Until recently, the function of magnesium in biological processes was largely ignored to the point where it was described as the ‘forgotten ion’. However, in the last few years there has been an explosion of interest in both the physiological and pharmacological properties of this essential substance. Magnesium deficiency is now thought to contribute to a wide variety of disease states, and many indications have been claimed for the use of the ion as a pharmacological agent. In this issue of the British Journal of Anaesthesia, Fawcett, Haxby and Male have presented a wide ranging review of the role of magnesium that touches on many of these, often controversial, aspects. The difficulty for the clinician lies in trying to decide which of the many effects are of clinical importance, and which are not. This difficulty is well illustrated by the continuing controversy surrounding the role of magnesium in the acute management of myocardial infarction and the contrasting results of the LIMIT-2 study and the much larger ISIS-4 study. Whether the discrepancy reflects a triumph for large multi-centre study methodology or differences in experimental design is impossible to say with certainty at this juncture.

Less controversial is the role of magnesium in the management of eclampsia where sound clinical research has shown beyond doubt that magnesium is superior to either diazepam or phenytoin for the prevention of recurrent convulsions. For this indication alone, anaesthetists are likely to come into contact with magnesium-treated patients with increasing frequency, and thus a working knowledge of the pharmacology of this ion is now essential for those working in the obstetric field.

From a pharmacological perspective, magnesium is best regarded primarily as a calcium antagonist with actions more resembling nifedipine than verapamil. In pharmacological doses (plasma concentrations greater than 2 mmol litre⁻¹), it is a potent vasodilator with little, if any, negative inotropic effect. It is also a highly effective adrenergic antagonist and has a significant anti-arrhythmic action, the precise indications for which are still to be established. These pharmacological properties, together with its lack of serious lasting toxicity, have led to several suggestions for the use of magnesium in clinical practice. Magnesium has yet to achieve an established place in anaesthesia, but there have been pointers to some of its interesting and potentially valuable actions. The effectiveness of magnesium in antagonizing the effects of catecholamines led to the use of magnesium sulphate infusions in the control of the haemodynamic disturbances of phaeochromocytoma and its use in this condition has recently been reviewed extensively.

Similar considerations led to the use of magnesium sulphate to moderate the intubation response, particularly in pre-eclamptic patients requiring general anaesthesia. However, the vagal blocking action of the ion, and resultant potential to produce tachycardia, inhibited the use of this agent in patients with myocardial ischaemia. However, recent work suggests that the increase in heart rate is minor and that magnesium may usefully attenuate the haemodynamic response to intubation and perhaps even offer some protection against the development of ischaemia in the presence of coronary artery disease. Catecholamine antagonism, possible protection of ischaemic cardiac tissue and favourable pharmacokinetic properties suggest that magnesium salts may be useful in managing perioperative hypertensive emergencies, particularly during anaesthesia.

To date, there has only been one rather superficial study investigating this use of the ion, which reported favourable results. As an anti-arrhythmic agent, magnesium has been suggested as a treatment for a wide variety of cardiac arrhythmias of both supraventricular and ventricular origin. While some studies of the action of magnesium on a number of arrhythmias have been impressive, others have been less convincing. Currently, magnesium is the recommended agent for treatment of torsades de pointes and may be of use in resistant ventricular arrhythmias, particularly where bretylium is unavailable. Of interest to anaesthetists is the suggestion that magnesium may be effective in the prevention and treatment of bupivacaine-induced cardiac arrhythmias (J. M. Thomas, A. R. Reed, personal communication). Personal experience of the effectiveness of magnesium sulphate for the treatment of supraventricular arrhythmias has not been particularly convincing.

There are several new research areas that have suggested some exciting possibilities for the use of magnesium. These centre largely on neuronal effects of magnesium, possibly through its action as a non-specific NMDA antagonist. Studies in pain research have produced mixed results, with some researchers demonstrating a reduction in postoperative pain and improvements in chronic pain after parenteral administration of magnesium; others have produced discouraging results. A recent study examined the role of a combination of magnesium sulphate and morphine administered intrathecally and showed no analgesic effect of magnesium alone, but a synergistic effect of a combination of magnesium with morphine. This line of research seems unlikely to produce major advances in the use of magnesium for pain therapy, but may assist in elucidating
the role of NMDA receptors in pain generation. More interesting is the role of magnesium in modulating the NMDA-induced tissue damage associated with neuronal injury. Parenterally administered magnesium salts have had some success in ameliorating the outcome of brain injury and cerebral ischaemic events. A recent study of magnesium sulphate injections into the carotid artery before arterial occlusion showed very encouraging effects in laboratory animals, with the degree of cerebral protection against ischaemia being proportional to both the duration of ischaemia and the dose of magnesium sulphate administered. Direct administration of magnesium salts into the CSF has also shown promise in improving the tolerance of neuronal tissue to ischaemia, both at a cerebral level and in the spinal cord. Several recent studies have demonstrated that a range of concentrations of magnesium sulphate solutions are well tolerated within the CSF of laboratory animals, with no evidence of neuronal injury. The possibility exists that such research may lead to the development of neuroplastic solutions that could allow safer surgery in situations where the cerebral or spinal cord circulation is disrupted during the performance of cardiovascular and neurosurgical procedures.

The role of magnesium in obstetrics was controversial for more than 60 yr, a debate that was dominated more by opinion than by science. Current research suggests that magnesium salts may have further real pharmacological benefits in several areas, including the control of acute hypertension, treatment of some cardiac arrhythmias and possibly in the protection of the heart and brain against ischaemia. If the true value of magnesium is to be properly established, it will be necessary for future opinion to be based on sound clinical science.

M. F. M. James
Department of Anaesthesia
UCT Faculty of Health Sciences
Anzio Road
Observatory 7925
Western Cape
South Africa

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