Case Report

The role of magnesium in perioperative management of intracranial aneurysm surgery: A case series

ABSTRACT

As the motivation to potentially allow for a more expansive role of opioid-sparing anaesthesia in various surgical specialities transpire with new zeal, promising evidence needs to be accumulated to substantiate the same. Appropriate to this context, the index case series highlight the beneficial effects of an intraoperative magnesium sulphate infusion on perioperative hemodynamic profile and postoperative recovery in patients undergoing intracranial cerebral aneurysm surgery.

Key words: Cerebral aneurysm surgery; magnesium sulphate; neuroanaesthesia; opioid-sparing anaesthesia

Introduction

Aneurysmal subarachnoid haemorrhage (9:100,000) incurs a significant burden on the health care resources given the considerable degree of associated mortality and morbidity (25%, 40% respectively).[1] An early surgical intervention closely backed by a meticulous perioperative management is pivotal to favourable neurological outcomes in this peculiarly predisposed cohort. Herein, the maintenance of an adequate cerebral perfusion by tenuously balancing the perioperative alterations in mean arterial pressure (MAP) and intracranial pressure, constitutes the cornerstone of a successful anaesthetic plan.[2] Meanwhile, the modern-day anaesthetic approach to an early postoperative recovery continues to escalate the interest in opioid-sparing analgesic/hemodynamic management.[3,4] In this context, magnesium sulphate (Mg) classifies as a versatile adjuvant to a general anaesthesia regimen. Despite the elucidation of a reduced anaesthetic-analgesic requirement attributable to Mg infusion in neurosurgical patients by Manna *et al*., there is a lack of isolated evaluation of the role of Mg infusion in cerebral aneurysm surgical patients with particular emphasis on perioperative haemodynamic and recovery parameters.[5] Therefore, the index case series was contemplated with the aim of evaluating the role of the drug in obtunding the perioperative haemodynamic surges alongside the effect on postoperative recovery following intracranial aneurysm surgery.

Case Series

After obtaining written informed consent, 10 American society of anaesthesiologist (ASA) physical status II patients (controlled

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hypertensives) belonging to the World Federation of Neurological Surgeons (WFNS) grade I undergoing aneurysmal clipping surgery were enrolled. Ensuring adherence to the preoperative orders, patients were wheeled inside operation theatre and standard ASA monitors were applied along with depth of anaesthesia (bispectral index (BIS)), neuromuscular and intra-arterial blood pressure monitoring. Haemodynamic parameters namely pulse rate, blood pressure, heart rate and oxygen saturation were continuously monitored and recorded at the following timestamps: Baseline (T0), pre-induction (T1), post-intubation (T2), pre-positioning (T3), post-positioning (T4), pre-extubation (T5), post-extubation (T6). Prior to induction, patients received Mg (50% w/v) 50 mg/kg bolus over 10 minutes followed by 15 mg/kg/hr intravenously till extubation. Patients were premedicated with midazolam (20 μg/kg) and fentanyl (1 μg/kg) IV. Local anaesthetic was infiltrated at the site of incision along with two repeat fentanyl boluses (0.5 μg/kg): Before pinning and at dural opening. Anaesthesia was induced with propofol (1–2 mg/kg) with an adequate neuromuscular blockade (train of four (TOF) count ≤2) ensured using vecuronium intravenously. Subsequent to induction, anaesthesia was maintained with sevoflurane (minimum alveolar concentration <1) and oxygen (FiO_2-0.4) maintaining BIS between 40-60 and EtCO2 of 30-35 mmHg. Paracetamol 15 mg/kg and ondansetron 0.1 mg/kg IV were administered at the beginning of skin closure. Based on TOF count, reversal agent was administered, and trachea was extubated once the patient responded to verbal command (the duration between these two time points was used to compute the time to extubation). Numerical rating scale (NRS) (0-10) for postoperative pain and Ramsay sedation score (RSS) were assessed every 15 minutes for the first-hour post-extubation. Rescue analgesia (fentanyl 0.5 μg/kg IV) was administered once NRS ≥4 was documented. Considering the guidelines on perioperative haemodynamic management in aneurysmal surgery advocate maintaining systolic blood pressure <160 mm Hg prior to clipping while ensuring a MAP between 70-90 mmHg post-clipping with no more than 20% fluctuations from the baseline parameters.[2] In all the patients receiving Mg infusion, the recorded haemodynamic parameters were within the guidelines specified range [Table 1]. Postoperative pain (NRS 1-3) and sedation (RSS 2-3) were also within permissible limits with only 2 out of 10 patients requiring rescue analgesia. None of the patients manifested any complications like postoperative nausea and vomiting (PONV) and shivering [Table 1]. Postoperative serum magnesium levels were within the normal range (1.7–2.2 mg/dL).

