Incorrect Use of Metered Dose Inhalers by Medical Personnel

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We administered a questionnaire and observed usage of a placebo metered dose inhaler (MDI) among 35 physicians, 14 nurses, and 12 respiratory therapists. Ninety-two percent of the respiratory therapists performed at least four of seven steps correctly, compared with 65 percent of house staff physicians, 57 percent of nurses, and 50 percent of nonpulmonary faculty. Most participants followed package insert instructions, while only 18 percent followed recent recommendations for proper MDI use. We conclude that

Metered dose inhalers are the most widely used method of delivery of β-adrenergic agonists, because they provide rapid onset of action and a decrease in associated side effects. An important limitation to the effective use of MDI is improper inhalation technique, ranging from 24 to 67 percent in reported series. Poor technique is not limited to the patients themselves, but medical personnel responsible for educating patients in their proper use may not understand the factors responsible for optimal aerosol delivery. Kelling et al showed that only 40 percent of physicians correctly performed four or more of seven steps comprising a recommended inhalation maneuver. However, it is often not the physician himself who instructs the patient, but respiratory therapists and nurses, who are involved in inpatient and outpatient education programs. To our knowledge, no reported study has compared the ability of physicians, nurses, and respiratory therapists to educate patients in proper MDI use. This study was designed to compare the knowledge of MDI use among hospital personnel involved in treating and educating patients with obstructive airways disease.

METHODS

Thirty-five physicians, 14 nurses working in outpatient clinics, and 12 respiratory therapists, comprising half the medical personnel in those categories on duty at the LSU Medical Center at the time of study, were randomly selected to be tested. The professional status of the study group is shown in Table 1.

Of the 35 physicians, 23 were Internal Medicine residents and 12 were Department of Medicine faculty members in specialties other than pulmonary diseases. Medical residents were selected from all three levels of training, and responses from all levels were grouped together for analysis. The 14 nurses consisted of nine registered nurses (RNs) and five licensed practical nurses (LPNs), all of whom were involved to some extent in outpatient care involving patient instruction in MDI use. All 12 respiratory care personnel were certified respiratory therapy technicians (CRTTs). Thirty percent of all participants stated that they frequently instruct patients in MDI use, 49 percent occasionally, and 21 percent never instructed patients in their use. Among the therapists, 58 percent frequently instructed patients, and 39 percent of the residents and 17 percent of the faculty stated that they frequently instructed patients.

All participants were interviewed by the same two investigators working together. The participants were given a placebo canister nebulizer and were asked to use the canister in the same manner they would want their patients to use the nebulizer. One of the investigators then observed and recorded performance of seven selected steps of proper MDI use, according to one of two recommended regimens: the technique included in the package insert; and the recommended technique of Dolovich et al (Table 2). The two techniques are similar except for the following: (1) the positioning of the mouthpiece (the insert instructs the subject to place the mouthpiece inside closed mouth, while Dolovich et al recommend holding the mouthpiece 2 to 4 cm in front of the wide open mouth); and (2) the point of beginning inhalation (the package insert recommends the end of forced expiration [residual volume, RV] while Dolovich et al recommend end exhalation [functional residual capacity, FRC]).

The participants were then asked to complete a multiple choice questionnaire regarding the optimal delivery of aerosols from an MDI. The questionnaire tested the practitioner’s understanding of six selected aspects of MDI use: (1) shaking the nebulizer prior to use; (2) inhaling from end exhalation (FRC); (3) position of the mouthpiece; (4) slow inspiration; (5) breath hold; and (6) the average amount of inhaled aerosol deposited in the lung parenchyma using proper technique. Finally, subjects were asked how they acquired knowledge of the MDI technique and how often they instructed patients in use of the MDI. At the completion of the study, all participants were mailed the results of the survey along with our recommendations for proper MDI use, and in-service presentations were given to the individual groups.

