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# Magnesium sulphate in the treatment of acute asthma: evaluation of current practice in adult emergency departments

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## ABSTRACT

**Background:** A recent meta-analysis showed that intravenous and nebulised magnesium sulphate have similar levels of evidence to support their use in the treatment of acute asthma in adults. This consisted of weak evidence of effect on respiratory function and hospital admissions, with wide confidence intervals ranging from no effect to significant positive effects. Current BTS/SIGN guidelines suggest an equivocal role for intravenous magnesium sulphate and no role for nebulised magnesium sulphate. A study was performed to assess what emergency physicians currently do in their management of acute asthma.

**Method:** A postal survey was undertaken of all adult emergency departments within the UK. A structured questionnaire was sent to all clinical leads in emergency medicine about their current usage of both intravenous and nebulised magnesium sulphate in the treatment of acute asthma.

**Results:** 180 of the 251 emergency departments in the UK responded (72%). Magnesium sulphate was used in 93%, mostly because it was expected to relieve breathlessness (70%) or reduce HDU/ITU admissions (51%). It was predominantly given to those patients with acute severe asthma (84%) and life-threatening exacerbations (87%), with most stating they would give the drug if there was no response to repeated nebulisers (68%). In comparison, nebulised magnesium sulphate was only used in two emergency departments (1%). The main reason for not administering the drug via a nebuliser was insufficient evidence (51%).

**Conclusions:** Intravenous magnesium sulphate is widely used for acute asthma, usually for patients with severe or life-threatening asthma who have not responded to initial treatment. Nebulised magnesium sulphate, by contrast, is hardly used at all. The use of intravenous magnesium sulphate is more extensive than current guidelines or available evidence would appear to support.

Asthma is estimated to affect one in 12 adults in the UK.<sup>1</sup> This equates to 4.1 million of the adult population. It is also estimated that, following an acute exacerbation of asthma, 75% of the subsequent hospital admissions are avoidable.<sup>1</sup>

A recent meta-analysis of the use of intravenous and nebulised magnesium sulphate reviewed 24 relevant studies consisting of 1669 patients. They showed that both methods of delivering magnesium sulphate have similar levels of evidence to support their use in the treatment of acute asthma in adults.<sup>2</sup> However, the evidence relating to the effect on respiratory function and hospital admissions was shown to be weak, with wide confidence intervals ranging from no effect to significant positive effects. Meanwhile, the current BTS/

SIGN guidelines suggest that intravenous magnesium sulphate should be considered in the management of acute severe and life-threatening asthma if there is no response to initial therapy, but they do not mention nebulised magnesium sulphate.<sup>3</sup>

We wanted to assess how emergency physicians currently use magnesium sulphate in their management of acute asthma.

## METHODS

A postal survey was undertaken of all adult emergency departments within the UK. A structured questionnaire was sent to all clinical leads in emergency medicine about their current usage of both intravenous and nebulised magnesium sulphate in the treatment of acute asthma.

The questionnaire was developed by the authors. A 10-question model was piloted and reviewed using a small cohort of local senior emergency doctors. The questionnaire was modified to improve response by virtue of saliency and visual appeal (see Appendix 1).

The survey was sent out to all clinical leads with a covering letter from the authors and a stamped addressed envelope for ease of return. All 251 emergency departments in the UK that cater to the adult population were contacted. Non-responders were sent up to two re-mailings 3 weeks apart.

## RESULTS

After three mail shots a response rate of 72% (180/251) was achieved. The responses indicated that 93% of departments (n = 167) currently use intravenous magnesium sulphate in their treatment of acute exacerbations of asthma, while only two (1%) use nebulised magnesium sulphate, of which one reported a "single episode last month in the presence of an ITU consultant" and the other reported that "my junior staff do at least".

