ASTHMA AND THE INHALATION TECHNIQUE FOR THE PRESSURIZED METERED-DOSE INHALER WITH SPACER: AN INTEGRATIVE REVIEW*

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ABSTRACT
Objective: to identify which Pressurized Metered-Dose Inhaler with spacer inhalation techniques have been used in patients with asthma.
Method: this was an integrative review, conducted in January 2018, in the US National Library of Medicine and Latin American and Caribbean Health Sciences Literature databases. 14 articles, published between January 2011 and December 2017, which contained the description of the sequence of inhalation technique steps, were selected.
Results: the articles predominantly studied individuals aged 14 years or over and justified the adoption of the steps of the inhalation technique from literature references. The steps indicated by each article were reviewed by experts and a quantification of those most cited was performed, with 15 steps being defined.
Conclusion: the synthesis of the knowledge generated can help healthcare providers in the proper management of asthma, since it provides evidence related to the efficacy of each step.

DESCRIPTORS: Asthma; Metered-Dose Inhalers; Inhalation Spacers; Administration by Inhalation; Review.

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ASMA E A TÉCNICA INALATÓRIA DO INALADOR PRESSURIZADO DOSIMETRADO ACOPLADO AO ESPAÇADOR: REVISÃO INTEGRATIVA

RESUMO
Objetivo: identificar quais técnicas inalatórias do Inalador Pressurizado Dosimetrado, acoplado ao espaçador, têm sido utilizadas em pacientes com asma.
Resultados: os artigos, predominantemente, estudaram indivíduos com idade igual ou superior a 14 anos e justificaram a adoção dos passos da técnica inalatória em referências da literatura. Os passos indicados por cada artigo foram revisados por pares e realizou-se uma quantificação daqueles mais citados, em que 15 passos foram definidos.
Conclusão: a síntese do conhecimento gerado pode auxiliar profissionais de saúde no manejo adequado da asma, uma vez que traz evidências relacionadas à eficácia de cada passo.

DESCRITORES: Asma; Inaladores Dosimetrados; Espaçadores de Inalação; Administração por Inalação; Revisão.

ASMA Y LA TÉCNICA DE INHALACIÓN CON INHALADOR PRESURIZADO CON DOSIFICADOR ACOPLADO A LA CÁMARA ESPACIADORA: REVISIÓN INTEGRAL

RESUMEN
Objetivo: identificar las técnicas de inhalación del inhalador presurizado con dosificador acoplado al espaciador que se utilizan en pacientes con asma.
Resultados: los artículos, de modo predominante, abordaron individuos con edad igual o superior a 14 años y justificaron la adopción de los procedimientos de la técnica de inhalación en referencias de la literatura. Se revisaron los procedimientos apuntados por cada artículo por pares y se realizó una cuantificación de aquellos más mencionados, en la cual se definieron 15 procedimientos.
Conclusión: la síntesis del conocimiento que se generó puede ayudar a los profesionales de salud en el manejo adecuado del asma, pues trae evidencias asociadas con la eficacia de cada procedimiento.

DESCRIPTORES: Asma; Inhaladores Dosificadores; Espaciadores de Inhalación; Administración por Inhalación; Revisión.
INTRODUCTION

Current clinical evidence suggests that while contemporary inhalation asthma therapy has the potential to control the disease, control is generally not achieved in most patients. A prominent reason for poor disease control is the ineffective inhaler use technique, because no matter how effective a drug is, it will not be effective if it does not reach the lower airways\textsuperscript{(1-7)}.

Problems with the inhalation technique were recognized shortly after the introduction of Pressurized Metered-Dose Inhalers (pMDIs) in the 1960s, with subsequent reports suggesting that problems persisted despite elaborate initiatives to reduce them\textsuperscript{(3,7-8)}. Initiatives that have been tried to improve the situation have included regular training programs for patients and healthcare providers, printed materials, videos and software. In addition, measures and devices to facilitate inhalation have been developed, such as an inhaler with respiratory function and another with an inhalation chamber\textsuperscript{(5,8)}.

However, the incorrect use of the inhaler in asthma patients is high and has not improved in the last 40 years\textsuperscript{(3)}. This can be a major obstacle to achieving asthma control and is a challenge for the multidisciplinary team that serves this population\textsuperscript{(1,3,8)}. Therefore, new approaches to dealing with this problem must be explored.

The lack of standardization of the sequence of correct steps in the inhalation technique for the pMDI with spacer may be one of the real problems. The healthcare providers themselves, uncertain of which sequence to use, often choose to use the manufacturer’s instructions or manuals and/or consensuses\textsuperscript{(1-2,7)}. Accordingly, they teach patients techniques that do not present evidence related to the step-by-step efficacy\textsuperscript{(7-8)}.

Considering the worrying increase in the lack of asthma control and also the non-standardization of the correct medication technique, it is essential to deepen the knowledge in this area so that the adequate management of asthma can be promoted.

The aim of this study was to search for evidence available in the literature in order to identify, gather and synthesize the knowledge produced on the pMDI with spacer inhalation technique, in asthma patients.

