

A Case Report of the Use of Magnesium Sulphate during Anaesthesia in a Patient who had Adrenalectomy for Pheochromocytoma

K S Lim,*^{FAMS, M Med (Anaes), FANZCA}, T C Low,**^{MBBS, M Med (Anaes)}, B K Ng,***^{FAMS, MBBS, FRCS (Engl)},
C Rajasoorya,****^{FAMS, FRCP (Edin), FACE}

Abstract

Introduction: Patients with pheochromocytoma have haemodynamic instability during adrenalectomy. **Clinical Picture:** A case showing major swings of blood pressure during tumour handling. **Treatment:** Magnesium sulphate infusion alone failed to prevent severe hypertension. **Outcome:** The patient had to be given phentolamine and sodium nitroprusside to control the severe hypertension. **Conclusion:** The greatest value of magnesium sulphate is in controlling catecholamine release at induction and intubation, and in association with other agents in controlling arrhythmias and hypertension during tumour handling.

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Introduction

Pheochromocytomas are catecholamine-secreting tumours of the chromaffin cells of the body derived from neural crest tissue. They may secrete both adrenaline and noradrenaline in varying proportions. Despite their rarity, these tumours are of significant interest to anaesthetists and an in-depth knowledge is essential to the safe perioperative management of these patients presenting for surgery.

The use of magnesium sulphate in anaesthesia for pheochromocytoma was first reported in 1985.¹ It has subsequently been shown to possess some pharmacological and physiological actions that make it suitable for use in this setting. A case in which MgSO₄ alone was found to be ineffective in the perioperative management of pheochromocytoma undergoing adrenalectomy is reported.

Case Report

A 54-year-old Chinese man presented with fluctuating blood pressure, paroxysms of palpitations, perspiration and postural hypotension. He had a markedly raised urinary vanillylmandelic acid and raised urinary normetanephrine

of about 50 times normal levels. A CAT scan showed a left adrenal mass of about 5 cm but there was no demonstrable metastasis. He had a long history of hypertension and had episodic angina and, on two occasions, was diagnosed to have myocardial infarction. However, coronary angiograms were normal. In the latest admission, he had chest discomfort. Based on serial electrocardiograms and cardiac enzymes, there was no evidence of coronary infarction. The endocrinologist diagnosed catecholamine cardiomyopathy. He had a mild cerebral vascular accident five years ago, and also has diabetes mellitus. He received a graduated dose of alpha and beta blockade, with prazosin and propranolol, with relatively better control of blood pressure.

A review by the cardiologist showed no dyspnoea or orthopnoea. Chest X-ray showed a top normal heart size. Electrocardiogram showed persistent T wave inversion in the anterolateral leads, poor progression of R waves and left ventricular hypertrophy. Bedside echocardiogram showed impaired left ventricular function, with estimated left ventricular ejection of 40% and no regional wall abnormalities to suggest ischaemic heart disease. Coronary

* Consultant Anaesthetist

** Head

Department of Anaesthesia

*** Clinical Associate Professor and Consultant Surgeon

Department of Surgery

**** Consultant Physician and Endocrinologist

Department of Medicine

Alexandra Hospital

Address for Reprints: Dr Lim Kim Seong, Department of Anaesthesia, Alexandra Hospital, 378 Alexandra Road, Singapore 159964.

arteries were normal on cardiac catheterisation.

The risk of surgery was increased but the risk of conservative treatment was even higher. This risk was explained and accepted by the patient. The day before surgery, a 4-lumen pulmonary artery catheter was inserted through the right internal jugular vein. Cardiac output studies were done. The left radial artery was cannulated. He was premedicated with midazolam 7.5 mg the night before surgery. On the morning of the surgery, he was given midazolam, propranolol, prazosin and sorbitrate.

The following were his parameters before induction of anaesthesia: blood pressure (BP) 130/60 mmHg, heart rate (HR) 85 beats/minute, pulmonary artery wedge pressure (PAWP) 25/12 mmHg, central venous pressure (CVP) 7 mmHg and SpO₂ 98%.

General anaesthesia was induced with fentanyl, etomidate, vecuronium, and magnesium sulphate 2 g over 20 minutes and morphine 5 mg. MgSO₄ infusion of 2 g/h was started from 0815 to 1045 hours. Two more boluses of magnesium sulphate of 1 g were given at 0930 and 1100 hours. The patient was intubated and ventilated with nitrous oxide and oxygen and maintenance was with isoflurane.

