

Intraoperative Infusion of Magnesium Sulphate does not Reduce Laryngospasm and Agitation during Emergence from Anaesthesia in Children

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ABSTRACT

Background

Laryngospasm and agitation during emergence from general anaesthesia are frequent in children. Magnesium sulphate may have the potential of reducing both of these adverse events. In addition, magnesium has analgesic and anaesthetic properties.

Objective

To find out the effectiveness of magnesium sulphate in reducing the occurrence of emergence laryngospasm and agitation and other adverse events if any in children.

Method

Randomized, placebo controlled study was conducted at a tertiary care hospital in 132 children, aged 3-12 years undergoing general anaesthesia for hernia and hydrocele surgery. Children with American Society of Anaesthesiologist Physical Status > II were excluded. After insertion of laryngeal mask airway, 20 ml of either magnesium sulphate 15 mg/kg (Group M) or normal saline (Group N) was infused at the rate of 1 ml/min. The severity of laryngospasm and agitation was assessed. We also noted other adverse events, if occurred.

Result

Laryngospasm occurred in 7(10.6%) patients of group M and in 10(15.1%) patients of group N($p=0.40$). While 14(10.6%) patients developed laryngospasm immediately after removal of LMA, only 3(2.2%) patients developed it in the post anaesthetic care unit. Two (3.0%) patients of group M and four patients (6.0%) of group N were agitated ($p=0.40$). Three (4.5%) patients of group M and 14(21.2%) patients of group N coughed during emergence ($p=0.004$).

Conclusion

Intraoperative infusion of 15 mg/kg magnesium sulphate, does not reduce the occurrence of emergence laryngospasm and agitation in children. However, it significantly reduce emergence cough.

KEY WORDS

Agitation, Cough, Emergence laryngospasm, Pediatric anaesthesia

INTRODUCTION

Laryngospasm during emergence from general anaesthesia occurs frequently in children.^{1,2} It often leads to hypoxemia, bradycardia and pulmonary aspiration.³ Agitation is also common during emergence and may cause self harm.⁴ Prevention of laryngospasm and agitation during emergence from general anaesthesia is therefore crucial in pediatric patients.

Drugs like propofol and lignocaine are currently used for preventing laryngospasm, but with variable success.⁵ Few authors suggest the potential of magnesium sulphate in reducing emergence laryngospasm and agitation.^{6,7} In addition, the analgesic, anaesthetic and bronchodilatory properties of magnesium sulphate would make it an ideal anaesthetic adjuvant during pediatric anaesthesia.⁸

We aimed to evaluate the effectiveness of intravenous magnesium sulphate in reducing the occurrence of laryngospasm and agitation during emergence from general anaesthesia in children undergoing hernia and hydrocele surgery. We also noted other adverse events if any, that occurred during intraoperative and postoperative period until children were transferred to the inpatient unit.

METHODS

This was a randomized placebo controlled study conducted at B P Koirala Institute of Health Sciences from February 2015 to January 2016. Sample size was calculated using Stata software. Based on the expected proportion of laryngospasm in the control group ($p_1=0.4$), and experiment group ($p_2=0.15$), alpha level of 0.05 and a power of 80% for detecting difference in the incidence of laryngospasm, 61 samples in each group was calculated.^{6,9} To allow for possible drop outs, we enrolled 66 patients. Computer generated random number table was used for enrolling patients in to two groups and the sealed opaque envelopes containing the allocated study group was handed over to an anaesthesia technician in charge, who was involved in preparing the study drug. The anaesthesiologist involved in the patient management and the investigator collecting data were blinded to the group allocation. Consecutive sampling was done.

Approval from Institutional review committee (Ref. No. 043/014) was taken and informed consent from a parent of each child was obtained at the preanaesthetic clinic. We enrolled 132 children, aged 3 to 12 years with American Society of Anaesthesiologist Physical Status (ASA PS) I/II, scheduled for inguinal hernia or hydrocele surgery under general anaesthesia with laryngeal mask airway (LMA) insertion. Children presenting with cardiac, respiratory or hepatobiliary diseases or having ASA PS > II were excluded. History of respiratory tract infection within four weeks before surgery, asthma, hypersensitive airway or passive smoking in a child was considered as the risk factor for

occurrence of perioperative laryngospasm.⁵

Children were premedicated with syrup promethazine hydrochloride, 0.5 mg/kg at night and in the morning of surgery. Induction of anaesthesia was done with halothane in oxygen. Intravenous (IV) propofol (1-2 mg/kg) was added and fentanyl (1.5-2 µg/kg) was administered for analgesia. After insertion, LMA was connected to Ayer's T-piece Circuit and patients were allowed to breathe spontaneously. After two minutes, an equal volume (20 ml) of either magnesium sulphate (15 mg/kg)(Group M) or Normal saline (Group N) was infused at 1 ml/min. Anaesthesia was maintained with 1.5 to 2% halothane in oxygen. Approximately ten minutes before the end of surgery, IV paracetamol 15 mg/kg was administered for postoperative analgesia. After surgery, LMA was removed, halothane was discontinued and the airway was maintained with face mask and Ayer's T-piece Circuit. The time interval between discontinuation of halothane and maintenance of respiration spontaneously without additional chin lift or jaw thrust maneuver was defined as recovery time. Patients were transferred to the post anaesthesia care unit (PACU) with oxygen by face mask.

