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ORIGINAL ARTICLE

Efficacy of the use of intravenous magnesium sulfate in the treatment of acute asthma in children and adolescents: an integrative review

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Abstract

The objective of this study was to analyze the main effects of intravenous magnesium sulfate for the treatment of severe acute asthma in children and adolescents. An integrative review was carried out using the descriptors "magnesium sulfate", "severe asthma", "children", and "adolescents" in English, Portuguese, and Spanish. The inclusion criteria were full articles that portrayed the topic of intravenous use of magnesium sulphate in the treatment of severe acute asthma in children and adolescents, published between 2010 and 2018. The study was completed with 6 articles and the main effects observed were efficacy and decrease in the hospitalization rate of the pediatric patients, causing greater benefit to the patients studied in the last 7 years.

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INTRODUCTION

The prevalence of asthma is high worldwide, affecting approximately 330 million people¹. It is the most frequent chronic disease in pediatrics, with great morbidity and high consumption of health resources².

Asthma exacerbation is an important cause of mortality, school and work absenteeism³. They are common causes of need for treatment in emergency and inpatient services. A significant number of hospitalizations in Brazil are due to asthma^{4,5}.

Severe acute asthma, defined as an asthma attack that does not respond to repeated doses of beta-agonists and requires hospital admission, is a medical emergency that must be diagnosed and treated quickly. Airflow obstruction during exacerbations can become severe, resulting in respiratory failure, which puts the patient's life at risk^{3,6,7}.

First-line asthma treatment involves a B2-adrenergic bronchodilator, ipratropium bromide, and the anti-inflammatory action of systemic corticosteroids. These drugs are recommended with evidence levels A in clinical practice guides such as the Global Initiative for Asthma (GINA) and in national guides⁷. For those patients who do not respond to standard therapy, magnesium sulfate appears as a therapeutic option³.

Magnesium participates in several enzymatic reactions, assisting in cellular homeostasis, a role that has not yet been defined in asthma. It causes bronchodilation through modulation of calcium ion movement and inhibition of acetylcholine release from nerve terminals, stabilizes T cells and inhibits mast cell degranulation leading to a reduction in inflammation mediators. And it can reduce the severity of asthma by stimulating the synthesis of nitric oxide and prostacyclin^{8,9}.

The aim of this study is to analyze the effectiveness of intravenous magnesium sulfate for the treatment of severe acute asthma in children and adolescents in hospital emergency rooms.

METHODS

Search strategies

Study carried out through a bibliographic survey in the following databases: Latin American and Caribbean Literature on Health Sciences (LILACS), Medical Literature Analysis and Retrieval System online (MEDLINE), Scientific Electronic Library Online (SciELO) and Cochrane Library. The following descriptors and their combinations in Portuguese, English and Spanish respectively were used as search criteria for articles: Magnesium sulfate, severe asthma, children and adolescents; magnesium sulfate, severe asthma, children and teenage; magnesium sulfate, severe asthma, children and adolescents. 20 articles were identified in MEDLINE, 01 in Cochrane, 03 in SciELO and 04 in LILACS, totaling 28. Inclusion criteria were: articles published in Portuguese, English and Spanish; full articles that portrayed the topic of intravenous use of magnesium sulfate in the treatment of severe acute asthma in children and adolescents, published from 2010 to 2018.

Analysis and description of articles

Titles and abstracts of the 28 articles identified were evaluated, with a view to inclusion among those that would be read in full. The inclusion criterion for full reading was the existence of a relationship between the use of intravenous magnesium sulfate in the treatment of severe acute asthma in children and adolescents. Nineteen articles were selected to be read in full, but eleven were excluded, four of them because it was not possible to access the full text and seven because they did not meet the inclusion criteria established for the research. The study was then carried out with 06 articles, establishing among the evaluators that, in the event of any disagreement regarding the selection of the article, it would be analyzed by a third reviewer, a professional in the area related to the study topic.

The analysis and synthesis of the data obtained were performed in a descriptive way, making it possible to observe, describe and classify the data, in order to gather the knowledge produced on the intravenous use of magnesium sulfate in the treatment of severe acute asthma in children and adolescents.

