Physician Knowledge in the Use of Canister Nebulizers*

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The knowledge and skills of physicians were evaluated regarding some practical details of the usage of bronchodilators administered by canister nebulizers to determine the need for specific physician instruction in the correct usage. Fifty-five house officers and nonpulmonary attending staff from the Department of Medicine were interviewed individually. Each physician was handed a placebo canister and asked a series of standard questions regarding the recognition, assembly, and correct inhalation technique of the device. Correct assembly of the device was performed by 68 percent and 36 percent of house officers and attending staff, respectively. Only 40 percent of the participants correctly performed more than four of the seven steps felt to constitute a correct inhalation maneuver. The results reveal inadequacies in physicians' knowledge of the correct technical usage of canister nebulizers and suggest that greater attention be paid to instructing physicians in the correct inhalation technique if their role in patient education is to be effectively realized.

Canister nebulizers represent a convenient means of administering bronchodilator aerosols and are widely used in the treatment of reversible airway obstruction. Optimal therapeutic benefit depends upon proper inhalation technique. Several studies have documented incorrect inhalation techniques in a significant proportion of patients.1-4 It has been urged that physicians prescribing aerosolized medication evaluate patients' inhalation techniques and provide appropriate instruction.1,2,4,6 This clearly requires the physician to be familiar with correct technique.

The purpose of this study was to evaluate the knowledge and skills of medical house officers and attending staff in a university-affiliated teaching hospital regarding the practical details of the usage of aerosolized bronchodilators and to determine the need for specific physician instruction in the correct usage.

**METHODS**

Fifty-five house officers and attending staff from the Department of Medicine were interviewed individually during regular ward rounds. Members of the Pulmonary Division were not included as participants. Attending staff interviewed were all currently involved in supervision or teaching on one of five general medical wards. Interviews with each physician were conducted by one of four teams of investigators. A team consisted of two investigators, including one chest physician. One investigator acted as the interviewer while the other recorded results. Participants received no prior notice of the intent or content of the interview. All interviews were performed during a single morning near the end of the academic year. The participants were casually interrupted from their ward duties and interviewed in a relaxed atmosphere.

Each physician was handed a placebo canister nebulizer (provided by Boehringer Ingelheim, Ltd) and was asked a series of standard questions. Included were questions regarding their general recognition of an aerosol inhaler, assembly and disassembly of the device, and a checklist of steps felt to constitute a correct inhalation maneuver. The steps were extracted from the general recommendations provided in the product brochure. A correct maneuver consisted of first shaking the canister, positioning the canister upside down, then inserting the mouthpiece in the mouth between closed lips, and exhaling completely. While inhaling slowly but deeply through the mouth from residual volume, the canister was to be activated once. Thereafter, the breath was to be held for four to five seconds at total lung capacity followed by a slow exhalation. Each of the seven steps comprising the inhalation maneuver were scored as correct or incorrect.

The participants then were asked to reassemble the canister for storage and questioned regarding the average longevity of an individual canister, features identifying an empty canister, and their frequency of prescribing aerosolized bronchodilators. In addition, the physicians were asked how their patients acquired knowledge of correct technique.

At the end of the interview, the level of training of each participant was noted. The correct technique was demonstrated by the investigators and repeated by the participants. Participants were given the placebo canister for their use in patient instruction.

Statistical difference between groups was analyzed by application of chi square or Fisher Exact test.7

**RESULTS**

Participants included 41 first year, second year, and third year residents in internal medicine, and 14 members of the attending staff representing most nonpulmonary subspecialty disciplines and including four members of the general medicine division. There were no differences in the results in house officers based on their level of training. Accordingly, data from

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*From the Department of Medicine, Cleveland Metropolitan General Hospital, and Case Western Reserve University, Cleveland.
Supported in part by American Lung Association and grant HL-25830, National Institutes of Health.
Manuscript received August 2; revision accepted October 14.
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Table 1—Use of Canister Nebulizers

<table>
<thead>
<tr>
<th></th>
<th>House Officers</th>
<th>Attending Staff</th>
<th>Total n=55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shake canister</td>
<td>6 (14)*</td>
<td>1 ( 7)</td>
<td>7 (13)</td>
</tr>
<tr>
<td>Position canister</td>
<td>21 (51)</td>
<td>5 (36)</td>
<td>26 (47)</td>
</tr>
<tr>
<td>Complete exhalation, slow inhalation</td>
<td>22 (54)</td>
<td>4 (29)</td>
<td>26 (47)</td>
</tr>
<tr>
<td>Time of canister actuation</td>
<td>24 (56)</td>
<td>4 (29)</td>
<td>28 (51)</td>
</tr>
</tbody>
</table>

Number of actuations

<table>
<thead>
<tr>
<th></th>
<th>House Officers n=41</th>
<th>Attending Staff n=14</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33 (80)</td>
<td>9 (64)</td>
<td>42 (76)</td>
</tr>
<tr>
<td>&gt;1</td>
<td>8 (20)</td>
<td>5 (36)</td>
<td>13 (24)</td>
</tr>
<tr>
<td>Breathhold</td>
<td>27 (66)</td>
<td>9 (64)</td>
<td>36 (65)</td>
</tr>
<tr>
<td>Slow exhalation</td>
<td>26 (63)</td>
<td>6 (43)</td>
<td>32 (58)</td>
</tr>
</tbody>
</table>

*Values represent correct responses and values in parentheses, the percentage of correct responses.

all house officer participants were pooled.

