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Original Contribution

Magnesium sulfate or diltiazem as adjuvants to total intravenous anesthesia to reduce blood loss in functional endoscopic sinus surgery☆

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Abstract

Study objective: This study was designed to know whether addition of magnesium sulfate ($MgSO_4$) or diltiazem to total intravenous anesthesia (TIVA) (propofol) aided reduction in blood loss during functional endoscopic sinus surgery (FESS). The secondary outcomes measured were surgeon's assessment of the surgical field and hemodynamics.

Design: Randomized, double-blinded, placebo-controlled trial.

Setting: Operating room.

Patients: Forty-five American Society of Anesthesiologists I and II adult patients (18-60 years) undergoing FESS.

Interventions: All groups received propofol-fentanyl TIVA. Patients were randomly allocated to 1 of the 3 groups ($MgSO_4$ group, n = 15; diltiazem group, n = 15; saline group, n = 15).

Measurements: Intraoperative bleeding was quantified, and quality of surgical field was graded. Hemodynamic parameters were recorded.

Main results: Addition of both $MgSO_4$ and diltiazem significantly reduced blood loss (240 and 350 mL) in comparison to control group (415 mL) ($P = .003$). The surgical field was significantly better in the $MgSO_4$ group compared with the diltiazem ($P = .028$) and saline groups ($P = .0001$).

☆ Disclosures: none.

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Conclusion: It was concluded that the addition of both $MgSO_4$ and diltiazem to TIVA propofol results in significant reduction in blood loss and significant improvement in the quality of surgical field during FESS without causing any adverse effects on the hemodynamics or on the recovery from anesthesia. The surgical field in the $MgSO_4$ group was significantly better than that in the diltiazem group ($P = .04$).

1. Introduction

Functional endoscopic sinus surgery (FESS) [1] is a minimally invasive technique used to restore sinus ventilation and function in patients with recurrent acute or chronic infective sinusitis in whom medical therapy has failed. Continued bleeding into the surgical field during FESS not only impairs endoscopic vision but can lead to complications [2]. Compared with conventional anesthesia, total intravenous anesthesia (TIVA) [3–5] has been previously reported to result in reduced blood loss when used for FESS. However, few recent studies point out that TIVA may not significantly reduce blood loss [6–9].

Magnesium [10] is a naturally occurring calcium antagonist and a noncompetitive antagonist of the *N*-methyl-D-aspartate receptor [11]. It competes for calcium channels in the presynaptic nerve terminal inhibiting acetylcholine release at the motor endplate. It also acts as a vasodilator by increasing the synthesis of prostacyclin, as well as inhibiting angiotensin converting enzyme activity. It is widely used for controlling blood pressure in preeclampsia and pheochromocytoma [12–14].

Diltiazem, a calcium channel blocker, blocks the influx of calcium into smooth muscle cells and cardiac muscle cells [15]. This causes relaxation of the muscle, thereby causing reduced arteriolar tone and fall in blood pressure. The use of diltiazem as vasodilator to produce induced hypotension is not mentioned in literature.

This study was carried out to determine whether addition of magnesium sulfate ($MgSO_4$) or diltiazem to propofol TIVA would enhance operative conditions and reduce blood loss compared with TIVA alone during FESS.

2. Methods

Institutional Ethics Committee approval and written informed patient consent were obtained. This prospective, randomized, placebo-controlled, double-blinded study was carried out in 45 American Society of Anesthesiologists (ASA) I-II patients aged 18-60 years of either sex undergoing elective FESS under general anesthesia. Patients were randomized to receive $MgSO_4$ (group M, n = 15), diltiazem (group D, n = 15), or saline (Group S, n = 15) as adjuncts to propofol TIVA.

Patients with known coronary artery disease, previous myocardial infarction, stroke, ??CHF, arrhythmias, bleeding diathesis, uncontrolled systemic illness, anticipated difficult intubation, and history of allergy to the study drugs and those who refused to participate were excluded from the study. All patients underwent CT scan to classify disease burden and severity. Forty-five sealed opaque envelopes containing the group to which the patient would be allocated were prepared.

In the operation room, monitors (electrocardiogram (ECG), pulse oximetry Spo2, NIBP) were attached and intravenous (IV) midazolam (1.0 mg) administered. After radial artery cannulation under local anesthesia, the baseline heart rate (HR, beats per minute); electrocardiogram; oxygen saturation; and systolic, diastolic, and mean arterial (MAP) pressure (mm Hg) were recorded. A target-controlled infusion (TCI) (Orchestra, Base Primea, Fresenius Vial, France) device was set up to deliver propofol infusion. Entropy electrodes (GE, 8,002,858) were applied on the forehead, and neuromuscular transmission device with train-of-4 watch was set up for adductor pollicis response.

2.1. Anesthesia technique

Anesthesia was induced with fentanyl 2 μg/kg and propofol 10 mg/mL delivered through the TCI device to achieve an effect site concentration (Ce) of 2-4 micrograms/kilogram. When entropy (State Entropy [SE], Response Entropy [RE]) values decreased below 60, vecuronium 100 μg/kg was administered to facilitate tracheal intubation. A preweighed oropharyngeal pack was inserted. Mechanical ventilation was provided through a closed circuit using oxygen/air mixture to maintain end-tidal CO_2 at 35 ± 5 mm Hg. Anesthesia was maintained with TCI of propofol and fentanyl infusion at 1 μg/(kg h). All patients received 1 g IV paracetamol. The patients were then allocated to 1 of 3 groups by an anesthesiologist (not participating in the study) who picked up a sealed, opaque envelope from a bag containing 45 pre-prepared envelopes. He/she also prepared the bolus and infusion of the study drugs, and did not participate further in patient care.

- Group $MgSO_4$: 40-mg/kg bolus in a volume of 5 mL followed by 15-mg/(kg h) infusion (total volume of 10 mL/h)
- Group diltiazem: 0.1-mg/kg bolus made in a volume of 5 mL followed by 0.2-mg/(kg h) infusion (total volume of 10 mL/h)
- Group saline (control): 5 mL of normal saline followed by saline infusion at 10 mL/h.