For the extraction of data from the selected articles, an instrument previously developed and adapted by Ursi¹⁰ in 2005 was used, capable of ensuring that all relevant data were extracted, that the risk of errors in data transcription was minimal and that there was precision in checking the information. Data included: definition of subjects, methodology, sample size, measurement of variables, analysis method and underlying concepts used. Chart 1 represents the instrument used¹⁰. The organization of information in the articles was performed through a synthesis of the main information of each study in a table containing the following topics: origin, article title, authors, journal, considerations and theme. Chart 2

RESULTS AND DISCUSSION

When evaluating the six articles included in the study on the use of intravenous magnesium sulfate in severe asthma attacks, it was found that most of them addressed the relationship between the use of the substance and the impact on the length of hospital stay and the need for invasive mechanical ventilation.

In the South American study, carried out by an experimental quantitative study in patients with severe acute asthma, in the emergency department of a hospital in Buenos Aires, 143 patients were randomized into 2 case and control groups. The intervention group included 76 patients who received magnesium sulfate within the first hour of treatment, and the control group included 67 patients treated with standard guideline. 33% (n=22). Of the patients in the control group, 33% required mechanical ventilatory support, when compared to those who received treatment with magnesium sulfate, only 5% of the patients required mechanical ventilation ($p = 0.001$). Regarding the length of stay in days, the patients in the group that received the treatment ranged from 3 to 12 days with an average of 7 days, while that of the control

Chart 1. Instrument for data collection (Ursi)¹⁰.

A - The identification article title Journal title authors Country Language year of publication	Name Workplace University graduate
B - Institution where the article is based Hospital University Research Center single institution multicentric research other institutions Does not identify the location	
C - Publication type nursing publication Publicação médica Publication of another area of health. Which one?	
D - Methodological characteristics of the study	
1. Publication type Research () quantitative approach - design () experimental () quasi-experimental () non-experimental () qualitative approach non-research () literature review () experience report () others	
2. Research objective or question	
3. Sample Selection () random () convenience () other Start Size: End: Features: age sex breed diagnosis Inclusion and exclusion criteria for subjects	
4. Data processing	
5. Interventions carried out	independent variable
	dependent variable
	Control group: yes () no ()
	Study duration
7. Analysis	Methods used to measure the intervention
	Statistical treatment
8. Implications	Significance level
	The conclusions are justified based on the results
9. Level of Evidence	What are the authors' recommendations?
E - Assessment of methodological rigor	
Clarity in identifying the methodological trajectory in the text (method used, participating subjects, inclusion/exclusion criteria, intervention, results)	
Identification of limitations or biases	

Chart 2. Artigos levantados nas bases de dados LILACS, MEDLINE e Cochrane sobre o uso do sulfato de magnésio endovenoso no tratamento da asma aguda grave em crianças e adolescentes, no período de 2010 a 2018.

<p>Provenance: LILACS</p> <p>Title: <i>Efficacy of magnesium sulphate as the initial treatment of acute severe pediatric asthma. Randomized and controlled study.</i></p> <p>Autores: Torresa S, Sticco N, Boscha JJ, Iolstera T, Siabaa A, Rivarolaa MC, Schnitzlera E.</p> <p>Journal: Arch Argent Pediatr 2012;110(4):291-297.</p> <p>Conclusions: Intravenous magnesium sulfate administration within the first hour of patient admission was associated with a decrease in the proportion of children who required mechanical ventilatory assistance.</p>
<p>Provenance: LILACS</p> <p>Title: <i>Magnesium sulfate infusion for acute asthma in the emergency department.</i></p> <p>Authors: Irazuzta JE, Chiriboga N.</p> <p>Journal: J Pediatr (Rio J). 2017;93(1):19-25.</p> <p>Conclusions: Improvements in the management of severe asthma, diagnosis and correct interventions decrease hospital admissions and have a significant economic impact, especially in areas with few resources. The incorporation of IV magnesium sulfate at 50 mg/kg/hour for five hours facilitates early discharge, reduces hospitalization rates, and is cost-effective.</p>
<p>Provenance: LILACS</p> <p>Title: Use of venous magnesium sulfate to treat severe acute asthma in children in the emergency department.</p> <p>Authors: Bittar TMB, Guerra SD.</p> <p>Periodical: Rev Bras Ter Intensiva. 2012;24(1):86-90.</p> <p>Conclusions: Intravenous magnesium sulfate was shown to be effective in the pediatric population with moderate and severe acute asthma, in response to initial treatment, at a dose of 50 mg/kg/dose (max. 2 g/dose). Adverse effects reported in the literature were rare and the contraindications described were renal failure, myasthenia gravis, heart block and myocardial damage.</p>
<p>Provenance: LILACS</p> <p>Title: <i>Magnesium sulfate in the asthmatic crisis: What are their contributions?</i></p> <p>Authors: Catenaccio V, Xavier S, Artagaveytia P, Speranza N, Telechea H, Giachetto G.</p> <p>Journal: Arch Pediatr Urug. 2015;86(2):130-2.</p> <p>Conclusions: Although there is a correlation between the use of magnesium sulfate in reducing the need for mechanical ventilation and reducing hospitalizations and length of stay in the intensive care unit, there is a need to reflect on its limitations. There is still a need to continue carrying out studies, focused on variables that allow us to determine the role of Mg sulfate in the asthmatic crisis.</p>
<p>Provenance: MEDLINE</p> <p>Title: <i>North American Practice Patterns of Intravenous Magnesium Therapy in Severe Acute Asthma in Children.</i></p> <p>Authors: Schuh S, Macias C, Freedman SB, Plint AC, Zorc JJ, Bajaj L, et al.</p> <p>Journal: Acad Emerg Med. 2010;17(11):1189-96.</p> <p>Conclusions: The intravenous use of magnesium sulfate was little used among respondents in the treatment of children with asthma, although most agree that the substance is effective in the treatment of attacks. The drug does not play a major role in reducing hospitalizations, but it does reduce rates of admission to intensive care units and severity of illness.</p>
<p>Provenance: Cochrane</p> <p>Title: <i>Intravenous magnesium sulfate for treating children with acute asthma in the emergency department.</i></p> <p>Authors: Griffiths B, Kew KM.</p> <p>Journal: Cochrane Database of Systematic Reviews. 2016.1 - 36. Review.</p> <p>Conclusions: Intravenous use of magnesium sulfate may reduce the need for hospitalization in children with moderate to severe asthma exacerbations, but evidence is extremely limited by the number and size of studies.</p>