METHOD

This was an integrative review of the literature, a method that gathers and synthesizes the results of experimental and non-experimental studies in a systematic and organized way, from the delimitation of a theme\textsuperscript{(9)}.

In order to conduct the search in the published literature, the following steps were followed: definition of the problem and formulation of the guiding question; establishment of the inclusion and exclusion criteria for the studies; selection of the sample; evaluation of the studies included; discussion of the results and presentation of the synthesis\textsuperscript{(9)}.

The guiding question was: “What steps of the Pressurized Metered-Dose Inhaler with spacer inhalation technique are described in the literature?”. In order to respond, a search was made, in January 2018, in the US National Library of Medicine (PubMed) and in the Latin American and Caribbean Health Sciences Literature (LILACS) databases, using the descriptors: asthma and inhaler technique, with the Boolean operator AND.

Articles published between January 2011 and December 2017 were included in order to analyze more recent evidence on the subject; with publication languages of Portuguese, English and Spanish; full text available; studies involving human subjects; containing the description of the sequence of steps of the medication inhalation technique related to the pMDI. Articles that addressed only the errors of the inhalation technique and review
studies, opinions, letters and editorials were excluded.

Data were analyzed from February to March 2018, using an instrument that covered the following items: study title; period and year of publication; authors; objectives and study design; sequence of the steps of the technique used; justification for the steps; and age of the technique application group.

The inhalation technique steps, indicated in each selected article, were reviewed by the researchers and the quantification of those most cited was performed. Accordingly, 15 steps were defined for the inhalation technique of a pMDI type device. This sequence considered scientific evidence and was approved by five researchers, three physicians and two nurses, who work in the asthma clinical practice.

To select the publications included in the study, the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)(10) were adopted (Figure 1).

Figure 1 - Flowchart of the selection process of the articles on the inhalation technique for the Pressurized Metered-Dose Inhaler with spacer, elaborated based on the PRISMA recommendations. Goiânia, GO, Brazil, 2018

RESULTS
From the selection of the publications, 14 articles fulfilled the eligibility criteria and answered the guiding question of this review. Analytical reading of the selected studies was carried out, which were categorized, as presented in Table 1.

Table 1 - Description of the articles selected for review according to title, authors, design, journal and year of publication. Goiânia, GO, Brazil, 2018 (continues)

<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Study design</th>
<th>Journal/Year of publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhaler device technique can be improved in older adults through tailored education: findings from a randomised controlled trial</td>
<td>Crane MA, Jenkins CR, Goeman DP, et al.</td>
<td>Randomized controlled clinical trial</td>
<td>Nature Partner Journals Primary Care Respiratory Medicine (2014)</td>
</tr>
</tbody>
</table>
Considering the justification for the steps of the inhalation technique used by the articles, six used only references in the literature\textsuperscript{(11-12,14,16,18-19)}; one study, in addition to using the literature, validated the sequence of steps with four experts\textsuperscript{(13)}; three articles indicated the choice of technique based on a literature review and the manufacturers’ instructions\textsuperscript{(15,20,22)}; one article referred, in addition to literature and manufacturers’ instructions, to a guideline\textsuperscript{(17)}; one study indicated that the technique was developed from a literature review and the clinical experience of specialists\textsuperscript{(21)}; and two articles referenced a guideline\textsuperscript{(23-24)}.

Regarding the age of the technique application group, three studies\textsuperscript{(11,20,24)} worked with both children and adults, one study\textsuperscript{(16)} reported the application in individuals aged 14 years or over, eight studies\textsuperscript{(12-15,18-19,22-23)} applied it in adults and two\textsuperscript{(17,21)} in children.

The inhalation technique steps, indicated in each article selected, were reviewed by the researchers and the quantification of those most cited was performed. Accordingly, 15 steps were defined for the pMDI type device inhalation technique (Table 2).

<table>
<thead>
<tr>
<th>Inhalation technique steps</th>
<th>Articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remove the inhaler cap;</td>
<td>11-15,18-24</td>
</tr>
<tr>
<td>2. Remove the spacer cap;</td>
<td>18,22</td>
</tr>
<tr>
<td>3. Shake the inhaler before use;</td>
<td>Nov-24</td>
</tr>
<tr>
<td>4. Position the inhaler vertically with the nozzle down and hold it in this position throughout the entire use;</td>
<td>11-14,20-21,23-24</td>
</tr>
<tr>
<td>5. Snap the inhaler into the spacer;</td>
<td>11-15,18-24</td>
</tr>
<tr>
<td>6. Lift the chin slightly or keep the head erect;</td>
<td>13,15,21</td>
</tr>
<tr>
<td>7. Exhale, emptying all the air from the lungs;</td>
<td>11-16,18-22</td>
</tr>
<tr>
<td>8. Place the mouthpiece between the teeth without biting and close the lips firmly;</td>
<td>- put between the teeth: 12,14-15</td>
</tr>
<tr>
<td></td>
<td>- do not bite: 12,14</td>
</tr>
<tr>
<td>9. Press the bottle once only;</td>
<td>11-19,21-24</td>
</tr>
<tr>
<td>10. Immediately initiate a slow and deep inhalation (obs.: inflate chest);</td>
<td>11-16,18-19,21-24</td>
</tr>
<tr>
<td>11. Inhalation should be maintained until the lungs are filled with air;</td>
<td>11,13,18-19,21-22</td>
</tr>
<tr>
<td>12. Remove the spacer from the mouth with the lips closed, holding the breath (obs.: chest still inflated);</td>
<td>12,14-15,22</td>
</tr>
<tr>
<td>13. Hold the breath, counting silently to 10 seconds;</td>
<td>11-16,19,21,23-24</td>
</tr>
</tbody>
</table>
Asthma is the most common of the chronic respiratory diseases, affecting around 300 million people\(^1\). The average cost of each hospitalization in Brazil is approximately R$160.00\(^{25}\). The main direct expenses are related to hospitalizations and medications, in which R$733.00/patient is spent per year, which highlights the high economic costs\(^{26}\).