Laryngospasm was defined as signs of airway obstruction that could not be relieved by chin lift and jaw thrust maneuver with or without oropharyngeal airway.¹⁰ Whereas the signs of airway obstruction that could be relieved by airway optimization maneuver was defined as supraglottic airway obstruction.

The severity of laryngospasm was graded based on the sequentially applied intervention: (1) Positive pressure ventilation with 100% O₂ with face mask (Grade-I) (2) Administration of IV Propofol 0.5 mg/kg (Grade-II) (3) Administration of IV succinylcholine 0.5 mg/kg and or tracheal intubation (Grade-III).⁵

Agitation score was recorded at PACU when the child opened eyes spontaneously, or started crying/moving. Child was considered agitated if the sum of pain discomfort scale (PDS) exceeded three.¹¹

Table 1. Modified Pain Discomfort Scale.¹¹

Score	Zero	One	Two
Crying	Not Crying	Responding to pain	Not responding to comforting
Moving	None	Restless	Thrashing
Agitation	Asleep/Calm	Mild agitation	Severe agitation/Hysterical

Intravenous fentanyl 0.2 µg/kg was administered and repeated if child was agitated or complained of pain in the PACU. The duration of anaesthesia, recovery time and stay in PACU were recorded.

Data was analyzed using SPSS software version 11.5 for windows and are presented as number, percentage or mean (SD). Data was tested for normal distribution by using

the Shapiro-Wilk test. Categorical data was compared by either Chi squared test or Fisher exact test as appropriate. Independent t-test was used to compare means. A p value of < 0.05 was considered as statistically significant.

RESULTS

A total of 66 children undergoing hernia or hydrocele surgery under general anaesthesia were enrolled in each group. The demography, risk factors for perioperative laryngospasm and intraoperative adverse events were similar between the two groups (Table 2). Out of 39(29.5%) children with the history of hyperreactive airways or URTI within last four weeks, 9(23%) developed emergence laryngospasm (p=0.000). Similarly, of the 21(15.9%) children with passive smoking, three (14.2%) developed emergence laryngospasm (p=0.08).

Table 2. Demographic and perioperative characteristics

Parameters	Group M (n=66)	Group N (n=66)	P value
Age (yr)	5.7(2.7)	5.5(2.9)	0.69
Sex (M/F)	53/13	57/9	0.48
Weight (kg)	17.5(6.1)	17.6(7.5)	0.39
URTI within 4 weeks	13	19	0.43
Asthma/hyperreactive airways	5	6	0.75
Passive smoking	12	9	0.63
Attempts at LMA insertion, > 1	10	8	0.85
Oropharyngeal trauma at LMA insertion	2	1	1.0
Intraoperative Cardiac adverse event*	4	2	0.68
Intraoperative Respiratory adverse events**	4	2	0.68
Duration of anaesthesia (min)	44.5(15.0)	42.3(13.4)	0.20
Recovery time (min)	16.2(4.5)	14.1(2.4)	0.22
PACU stay (min)	55.7(17.3)	49.13(15.6)	0.82

Data presented in mean (SD) and number of patients. URTI, upper respiratory tract infection; PACU, post anaesthesia care unit. *premature ventricular contractions=5, bradycardia=1. **upper airway obstruction=3, apnoea=1, laryngospasm=1, cough=1.

Laryngospasm during emergence from anaesthesia occurred in 7(10.6%) patients of group M and in 10(15.1%) patients of group N (p=0.60) (fig. 1). Grade three laryngospasm occurred in one patient of group M. Two (3.0%) patients of group M and four (6.0%) patients of group N were agitated (PDS > 3) during the emergence (p=0.68). Overall, pain discomfort score was lower in patients of group M as compared to group N (p=0.038) (fig. 1).

Upper airway obstruction was the most common adverse event that occurred during emergence from anaesthesia in both the groups. It was followed by laryngospasm (Table 3). While 14(10.6%) patients developed laryngospasm after

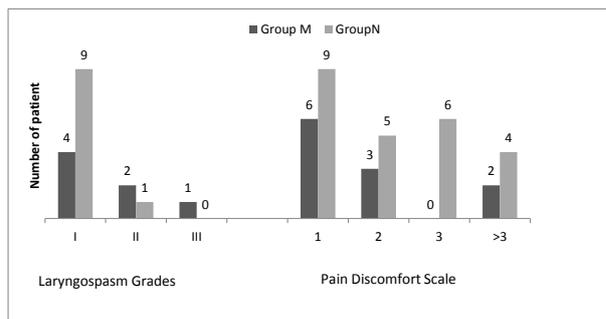


Figure 1. Patients with emergence Laryngospasm and Agitation

Table 3. Adverse Events during emergence from anaesthesia

Adverse Events	After LMA removal		At PACU	
	Group M (n=66)	Group N (n=66)	Group M (n=66)	Group N (n=66)
(P value)Upper AO (1.0)	9	15	8	1
Laryngospasm (0.60)	5	9	2	1
Cough (0.008)	0	3	3	11
Pain (0.240)	0	0	4	9
Shivering (0.11)	1	0	5	1

removal of LMA, only three (2.2%) patients developed it in the PACU. Unlike laryngospasm, emergence coughing occurred mainly in the PACU. Coughing occurred in 14(21.2%) patients of group N and in three (4.5%) patients of group M (p=0.004) (Table 3).

