

Magnesium Sulphate Versus Dexmedetomidine for Prevention of Emergence Agitation (EA) after Sevoflurane in Adult Patients Undergoing Percutaneous Nephrolithotomy

Abbadly Abdallah Ahmed¹, Mohammed Hussam El-din Mohammed¹,
Gamal A. Alsagheer², Mahmoud Mohammed Ahmed Ismail*¹

Departments of ¹Anaesthesia and Surgical ICU and ²Urology, Faculty of Medicine,
South Valley University, Qena, Egypt.

*Corresponding author: Mohammed Hussam El-din Mohammed, Mobile: (+20) 01099763293,
E-mail: mohammedhussam1235@icloud.com

ABSTRACT

Background: The utilization of sevoflurane as inhalational agent may cause emergence agitation (EA) during recovery from general anesthesia. EA has also been specified to emergence delirium, and sometimes it is accompanied with negative postoperative behaviors. The aim of this study was to compare the effect of magnesium sulphate and dexmedetomidine infusion on prevention of EA after sevoflurane anesthesia in adult patients undergoing percutaneous nephrolithotomy (PCNL).

Patients and methods: This study was carried out at Anaesthesia, Intensive Care Unit and Pain Management Department, Qena university Hospital on 50 adult patients undergoing PCNL under general anesthesia using sevoflurane as inhalational agent. Participants were divided into two groups: group I (25 patients) received initial intravenous magnesium sulphate and group II (25 patients) received dexmedetomidine infusion.

Results: There was statistically significant difference between both groups regarding Richmond Agitation Sedation Scale (RASS). The mean VAS was 7.2 (SD 1.9) and 2.6 (SD 0.9) among groups 1 and 2, respectively. There was statistically significant difference between both groups regarding VAS and hemodynamics

Conclusion: Intraoperative infusion of either dexmedetomidine or magnesium sulfate after sevoflurane in adult patients undergoing PCNL decreased postoperative agitation and pain intensity with the superiority of dexmedetomidine. However, the magnesium sulfate gives more hemodynamic stability, so it was preferred for patients with severe comorbidities.

Keywords: Nephrolithotomy, Sevoflurane, Emergence Agitation, Dexmedetomidine, Intraoperative Infusion.

INTRODUCTION

Sevoflurane appears to have many advantages such as decreasing time to awakening with faster eye opening, response to verbal command, and orientation to person, place, and time ⁽¹⁾.

But there are some adverse effects shield it from being the 'perfect' anesthetic agent ⁽²⁾.

The utilization of sevoflurane as inhalational agent may cause emergence agitation (EA) during recovery from general anesthesia. EA has also been specified to emergence delirium, and sometimes it is accompanied with negative postoperative behaviors.

There are several factors that may increase the incidence of EA; Male gender, young age, smoking, postoperative pain and premedication with atropine reported a 55% incidence of EA They demonstrated that doxapram administration, pain, and presence of a tracheal tube and or a urinary catheter appear to be the most important causes of postoperative EA ⁽⁴⁾. EA although short-lived, is potentially harmful to the patient and the recovery staff. In the postoperative care unit, an agitated patient requires more nurses to control his abnormal movement and apply restrains that could result in bruises of his extremities. Percutaneous nephrolithotomy (PCNL) under general anesthesia is more susceptible for developing EA ⁽⁵⁾.

Dexmedetomidine acts on α -2 adrenergic receptors producing sedation, hypnosis, with anxiolytic effects without significant depressive effects on respiration. It

has been extensively used to decrease the incidence of EA ⁽⁶⁾. Magnesium sulfate also has been reported to decrease EA. Particular attention should be given to the high-risk group of patients such as young age, males, and smokers ⁽⁷⁾.

Finally, adequate control of postoperative pain by multimodal analgesic approach could be of help towards a smoother recovery with a calm, alert patient.

The aim of this study was to compare the effect of magnesium sulphate and dexmedetomidine infusion on prevention of emergence agitations after sevoflurane anesthesia in adult patients undergoing PCNL regarding Richmond Agitation Sedation Scale (RASS), visual analogue scale (VAS), and hemodynamics

PATIENTS AND METHODS

This study was a randomized controlled clinical trial. Anaesthesia, Intensive Care Unit and Pain Management Department, Qena university Hospital on 50 adult patients undergoing PCNL under general anesthesia using sevoflurane as inhalational agent. Participants were divided into two groups: group I (25 patients) received initial intravenous magnesium sulphate and group II (25 patients) received dexmedetomidine infusion.