Table 1 shows the reasons given for using magnesium sulphate in acute asthma. Most respondents used intravenous magnesium sulphate to improve breathlessness, about one-half to avoid HDU/ITU admission and one-third to improve survival. Only 3% used magnesium sulphate to facilitate patient discharge home.

In terms of the management protocol for acute asthma, our respondents believed that the drug should primarily be administered to those who had had no response to repeated nebulisers (68%) (table 2).

Table 3 shows the type of patients that respondents identified as being appropriate for treatment with magnesium sulphate. In current practice the cohort who use intravenous magnesium administer

**Table 1** Reasons for using magnesium sulphate in acute asthma

|                                    | Intravenous magnesium sulphate (%) | Nebulised magnesium sulphate (%) |
|------------------------------------|------------------------------------|----------------------------------|
| Improves breathlessness            | 126/180 (70)                       | 2/180 (1)                        |
| Avoids ITU/HDU admission           | 92/180 (51)                        | 2/180 (1)                        |
| Improves survival                  | 61/180 (34)                        | 0/180 (0)                        |
| Facilitates patient discharge home | 6/180 (3)                          | 0/180 (0)                        |

the drug if the exacerbation is classified as acute severe or if there are life threatening features (84% and 87% respectively).

Table 4 shows the reasons for not administering magnesium sulphate, so responses mainly relate to nebulised treatment. About half of the respondents believed that there is insufficient research available to justify using nebulised magnesium sulphate and half gave other reasons. The main other reasons were “unaware of its use” (37%), “prefer using intravenous” (14%) and “no personal experience” (13%). A combined 24% stated that nebulised magnesium sulphate was not within their guidelines; that included BTS-defined (8%), within their department (10%) or dictated to them by their in-house respiratory physician colleagues (6%).

## DISCUSSION

The results from our survey showed that 93% of adult emergency departments are currently using intravenous magnesium sulphate, principally to relieve breathlessness or avoid HDU/ITU admission in patients with severe or life-threatening asthma who do not respond to initial treatment. At present, nebulised magnesium sulphate does not appear to be used in the management of acute asthma, with most emergency practitioners feeling that there was insufficient evidence to justify its use.

With over 90% use of intravenous magnesium sulphate in the treatment of acute asthma, our results appear to show an established practice within UK emergency departments consistent with current BTS/SIGN guidelines. However, there is still uncertainty about when it should be given and the rationale for its use. This is perhaps unsurprising as the guidelines only state that its role should be “considered” in severe or life-threatening asthma that has not responded to initial treatment. Despite this rather equivocal recommendation, some respondents indicated that they used it earlier and in less severe cases than the guidelines suggest.

The equivocal role of intravenous magnesium sulphate in the guidelines reflects the lack of strong evidence to support its use in acute asthma. In addition to a recent meta-analysis, there have been previous reviews looking at the efficacy of the drug in both the intravenous and nebulised formats. None of these reviews produced strong evidence to show improvement in symptoms or reduced hospital admission.<sup>4-9</sup> There was some evidence of improvement in respiratory function, but it is not clear how this relates to patient well-being or clinical decision-making.

**Table 2** Role of magnesium sulphate in the management of acute asthma

|                                    | Intravenous magnesium sulphate (%) | Nebulised magnesium sulphate (%) |
|------------------------------------|------------------------------------|----------------------------------|
| All first-line cases               | 7/180 (4)                          | 1/180 (0.5)                      |
| No response to initial nebulisers  | 26/180 (14)                        | 4/180 (2)                        |
| No response to repeated nebulisers | 123/180 (68)                       | 22/180 (12)                      |
| Life-threatening features          | 65/180 (36)                        | 9/180 (5)                        |
| No role                            | 1/180 (0.5)                        | 28/180 (16)                      |

