



## Magnesium sulfate

### Description

Magnesium sulfate is an anticonvulsant drug recommended by the World Health Organization as the most effective, safe, and low-cost treatment available for severe pre-eclampsia and eclampsia. Severe pre-eclampsia is a common cause of maternal death, leading to approximately 50,000 maternal deaths per year.<sup>1</sup> Some early symptoms manifest as headaches, epigastric or right hypochondrial pain, vomiting, and visual disturbances.<sup>2</sup> If left untreated, the condition can lead to seizures and convulsions (known as eclampsia), hypertension, kidney and liver damage, and death. Teenage mothers in developing countries are most affected by eclampsia, which typically manifests during a woman's first pregnancy and is more common in areas of general poverty and poor access to antenatal and intrapartum care. However, the efficacy and low cost of magnesium sulfate make this condition a highly treatable one.<sup>3</sup>

Although its exact mechanism of action is unclear, magnesium sulfate is thought to treat eclampsia through affecting a series of cardiovascular and neurological functions and by altering calcium metabolism.<sup>4</sup> Some studies have suggested that magnesium sulfate could act as a vasodilator, having actions that relieve vasoconstriction, protect the blood-brain barrier, decrease cerebral edema formation, and act as a cerebral anticonvulsant.<sup>5</sup>

In terms of administering the drug, magnesium sulfate is a solution that can be administered intramuscularly or intravenously, at a recommended concentration of 1.8 to 3.0 mmol/L. For intramuscular administration, an initial 4-g dose is given intravenously, followed immediately by a 10-g intramuscular dose, and then 5-g intramuscular doses every four hours in alternating buttocks. For intravenous administration, an initial 4-g dose is given intravenously, followed by a 1- to 2-g/h maintenance infusion given by a controlled infusion pump.<sup>6</sup>

### Efficacy, safety, and benefits

A three-year study called “the Magpie Trials” was launched in 2002 as a collaborative effort including the World Health Organization (WHO), the United Kingdom Medical Research Council, and other partners to comprehensively study the efficacy of magnesium sulfate to treat eclampsia. The study was conducted in 33 countries and included nearly 10,000 pre-eclamptic pregnant women. The results of the study were that the women who were given magnesium sulfate had a 58 percent lower risk of eclampsia and a 45 percent lower risk of dying from eclampsia than women who were administered a placebo.<sup>7,8</sup> These results are consistent with other studies of the drug, notably the 1995 Collaborative Eclampsia Trial, in which the relative effectiveness of magnesium sulfate was compared with diazepam and phenytoin (two anticonvulsant drugs commonly used to treat eclampsia), validating the significantly higher efficacy rate of magnesium sulfate in the treatment of eclampsia and in the prevention of recurring seizures. Women administered magnesium sulfate had a 52 and 67 percent lower rate of convulsions than those treated with diazepam and phenytoin, respectively.<sup>9,10,11</sup> Furthermore, a recent systematic review of maternal and infant outcomes has demonstrated that real-world use of magnesium sulfate for pre-eclampsia and eclampsia results in comparably successful outcomes to randomized controlled trials.<sup>12</sup>

When magnesium sulfate is carefully administered and closely monitored, the toxicity of this treatment is minimal (<2 percent). Magnesium sulfate is almost entirely broken down in the body, with 90 percent of the compound being released through the urine within 24 hours.<sup>13</sup> Consequently, it does not act as a cure for pre-eclampsia, but rather as a treatment for eclampsia during individual births. It is currently being studied for use as a prophylactic.

In multiple studies including the Magpie Trials, there were no attributable deaths found in women who were administered the drug. A 2012 study assessed the long-term effects for women following the use of magnesium sulfate by following up with the same

women who participated in the Magpie Trials after two years, and found no correlation of the drug with death or disability.<sup>14</sup> The risk that magnesium sulfate poses to infants is likewise minimal.<sup>15,16</sup> There are a few minor side effects for women. About a quarter of women administered magnesium sulfate experienced headaches, nausea or vomiting, muscle weakness, or respiratory issues.<sup>17</sup> However, there is a general consensus that the side effects of using magnesium sulfate are negligible in comparison with the enormous benefit it has for at-risk women.

## Current program/sector use

Magnesium sulfate has been on the WHO's Model List of Essential Medicines since 1996 and is highly affordable (a typical dosage costs US\$0.35 per ampoule).<sup>18</sup> However, magnesium sulfate has not achieved widespread usage in developing countries. This is due to lack of public awareness of the drug, lack of adequate service-provider training, and lack of availability of magnesium sulfate in these areas.<sup>10,19</sup> Its use is relatively widespread in the United States and Europe, having been used to treat severe pre-eclampsia and eclampsia in the United States throughout the 20th century.<sup>20</sup> Use of magnesium sulfate was for many years less common in Europe due to a general perception that it was undesirable compared with more common, multipurpose anticonvulsants such as diazepam and phenytoin. However, since the Magpie Trials, there is general international consensus that magnesium sulfate is the drug of choice to treat eclampsia.<sup>21</sup>

In 2012, the United Nations Commission on Life-Saving Commodities for Women and Children endorsed magnesium sulfate as one of its 13 Life-Saving Commodities, catalyzing inter-organizational efforts to overcome several commodity-specific barriers currently inhibiting women in the developing world from benefiting from the drug.

## Manufacturers

The primary manufacturer of magnesium sulfate is Hospira, Inc. (www.hospira.com). The drug (liquid format) is encapsulated in Hospira's Ansyr® single-dose plastic syringes at varying doses (2.5 g/5 ml and 5 g/10 ml).

Magnesium sulfate is not currently manufactured for a global market because its low cost leaves little profit-based incentive for pharmaceutical companies to produce it.<sup>22</sup> For service providers or distributors to acquire magnesium sulfate, it is advisable to contact the local Ministry of Health and local pharmaceutical

companies (or comparable entities) for information on how to do so.

As of January 2012, WHO regulatory authorities had not yet prequalified manufacturers of magnesium sulfate. It was, however, placed on their 2010 Expression of Interest list as a drug for which they will accept requests for prequalification.

## Public-sector price agreements

There are no existing global public-sector price agreements for magnesium sulfate. Depending on the country, however, price agreements may exist between domestic pharmaceutical companies and their governments. For example, the South African government has set a price of US\$5.76 per pack of ten doses of magnesium sulfate.

## References

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