Ninety-six percent of all the participants generally recognized the device as a canister nebulizer. Sixty-eight percent of house officers, but only 36 percent of attending staff correctly assembled the device. This difference was statistically significant (p<0.05). All participants easily disassembled the device for storage. This improved performance represented the learning effect of their previous experience in assembly.

Table 1 shows the results of the attempts of the participants to use the canister nebulizer. The most common error in both groups was the failure to shake the canister prior to use. The majority of participants actuated the nebulizer once, but only half of the physicians properly actuated the nebulizer during the early part of inspiration. There was a greater incidence of error in the timing of actuating the nebulizer among the attending staff participants as compared to the house officers, but the difference was not statistically significant.

As shown in Table 2, all seven steps of the inhalation maneuver were correctly demonstrated by only four (10 percent) of the house officers. Three of these residents suffered from asthma and personally used canister nebulizers. None of the attending staff correctly performed all seven steps of the maneuver. Fifty-three percent of house officers and 79 percent of attending staff made three or more errors in using the canister nebulizer. This difference was not statistically significant.

Sixty-nine percent of respondents were unable to identify means of determining when a canister was empty. Also, 51 percent of the participants were unaware of the approximate number of doses provided by a canister.

The practice of prescribing canister nebulizers differed significantly between house officers and attending staff. Seventy-three percent of house officers indicated they prescribed canister nebulizers occasionally or frequently while 92 percent of attending physicians rarely or never prescribed these devices. Among the house staff, there was no statistical association between the frequency of prescribing aerosolized bronchodilators and accuracy in the use of canister nebulizers.

Forty-six percent of the house officers claimed they personally instructed their patients regarding the use of a canister nebulizer. Twenty-eight percent of the house officers indicated that instruction was provided by the nursing staff, and the remainder of those responding claimed patients were already using bronchodilators, and hence, had received prior instructions, received instructions from other sources, or received no instruction.

Of the 18 house officers who claimed to provide personal patient instruction, 12 correctly demonstrated five or more correct steps of the inhalation maneuver.

**DISCUSSION**

Inhaled bronchodilator aerosol is an important mode of therapy for reversible airways obstruction, yet its optimal benefits would appear to depend upon proper inhalation technique. Orehek et al.12 reported 15 of 20 patients who were unable to effect the same percentage change in airways resistance when self-administering aerosolized bronchodilator compared to the administration of the medication by a chest physician.

When patient inhalation technique has been examined, a relatively high incidence of incorrect techniques has been revealed. Using the product brochure as a standard, Shim and Williams4 demonstrated that despite many years of therapy, nearly half of their asthmatic patients failed to inhale medication correctly. Paterson and Crompton1 reported 14 percent of their patients with asthma were unable to effectively use an aerosolized canister despite careful pretreatment instruction. Epstein et al.5 evaluated the inhalation technique of 130 persons presenting for routine pulmonary function studies who had used aerosolized bronchodilators during the year prior to the study. Correct technique was composed of 11 standard maneuvers. They found only 10.8 percent performed all 11 maneuvers correctly while 24.7 percent failed to perform more than five in a satisfactory fashion.
These studies of the problem of poor patient performance emphasize the importance of proper patient education. The brochure distributed with each canister provides reasonably clear instructions in correct technique. The brochure alone, however, does not appear sufficient to effect correct usage in a relatively large population of patients.4

Several teaching aids have been devised to facilitate patient instruction of correct technique, particularly directed toward timing the activation of the canister with the onset of inspiration.4,6 Yet, patients often require repeated instructional periods to reteach proper technique. Investigators have emphasized the role of physicians in teaching proper technique and in providing continual evaluation of patient performance.1,3,4,6

In the present study, while essentially all the physicians correctly recognized the device as a canister nebulizer, nearly half of the participants incorrectly assembled the device for use. Inaccuracies in the technical usage of the device were illustrated further by the finding that less than half of the physicians studied were capable of demonstrating more than four of the seven steps of the inhalation maneuver. Only four participants correctly performed all seven steps of the maneuver.

This study was not intended to address the issue of respiratory maneuvers most efficacious in administering bronchodilators from canister nebulizers. Riley et al,4 for instance, have suggested that inhalation of isoproterenol at high lung volume may be more effective than inhalation of the same dose at low lung volume. Allowing inspiratory airflow around the mouthpiece (instead of the standard technique of inhaling with the mouthpiece between closed lips) may minimize deposition of medication particles in the mouth.39 We merely evaluated physicians' knowledge of an inhalation maneuver generally accepted for patient instruction as described by the bronchodilator procedure brochure.

Performance in demonstrating correct inhalation technique conceivably might relate to prescription practices and level of involvement in patient education. Among house staff, however, there was a poor correlation between frequency of prescribing bronchodilators and accuracy in the use of canister nebulizers. Similarly, one-third of those house officers who claimed to provide personal patient instruction failed to demonstrate more than four correct steps of inhalation. It might seem that the poor performance among nonpulmonary attending staff is explained by a limited experience or prescription practice with aerosol therapy; nevertheless, all these physicians had clinical and/or educational responsibilities on general medical wards where bronchodilator therapy is often used.

The present study, performed at a medical teaching hospital, revealed major defects in physicians' knowledge of the correct technical usage of canister nebulizers. The results imply that another factor explaining poor patient performance in usage of aerosol canisters is a problem with physician familiarity in the technical aspects of this form of therapy. Nevertheless, this unfamiliarity may be largely eliminated by a hands-on demonstration with an aerosol canister.

References