For the purpose of analysis, the physicians were separated into faculty members and house staff trainees. Statistical differences among the four groups (faculty physicians, house staff, nurses, and respiratory therapists) were determined using the χ² and Fisher exact tests, with a p value of 0.05 or less considered a significant difference.
RESULTS

The performance of members of the four groups in regard to the two recommended MDI techniques is shown in Table 3. The best technique was demonstrated by the respiratory therapists, 92 percent of whom performed at least four of seven steps correctly using the guidelines of Dolovich et al.10 compared with 65 percent of house staff physicians, 57 percent of nurses, and 57 percent of nonpulmonary faculty. Therapist performance was significantly better than that of the other three groups (p<0.05). The most common errors were rapid inhalation (92 percent) and breath hold less than 5 s (79 percent). Most participants (66 percent) followed package insert instructions, inserting the canister into a closed mouth position; only 18 percent followed the recommendations of Dolovich et al.10

Table 2 shows the results of the questionnaire in the four study groups. Twenty-eight (46 percent) of the participants indicated the optimum breath hold time was 5 s or less and 18 (30 percent) believed that 50 percent or more of the inhaled aerosol reaches the lung parenchyma. The most common incorrect answers were related to the position of the mouthpiece, and no subject in any group chose a mouthpiece position 4 cm from the open mouth. The majority believed that 20 percent or more of the aerosol reaches the lung parenchyma.

Table 2—Results of Questionnaire: Correct Answers, No. (%)  

<table>
<thead>
<tr>
<th></th>
<th>Faculty</th>
<th>Residents</th>
<th>Nurses</th>
<th>CRITs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shake inhaler prior to use</td>
<td>9 (75)</td>
<td>12 (52)</td>
<td>10 (71)</td>
<td>12 (100)</td>
<td>43 (70)</td>
</tr>
<tr>
<td>Inhale from end expiration (FRC)</td>
<td>7 (58)</td>
<td>10 (43)</td>
<td>9 (64)</td>
<td>11 (92)</td>
<td>37 (61)</td>
</tr>
<tr>
<td>Mouthpiece 4 cm from open mouth</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Slow inspiratory flow rate, &lt;1.5 L/s</td>
<td>2 (17)</td>
<td>7 (30)</td>
<td>2 (14)</td>
<td>4 (33)</td>
<td>15 (25)</td>
</tr>
<tr>
<td>Hold breath 10 s</td>
<td>2 (17)</td>
<td>6 (26)</td>
<td>3 (21)</td>
<td>0 (0)</td>
<td>11 (18)</td>
</tr>
<tr>
<td>10 percent of medication reaches lungs</td>
<td>2 (17)</td>
<td>3 (13)</td>
<td>1 (7)</td>
<td>2 (17)</td>
<td>8 (13)</td>
</tr>
</tbody>
</table>

DISCUSSION

Inhaled bronchodilator aerosol therapy is an important component of the management of reversible airways obstruction. When MDIs are used properly by patients with asthma, they are as effective as jet nebulizers using larger doses of medication.11,12 The lower dose of MDI aerosols required to achieve desired results is due to the fact that a larger percentage of the inhaled bronchodilator reaches the lung parenchyma.13

Dolovich et al10 and others14-15 have shown increased deposition in the lung when the actuator is held 2 to 4 cm from an open mouth position. This is in contrast to package insert information, which recommends placing the inhaler in the mouth with lips tightly closed around the mouth and exhaling fully to RV prior to inspiration. Thirty-five percent of our respondents obtained their information from the package insert while only 21 percent recalled receiving instructions other than those on the package insert.

The lung volume at which the aerosol was inhaled, beginning at RV, FRC, or 80 percent of total lung capacity (TLC), does not significantly affect the amount of aerosol deposited in the lung16 or the degree of bronchodilation achieved.17 However, it is possible that exhalation to RV could result in collapse of some airways, with poorer subsequent distribution of inhaled aerosol.18 Furthermore, it simplifies patient instruction if he or she is told to inhale from end expiration. For these reasons, we and others10,16 recommend FRC (the end of a normal expiration) as the lung volume at which inhalation should begin.

It has been estimated that it takes 10 to 25 min to instruct a patient properly in the use of MDI.6 It has also been shown that while patients improve their technique with instruction,5,6 instruction must be repeated several times.6,6 Because of the time required for initial instruction and repeated reinforcement, it is likely that personnel other than physicians often instruct patients in the outpatient setting. This study indicates that respiratory therapists and nurses are at least as qualified as physicians to perform the important task of patient education in proper MDI use.

Most participants in this study followed package insert instructions in educating patients. We suggest...
that patient educators become familiar with more recent recommendations for optimal deposition of aerosols, and that package inserts be amended to indicate the proper mouthpiece position for optimal delivery to the lungs.

References