It is important that patients receive education and skills to effectively manage asthma\(^{1-2}\). This is effectively achieved through the patient-healthcare provider partnership, in which the essential components mainly include the training of skills to effectively use inhalation devices and adherence to the use of medications.

For the correct use of the inhalation devices, it is important to perform an adequate and effective technique in order to avoid low asthma control and increase the risk of exacerbations and adverse effects\(^{1-3}\).

The main finding of this review was the existence of articles using various steps for the inhalation technique for the pMDI with spacer, sometimes without scientific evidence.

In this study, 15 steps were selected that comprise the entire pMDI administration process. The option to select studies that included the pMDI with spacer was due to the advantages provided by this device, such as: increased pulmonary deposition of the medication, more rapid reversibility of bronchospasms during asthmatic attacks, evidence of reduction of local and systemic adverse reactions, and the possibility of the inhaler being triggered without coordinating this action with inhalation\(^{25-27}\).

The medication is kept in a container, mixed with a propellant gas, a surfactant and lubricants, with the internal pressure being four times higher than that of the atmosphere. Therefore, it is necessary to shake the inhaler (step 3), considering that failure to perform this movement can cause loss of 36% of the aerosol dose\(^{28}\).

The need to tilt the chin (step 6) is due to the promotion of the opening of the airways. It may be associated with lifting the head tilt/chin lift maneuver, for respiratory support to open the airways by lifting the tongue from the posterior pharynx\(^{28-29}\).

After this, the air should be exhaled until the lungs are empty (step 7), followed by inhalation of the indicated medication, maintained until the lungs are full (step 11), aiming to provide the maximum volume of airway space for the inhaled medication\(^{29-30}\).

The literature indicates that inhalation should be slow and deep (step 10) to increase peripheral pulmonary deposition by sedimentation\(^{1,31-32}\) and to provide almost complete reduction of the exhaled, i.e., aerosolized, fraction\(^{33}\). In addition, there are indications for performing a 10-second apnea period (steps 12 and 13), as this maximizes lung deposition by sedimentation and amplifies the penetration of particles into the distal airways\(^{32}\). Without this mechanism, small particles can be expelled prior to sedimentation on the walls of the airways\(^{34}\).

Regarding the recommendation to remove the spacer from the mouth and keep the lips closed during the apnea (step 12), found in four articles\(^{12,14-15,22}\), it is believed that this action may help in the maintenance of the respiratory pause, especially considering that the target of these studies was the infant-juvenile population.
Oral hygiene after administration of the medication, a recommendation of specialized professionals and medication manufacturers, was not found in any of the articles selected to compose the review sample. There is evidence that children with asthma, who have used antiasthmatics, are at risk of developing caries\textsuperscript{(26,35-37)}. Therefore, this is an indispensable step to be included in the pMDI inhalation technique.

CONCLUSION

The data analyzed allowed the sequence of steps for the pMDI with spacer inhalation technique to be defined. However, there is still no evidence to prove the effectiveness of each step, since the studies only cite the technique used, referencing studies that were also not aimed at proving efficacy.

At the current juncture, the technique used is referenced in national and international consensus on asthma and also by the medication manufacturers’ instructions. Consensuses and similar documents are made by a group of individuals, organizations, and public health authorities who come together for the purpose of disseminating information on care for asthma patients and provide a mechanism for translating scientific evidence into improved asthma care. However, the standard of quality, evaluation and production can vary considerably, and their use as a reference of evidence is not recommended. The same occurs with medication manufacturers’ instructions, appearing in “gray literature”.

Regarding suggestions for future studies, clinical trials on the steps of the pMDI with spacer inhalation technique could be used to analyze the efficacy of asthma control using the inhalation technique steps identified in this study.

It is hoped that the efforts of the global scientific community to investigate the efficacy and effectiveness of each step of the inhalation technique for the pMDI with spacer will contribute to the adequate management of asthma.

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Asthma and the inhalation technique for the pressurized metered-dose inhaler with spacer: an integrative review


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