group ranged from 14 to 29 days with an average of 19 days. The authors concluded that the administration of intravenous magnesium sulfate within the first hour of the patient's admission was associated with a decrease in the proportion of children who required mechanical ventilatory assistance and a decrease in the length of hospital stay¹¹.

According to the results of the analysis of a North American study, in which 53 publications were analyzed through a literature review, the authors concluded that the role of magnesium sulfate is important as an adjuvant therapy in the initial management of asthma, whereas agonists β_2 -adrenergic drugs and corticosteroids remain the main management. The use of magnesium sulfate in severe asthma reduces hospitalization rates and is cost-effective¹².

A study carried out through a literature review of 21 publications showed that intravenous magnesium sulfate was effective in the pediatric population with moderate and severe acute asthma, in response to the initial treatment, at a dose of 50 mg/kg/dose (max. g/dose). Adverse effects reported in the literature were rare and the contraindications described were renal failure, myasthenia gravis, heart block and myocardial lesions¹³.

In a study carried out between 2005 and 2013, totaling 87 studies, the authors highlight the use of magnesium sulfate related to the variable hospitalization, subjectivity and clinical peculiarities that encompasses each patient, especially the social environment and other associated underlying pathologies, and not necessarily just the severity of the crisis. There is a correlation between the use of magnesium sulfate in the reduction of the need for mechanical ventilation, in the reduction of hospitalizations and in the length of stay in the intensive care unit¹⁴.

In the Canadian study, where a quantitative approach was used, physicians with training in pediatric emergency medicine, with at least 10 years of practice, who had experience in the use of magnesium sulfate in asthma attacks, were evaluated through an investigative questionnaire. serious or not. A sample of 186 professionals who collaborated with the study in the USA and Canada was obtained, where the authors highlighted that the intravenous use of magnesium sulfate is little used among the interviewees in the treatment of children with severe acute asthma, although most agree that the substance is effective in the treatment of crises, they also concluded that it does not play an important role in reducing hospitalizations, but reduces hospitalization rates in intensive care units and disease severity¹⁵.

A systematic review carried out in 2012, meeting five studies, with a sample of 182 patients. The included studies were generally at low risk of bias. The authors concluded that intravenous magnesium sulfate may reduce the need for hospitalization in children and adolescents with moderate to severe asthma exacerbations, but the evidence is extremely limited by the number and size of studies. Few treatment side effects were reported, but data were extremely limited¹⁶.

CONCLUSION

Therefore, some limitations are recognized, such as the small number of studies included for the present study, which would certainly enrich the result. The results found can be better explored in future studies.

The routine use of intravenous magnesium sulfate in pediatric emergencies can be recommended, as it is low cost and brings some benefits when used as adjunctive medication in cases of severe acute asthma.

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