**Table 3** Patients receiving magnesium sulphate

|                                     | Intravenous magnesium sulphate (%) | Nebulised magnesium sulphate (%) |
|-------------------------------------|------------------------------------|----------------------------------|
| Mild exacerbation of asthma         | 1/180 (0.5)                        | 0/180 (0)                        |
| Moderate exacerbation of asthma     | 20/180 (11)                        | 0/180 (0)                        |
| Acute severe exacerbation of asthma | 141/180 (78)                       | 2/180 (1)                        |
| Life-threatening features           | 145/180 (81)                       | 2/180 (1)                        |

**Table 4** Reasons for not administering magnesium sulphate in acute asthma

|                                | Intravenous magnesium sulphate (%) | Nebulised magnesium sulphate (%) |
|--------------------------------|------------------------------------|----------------------------------|
| Insufficient research evidence | 9/180 (5)                          | 91/180 (51)                      |
| Poor anecdotal evidence        | 5/180 (3)                          | 11/180 (6)                       |
| Risk of side effects           | 0/180 (0)                          | 1/180 (0.5)                      |
| Other                          | 5/180 (3)                          | 87/180 (48)                      |

Although the most recent meta-analysis<sup>2</sup> is comprehensive in its inclusion of all the current evidence, it does not provide clear guidance. The analysis concludes that there is only weak evidence available at present to advocate the use of intravenous or nebulised magnesium sulphate. As a result, a large multi-centre trial of intravenous and nebulised magnesium sulphate (the 3 mg trial) is currently underway to clarify the role of magnesium sulphate in adults with acute severe asthma.<sup>10</sup>

Our study has some limitations. The response rate was over 70%, which is acceptable<sup>11</sup> but may still result in some non-response bias. It is not clear how non-responders might differ from responders in this survey, but we might expect them to have less certainty about the role of magnesium sulphate in acute asthma or less interest in the topic. Another inevitable limitation of this method is that we can only ascertain what respondents tell us happens in their departments, not actually what does happen. However, magnesium sulphate is a relatively simple intervention, so there is no reason to suspect that reported use would differ dramatically from actual use.

In conclusion, we found that intravenous magnesium sulphate is used in the treatment of acute asthma in over 90% of emergency departments, usually for patients with severe or life-threatening asthma who have not responded to initial treatment. Nebulised magnesium sulphate, by contrast, is hardly used at all. The use of intravenous magnesium sulphate appears to be more extensive than current guidelines or available evidence support.

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## Emergency Medicine Questions (EMQs)

### EMQs: Paediatrics

#### QUESTION 1

The following statements are true regarding umbilical pathology:

- a. Umbilical erythema in a neonate may suggest omphalitis and require a full septic evaluation.
- b. Umbilical erythema in an older infant can be a sign of cow's milk protein allergy.
- c. Regular umbilical cord antiseptic wipes in neonates have been proven to reduce the incidence of omphalitis compared to simply keeping the cord dry and clean.
- d. Umbilical erythema in a neonate with a clear, light-yellow fluid discharge the consistency of water from the umbilicus should raise the suspicion of bladder outlet obstruction.

#### QUESTION 2

The following statements are true regarding children with gastroenteritis:

- a. Dilution of coca-cola with two parts distilled water reduces its osmolarity to approximate that of many accepted oral rehydration fluids and is therefore a viable and more easily administered alternative.
- b. A single oral dose of ondansetron improves the success of oral rehydration in dehydrated children with gastroenteritis,

resulting in a reduction of more than 50% in both the proportion of children who vomit during oral rehydration and the proportion treated with IV fluids

- c. The standard oral dose of ondansetron for children with severe vomiting due to gastroenteritis is 4 mg.
- d. Ondansetron may cause increased diarrhoea in children with gastroenteritis.

#### QUESTION 3

The following statements are true regarding syncope in children:

- a. Up to 20% of children will suffer a syncopal episode by adolescence.
- b. All children presenting to the ED after a syncopal episode should undergo a head CT.
- c. Loss of consciousness in association with exercise or stress is commonly due to epilepsy.
- d. It is important to document the family history in a patient with syncope.

See **page 830** for answers

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