Table 1: Demographic profile and haemodynamic parameters at different time stamps along with postoperative recovery profile

Age (yrs)/ Sex	SD (min)	Hemodynamic parameters [SBP/DBP (MAP), (HR)]							Postoperative recovery profile				
		T0	T1	T2	T3	T4	T5	T6	TE (min)	Mean RSS	Mean NRS	Rescue analgesia	PONV Shivering
32/F	160	146/82 (103), (86)	146/82 (103), (80)	146/84 (105), (78)	132/76 (95), (70)	138/76 (97), (78)	140/66 (89), (82)	138/62 (87), (94)	7	2	1	-	-/-
38/M	180	150/82 (104), (88)	150/78 (102), (76)	154/74 (101), (94)	140/74 (96), (84)	144/80 (101), (92)	132/64 (86), (86)	140/62 (88), (98)	6	2.5	2.5	-	-/-
52/M	170	148/74 (99), (66)	134/70 (91), (60)	146/78 (101), (70)	126/76 (93), (72)	148/84 (105), (78)	136/64 (88), (62)	140/66 (90), (74)	8	2	2	-	-/-
47/F	190	148/72 (97), (68)	142/68 (95), (66)	146/78 (101), (72)	136/74 (95), (66)	138/78 (98), (74)	130/66 (87), (60)	138/64 (88), (76)	8	3	2	-	-/-
45/M	175	148/82 (104), (80)	142/80 (101), (70)	132/82 (99), (78)	136/78 (97), (76)	140/78 (99), (86)	128/62 (84), 70)	132/64 (88), (92)	7	1.5	3	+	-/-
41/F	180	146/70 (95), (76)	134/70 (91), (74)	138/78 (98), (70)	126/78 (94), (68)	138/80 (99), (74)	130/66 (87), (66)	138/62 (87), (80)	7	2.5	1.5	-	-/-
35/M	160	158/80 (106), (72)	148/80 (103), (70)	134/82 (99), (80)	142/74 (97), (72)	140/80 (100), (82)	136/68 (90), (78)	138/64 (88), (88)	6	2	2	-	-/-
39/F	170	142/78 (99), (64)	138/74 (95), (60)	134/78 (97), (70)	140/76 (97), (68)	134/70 (91), (72)	136/64 (88), (68)	134/66 (88), (74)	7	2	1.5	-	-/-
30/M	190	138/78 (98), (90)	130/72 (91), (80)	124/82 (96), (94)	130/74 (93), (86)	132/78 (96), (94)	128/62 (84), (78)	136/64 (88), (90)	9	3	2	+	-/-
43/F	180	150/80 (103), (70)	146/74 (98), (68)	134/76 (95), (76)	138/70 (93), (66)	134/76 (95), (78)	138/66 (90), (70)	138/62 (87), (82)	7	2	2	-	-/-

DBP - Diastolic blood pressure; MAP - Mean arterial pressure; HR - Heart rate; SD-Surgical duration; TE - Time to extubation; min - minutes; yrs - years;(-)-No; (+)-Yes)

Discussion

There are certain peculiar caveats of perioperative management in these surgical patients that endorse a strong

case for a possible role of intraoperative Mg infusion. Firstly, haemodynamic perturbations in this subset need to be meticulously tackled as they can precipitate a catastrophic event of aneurysmal rupture with a consequential remarkable mortality.[2] The hemodynamic stability rendered in the present case series with a Mg infusion is noteworthy. Secondly, in conjunction to a favourable hemodynamic milieu, the analgesia-potentiation attributable to a Mg infusion potentially decreases the anaesthetic-analgesic requirement.[5] This is heralded by the N-methyl-D-aspartate receptor antagonist action of the drug at hippocampal presynaptic calcium channels. In addition, Mg also suppresses stress-induced catecholamine release.[5,6] The advantages of this property extend beyond down-titration of the perioperative opioid (assists fast-tracking) to immediate postoperative neurological assessment, particularly important in context of neurosurgery.[7] Thirdly, there is an encouraging literature on the role of Mg in ameliorating the cerebral vasospasm which needs to be addressed diligently in this postoperative cohort given it comprises the most important factor related to poor neurological outcome.[8] Fourthly, magnesium-associated increase in the seizure-threshold adds incremental value in relation to the predilected post-neurosurgical setting.[9] Lastly, reduced incidence of postoperative shivering, PONV (as in the present case-series) and correction of underlying hypomagnesemia collectively contribute to an augmented postoperative recovery.[10] Nevertheless, it becomes imperative to employ neuromuscular monitoring as Mg infusion can potentiate and prolong the neuromuscular blockade.

The present series highlights the benefits of perioperative Mg in aneurysmal surgery, ensuring stable hemodynamics, decreased opioid requirement and postoperative complications. The elucidation of the aforementioned opens newer avenues for future investigations in this clinically pertinent domain of opioid-sparing anaesthesia in neurosurgical patients.

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Conflicts of interest

There are no conflicts of interest.

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