Inclusion criteria: Adult patients aged between 18 and 70 years, undergoing elective PCNL under general anaesthesia, ASA I, II.

Exclusion criteria:

Hypersensitivity to study medications, history of alcohol or drug abuse, conditions associated with severe systemic diseases (cardiac, hepatic, renal, pulmonary, endocrinal, neurological, or psychiatric disease), got an opioid analgesic prescription within a 24-h period before the operation, on medications such as α -2 agonists, clonidine, beta-blockers, and tricyclic antidepressant, patients use MAO inhibitors or adrenergic block, cognitive impairment and ASA III, IV

Study tools:

The result of administrating of magnesium sulphate compared with administrating of dexmedetomidine infusion on the outcomes in patients undergoing PCNL during Post-Anesthesia Care Unit (PACU) Stay of a university hospital patients were prospectively randomized to either: group I (25patients) received initial intravenous loading dose of 30 mg/kg of 10% solution over 10 min of magnesium sulphate. This was followed by a continuous infusion of (10mg/kg/hr) for the entire duration of surgery. Group II (25 patients) received dexmedetomidine infusion 1 μ g/kg over 10 min as a bolus dose followed by 0.2 μ g/kg/h all over the operation.

Research outcome measures:

Primary (main): Effect of both Mg sulphate and dexmedetomidine on patients according to RASS if patients alert and calm, drowsy, light sedation, moderate sedation, deep sedation and cannot be aroused.

Secondary (subsidiary): Effect of both Magnesium sulphate and dexmedetomidine on patient's hemodynamics (heart rate, blood pressure) and complications that may occur.

Ethical consent:

Approval of the Ethical Committee of Faculty of Medicine, South Valley University was obtained. Every patient signed an informed written consent for acceptance of participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test (χ^2) to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed as mean \pm SD (standard deviation). Independent samples t-test was used to compare between two independent groups of normally distributed variables (parametric data). P value < 0.05 was considered significant.

RESULTS

The mean ages were 38.3 (SD 12.3) and 41.8 (SD 12.1) years among groups 1, and 2 respectively. There was no statistically significant difference between the two studied groups regarding age. There were 37.5% and 62.5%, and 38.5% and 61.5% females and males among groups 1 and 2, respectively. There was no statistically significant difference between the 2 studied groups regarding gender. There were 70.8% and 29.2%, and 69.2% and 30.8% grade I and grade II among groups 1 and 2, respectively. There was no statistically significant difference between the two studied groups regarding ASA (**Table 1**).

Table (1): Sociodemographic data of the participants

Variable		Group 1 n= 25	Group 2 n= 25	P value
Age/year	Mean \pm SD	38.3 \pm 12.3	41.8 \pm 12.1	0.189
Gender	Female, n (%)	9 (37.5)	10 (38.5)	0.944
	Male, n (%)	16 (62.5)	15 (61.5)	
ASA	Grade I, n (%)	18 (70.8)	18 (69.2)	0.902
	Grade II, n (%)	7 (29.2)	8 (30.8)	

*Student t test; Chi square test; *p is significant at <0.05*

There were 84% and 16% RASS 0 and +1 among group 1, while there were 12% and 88% RASS 0 and +1 among group 2, respectively. There was statistically significant difference between both groups regarding RASS (**Table 2**).

Table (2): RASS among the two studied groups

Variable		Group 1 (n= 25)	Group 2 (n= 25)	P value
RASS	0, n (%)	21 (84)	3 (12)	<0.001*
	+1, n (%)	4 (16)	22 (88)	
VAS, (Mean \pm SD)		7.2 \pm 1.9	2.6 \pm 0.9	<0.001*

The mean VAS was 7.2 (SD 1.9) and 2.6 (SD 0.9) among groups 1 and 2, respectively. There was statistically significant difference between both groups regarding VAS (**Table 3**).