About an hour after the start of surgery, the patient's blood pressure kept going up and boluses of phentolamine up to a total of 6 mg were given. This was not adequate and an infusion of sodium nitroprusside 0.1% was started to control the blood pressure, which had shot up to 288/115 mmHg on handling of the tumour by the surgeon. Subsequently, the blood pressure was maintained at around 140/90 mmHg. The blood pressure fell to 56 mmHg at one point on removal of the tumour. Noradrenaline infusion, 4 mg in 100 mL saline, was started. Intravenous hydrocortisone and calcium chloride were also administered. The blood pressure became more stable after this treatment. Blood loss was approximately 1200 mL. He was extubated 2 hours after the operation in the Intensive Care Unit. His blood pressure remained on the high side, but urinary vanillylmandelic acid, metanephrine and normetanephrine were back to normal.

Discussion

The use of MgSO₄ in anaesthesia for phaeochromocytoma was first reported in 1985.¹ It has been shown to possess several pharmacological and physiological actions that make it suitable for use in this setting. The mechanisms of action of magnesium sulphate include inhibition of release of catecholamines from the adrenal medulla and peripheral adrenergic nerve endings; direct blockade of catecholamine receptors; vasodilatation by direct effect on vessel walls; antiarrhythmic action and myocardial protection by preservation of adenosine triphosphate and glycogen stores and limitation of lactate production.²

Its therapeutic range is thought to be 2 to 4 mmol/L based on animal³ and obstetric⁴ studies. The use of magnesium in this range has been shown to be safe, primarily in large studies of its use in the management of eclampsia.^{4,5} Serum levels greater than 2.5 mmol/L produce a dose dependent inhibition of neurotransmitter release by competing with calcium for presynaptic membrane channels. Neuromuscular function should be closely monitored in patients receiving MgSO₄ in association with muscle relaxants, particularly in the presence of renal impairment.

James⁶ recommended the use of 40 to 60 mg/kg of MgSO₄ as a loading dose followed by an infusion of 2 g/h continuously until tumour devascularisation. Further boluses of 20 mg/kg were given to maintain systemic arterial pressure within 30 mmHg of the preoperative value. The total dose given was in the range of 8 to 18 g. In his series of 28 patients, James⁶ reported that MgSO₄ was sufficient to maintain haemodynamic stability in 23 cases, even during extensive tumour handling. However, 5 cases required further vasodilators to control the response to tumour manipulation. The probable reasons, as given below, are that magnesium blocks release of catecholamines by competition with calcium for membrane channels.

In this case, the magnesium sulphate doses administered were based on the dosage recommended by James. Magnesium sulphate was chosen in the belief that it would be able to control the cardiovascular disturbances. However, the blood pressure still shot up to 288/115 mmHg on tumour handling by the surgeon. The dose of magnesium sulphate was just above 8 g. Our recommendation is that future cases may have to be given higher doses of 8 to 18 g.

James⁷ measured plasma catecholamine levels in 5 patients both preoperatively, in response to anaesthetic and surgical stimulation, and following MgSO₄ administration. A rise in plasma levels was seen following induction in those patients not given MgSO₄, and this was reversed by administration of magnesium.

Magnesium sulphate proved ineffective in blocking the release of catecholamines during tumour handling, although it did control the systemic arterial pressure in 3 of 5 patients. This is probably to be expected since magnesium blocks release of catecholamines by competition with calcium for membrane channels, an action that would not be of use during physical manipulation of the tumour. When hypotension persists following magnesium administration, calcium should be administered as an antagonist.

The only other complication seen was an unpleasant burning sensation associated with the MgSO₄ infusion. This was obtunded by the prior administration of fentanyl

citrate in doses 3 to 5 ug/kg.

The rarity of phaeochromocytomas makes controlled studies impractical; however, James⁷ concluded that MgSO_4 is a useful drug in the anaesthetic management of patients with phaeochromocytomas. Its greatest value is in controlling cardiovascular disturbances and catecholamine release at induction and intubation and in association with other agents in controlling hypertension and arrhythmias during tumour manipulation.

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