Metered dose inhaler + chamber</td>
<td>61</td>
<td>4%</td>
</tr>
<tr>
<td>Turbuhaler®</td>
<td>349</td>
<td>25%</td>
</tr>
<tr>
<td>Diskus®</td>
<td>345</td>
<td>24%</td>
</tr>
<tr>
<td>Aerolizer®</td>
<td>12</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Novolizer®</td>
<td>9</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Other</td>
<td>30</td>
<td>2%</td>
</tr>
</tbody>
</table>

Figure 1. Reasons for changing the Inhalation Device (n=1430).
control and compliance ($r=0.23$, $p<0.0001$), and between the evolution of compliance and satisfaction with the ID ($r=0.22$, $p<0.0001$).

**GP Attitudes and Beliefs**

Participating practitioners were distributed throughout France. They were older than the average French GP population at 49.7 years versus 47.8 ($p<0.001$), and there were fewer women, namely 17.6% versus 38.3% ($p<0.001$).

According to the GPs about 40% of their patients were estimated to have poor inhalation technique, mostly because of inadequate “hand-lung” coordination. However, many GPs do not systematically educate their patients in the correct use of the ID when treatment is initiated, nor at follow-up, as shown in Figure 5. The main reason given for not generally or systematically demonstrating proper handling of the device was lack of time, which was reported by 51% of the GPs (Figure 6). The physicians believed that patients are most often unaware of their inappropriate inhaler technique and its potential deleterious impact on asthma control, as indicated in Figure 7. Spontaneous complaints were seldom reported.

**Discussion**

The primary objective of this prospective survey was to describe the impact on asthma control and compliance in asthmatic patients when initi-
ating treatment or replacing an already existing inhaler with a breath-actuated pMDI.

Most patients who participated in the study had poorly controlled asthma. After one month of treatment with the Autohaler® device an important and statistically significant improvement in asthma control, treatment compliance and patient satisfaction was observed. Despite the fact that the physicians judged a high fraction of patients to have a poor inhalation technique, they...
indicate neither demonstrating nor checking the inhalation technique systematically and believe that most patients are not aware of the importance of good inhalation technique to the successful treatment of their asthma.

Potential bias should be addressed before discussing the survey results. Due to the large sample size, the comparison of the characteristics of the survey physicians with those of the overall French population of GPs showed significant differences with regard to age and sex distribution. Except for gender, however, the differences in the numbers were small and are judged to have no effect on the results of the study. The present survey was designed to reflect real life rather than being a formal clinical study. Moreover, it is difficult to assess the impact of ID change on asthma outcomes in prospective randomized trials, since blinding is not possible for IDs with different technologies. However, new study designs such as prescription-event monitoring were applied to evaluate event rates in pre- and post-exposure periods when introducing a new inhaler. Surveys based on the participating physicians’ declarations often lead to an overestimation of their ID training practice and therefore probably underestimate lack of education in practice. Few data have been published in any case regarding the real practice of physicians when prescribing an ID.

Contrary to the Juniper ACQ, which has been acknowledged by the scientific community and is widely used for assessing asthma control, no specific questionnaire has been validated so far for the assessment of compliance with inhaled treatments. Therefore, we chose a modified version of the Morisky questionnaire for this survey. This questionnaire was developed for the evaluation of compliance with anti-hypertensive drugs. One month of therapy cannot provide a true prediction of long-term treatment compliance, but improvement cannot be expected if even short-term compliance is poor. The proportion of patients who returned their one-month questionnaire amounted to 58%, which is a satisfactory response rate for this type of survey. As physicians often do when reporting their activity, the patients probably overestimated their compliance with treatment during this survey.

The improvement of asthma control observed in this survey is clinically relevant and consistent with the only – to our knowledge – published study of the impact of an inhalation device on asthma outcomes. This pharmaco-epidemiological study, from a British GP medical database, shows better asthma control, namely less oral cor-

![Figure 7. GP's opinion about patients' perception regarding the change of Inhalation Device (n=701).](image-url)
ticosteroid courses and asthma-related GP consultations, in patients treated with the breath actuated MDI Easi-Breathe® (Teva Pharmaceutical Industries Ltd, UK) compared to patients treated with a conventional MDI. The improvement of asthma control observed in this survey was independent of the former ID and sex but was influenced by age and disease duration. The use of Autohaler®, an easy-to-use device, is likely to lead to less mistakes in inhalation technique. In addition, dose delivery is independent of the inspiratory airflow and allows the correct dose to be delivered in up to 98% of trained asthmatics patients, thus warranting optimal therapeutic effectiveness.

The improvement of treatment compliance observed in this survey was independent of the former ID, sex and duration of asthma, and was even greater in younger patients. Whether an improvement of compliance results in an improvement of asthma control has not yet been clearly demonstrated, but both aspects are certainly correlated. There are many determining factors for treatment compliance and some are directly linked with treatment complexity and difficulties encountered with the handling of IDs. The latter is probably an easy one to act on. Our results suggest that a simple device which allows a feedback on treatment intake is prone to improve patient satisfaction and consequently treatment compliance.

Our results confer with those of other Authors who have pointed out that patients are often unaware of their improper use of a device. This aspect should be addressed by healthcare providers in order to improve patient education. Nevertheless, GPs generally fail to provide their patients with basic education regarding asthma treatment, namely demonstration of the ID prescribed. When patients do not receive instruction, the change of ID, even to a newer system (e.g. from pMDI to DPI), is not accompanied by an improvement of the inhalation technique. In this survey, physicians most often claim that they lack time, while other reasons mentioned are a lack of demonstration systems and/or corresponding disposable mouthpieces. Pharmacists could therefore play an important role in patient education. The pharmacist is frequently in contact with the patient for treatment renewal and is the healthcare professional who sees the patient just before he actually takes his medication. An intervention in pharmacies focused on inhalation technique and medication adherence has shown an improvement in asthma control in poorly controlled patients. Interestingly a simple intervention focused only on inhalation technique is effective in improving asthma control and asthma related quality of life.

In conclusion, a correct inhalation technique is essential for the optimization of asthma treatment. Autohaler®, as a simple self-triggered device that delivers a constant dose independent of inspiratory airflow, appears to improve asthma control, compliance and patient satisfaction with the device. A minimal introduction of the patients to the device is still compulsory, but physicians encounter difficulties with such education on a day-to-day basis, mainly because of a lack of time. The involvement of pharmacists in patient education could improve inhalation technique and therefore asthma management.

References

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