DISCUSSION

In our study, intraoperative infusion of 15 mg/kg magnesium sulphate, did not reduce occurrence of the laryngospasm and agitation during emergence from general anaesthesia in children. However, it reduced the occurrence of emergence cough.

Laryngospasm during anaesthesia is mostly due to either insufficient depth of anaesthesia or increased stimuli like blood or secretions.^{5,12} Where drugs like lignocaine and propofol reduce laryngospasm by attenuation of the laryngeal reflexes, atropine reduces the risk by decreasing pharyngeal secretion.^{5,13-15} The timing of removal of LMA is also crucial, as the risk is reduced if removal is timed when either in a deep plane of anaesthesia or fully awake.¹⁶

In a quest for finding an ideal drug that prevents laryngospasm in children, we chose magnesium sulphate. In a study by Gulhas et al. use of 15 mg/kg of IV magnesium sulphate significantly reduced the incidence of emergence laryngospasm in 40 children after adenotonsillectomy.⁶ The postulated mechanism include increase in the depth of anaesthesia and smooth muscle relaxation by magnesium.⁶ Unlike their finding, magnesium sulphate did not reduce emergence laryngospasm in our patients.⁶ There are similar reports supporting our study.^{17,18} Probably, the study of Gulhas et al. was not powered adequately as it was a preliminary study on a small number of patients.⁶

Like laryngospasm, agitation is also a common problem during emergence from anaesthesia in children.⁴ The potential of magnesium sulphate in reducing emergence agitation has been postulated because of its neuroprotective and anticonvulsant properties.⁴ Reduction in the incidence and severity of emergence agitation in children was seen with the use of 30 mg/kg of magnesium sulphate as a bolus followed by an infusion of 10 mg/kg/hr.⁴ We wanted to find out whether the lower dose of magnesium as used in our study could reduce the occurrence of emergence agitation. Our finding was negative and so was with only the bolus dose of 30 mg/kg.¹⁹ Overall, the incidence of emergence agitation was very low, only 4.5% in our study. The reported incidence varies between 30 to 80%.⁴ Use of halothane for maintenance of anaesthesia in our patients could be the reason for this low incidence as agitation is reported to be more frequent with inhalational agents having rapid recovery profile like sevoflurane.²⁰

In our patients, the upper airway obstruction was common during the emergence from anaesthesia. This obstruction was possibly due to fall back of tongue as we could easily relieve it with chin lift and jaw thrust maneuver. In view of this finding, we assume that prophylactic insertion of an airway, immediately after removal of the LMA could possibly have reduced the airway obstruction in many children.

Incidentally, lesser number of children receiving magnesium developed cough during emergence from anaesthesia as compared to children receiving normal saline in our study. The potential of magnesium in reducing cough both during induction and emergence from anaesthesia is reported.^{17,21} This antitussive effect of magnesium could be because of its bronchodilatory and muscle relaxant properties. In addition, suppression of airway reflexes by magnesium might play a role. As postoperative coughing is troublesome to the patient, associated with hemodynamic instability and at times followed by laryngospasm, reduction in its occurrence by magnesium could be an additional benefit.

In our study, there were many children having the risk factors for perioperative laryngospasm. This could be the reason for higher incidence of laryngospasm in our study, the risk increases if a child has history of URTI, asthma or allergy.⁵ On sub group analysis, we found that laryngospasm occurred in significant number of children who already had these risk factors.

Overall, we found that intraoperative infusion of 15 mg/kg magnesium sulphate does not reduce the occurrence of emergence laryngospasm and agitation in children, but reduces the occurrence of emergence cough. As laryngospasm often follows cough, occurrence of laryngospasm could also be reduced indirectly. Although, statistically insignificant, lesser number of children receiving magnesium were agitated and complained of pain in the postoperative period as compared to children receiving normal saline in our study. Further dose finding study, using higher doses of magnesium is required to find out its analgesic and agitation reducing properties in children. Considering the benefit of magnesium sulphate in reducing the occurrence of emergence cough, we suggest its use in children particularly with risk for coughing during the emergence from anaesthesia.

Our limitation was we did not measure plasma magnesium concentration in our study because a dose of 50 mg/kg is reported to be clinically safe. Moreover, a high dose of 100 mg/kg has been used for the treatment of acute bronchospasm in children.^{21,22}

CONCLUSION

Intraoperative infusion of 15 mg/kg magnesium sulphate does not reduce occurrence of the laryngospasm and agitation during emergence from anaesthesia in children undergoing hernia-hydrocele surgeries. However, it significantly reduces the occurrence of emergence cough.

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