Table (3): VAS among the two studied groups

Variable	Group 1 n= 25	Group 2 n= 25	P value
VAS (Mean ± SD)	7.2 ± 1.9	2.6 ± 0.9	<0.001*

VAS score from zero to 10; zero the worst pain sensation
Student t test; Fisher Exact test; *p is significant at <0.05

At baseline the mean heart rate was not statistically significant differ among the two studied groups. During induction the mean heart rate was not statistically significant differ among the two studied groups. While the mean heart rate was statistically significant difference among the two studied groups at different points of time intraoperatively (5, 10, 15, 25, 30, 35, 40, 45, 50, 55, 60, 65 minutes).

At baseline the mean systolic blood pressure was not statistically significant differ among the two studied groups. During induction the mean systolic blood pressure was not statistically significant differ among the two studied groups. While the mean systolic blood pressure was statistically significant difference among the two studied groups at different points of time intraoperatively (5, 10, 15, 25, 30, 35, 40, 45, 50, 55, 60, 65 minutes).

At baseline the mean diastolic blood pressure was not statistically significant differ among the two studied groups. During induction the mean diastolic blood pressure was not statistically significant differ among the two studied groups. While the mean diastolic blood pressure was statistically significant difference among the two studied groups at different points of time intraoperatively (5, 10, 15, 25, 30, 35, 40, 45, 50, 55, 60, 65 minutes).

Table (4): Postoperative vital signs among the two studied groups

Variable	Group 1 n= 25 (Mean ± SD)	Group 2 n= 25 (Mean ± SD)	P value
Heart rate	96.7 ± 5.5	93.5 ± 15.1	0.129
Systolic blood pressure	102.4 ± 7.7	103.1 ± 9.2	0.768
Diastolic blood pressure	80.1 ± 5.9	81.2 ± 7.9	0.602

Student t test; Mann Whitney U test; *p is significant at <0.05

DISCUSSION

Inhaled anesthetic agents comprise the basis of modern anesthetic practice. The introduction of newer inhalational agents is aimed at identifying the perfect agent that rapidly induces anesthesia, has pleasant smells, and provides more safety, with less adverse effects ⁽¹⁾.

Rim *et al.* ⁽²⁾ found that EA in the postanesthesia care unit occurred in about 10% of patients undergoing urological surgery. PCNL is still used as the first-line treatment in large stones, even though there are many

recent retrograde ‘per vias naturales’ techniques that are becoming more popular in bigger large renal stone ⁽⁸⁾.

This study hypothesizes that magnesium sulphate or dexmedetomidine infusion during the maintenance of anesthesia leads to diminished rate of EA in adult patients posted for PCNL under sevoflurane anesthesia.

Regarding demographic data among the studied groups, our results showed that there was no statistically significant difference between the two studied groups regarding age or gender. No statistically significant difference was found between the two studied groups regarding ASA.

The current study can be supported by the randomized double-blinded, prospective, comparative, clinical study of Sabra *et al.* ⁽⁹⁾ aimed to evaluate dexmedetomidine efficacy for EA prevention in patients undergoing PCNL. The study enrolled 44 patients with ASA grades I–II aged between 21 and 70 years, experiencing an elective PCNL under general anesthesia, were included in the study. Placebo was given to group C, whereas a bolus dose of dexmedetomidine 1.0 µg/kg was given to group D patients, followed by 0.4µg/kg/h after anesthesia induction. The demographic characteristics (age, weight, and sex), duration type of surgery, and duration of anesthesia were comparable between the groups (P>0.05).

Also, our study was in line with Hussein *et al.* ⁽¹⁰⁾ aimed to investigate efficacy of intraoperative magnesium sulphate on prevention of EA in adults undergoing nasal surgeries under sevoflurane anesthesia. The study enrolled 0 adult patients of ASA physical status I and II between 20 and 40 years of age of both sexes, non-smokers, with BMI less than or equal to 30. There was no statistically significant difference found between magnesium sulphate and control group regarding demographic data of the studied patients except ASA classification which showed increase in cases with ASA 2 in magnesium sulphate group than control group (p-value = 0.041).

Furthermore, the study by Zarif *et al.* ⁽¹¹⁾ aimed to compare dexmedetomidine versus magnesium during laparoscopic colectomy. The study enrolled 51 patients with mean age of 61.2 (SD 7.3), range: 45–68 years, patients were randomly allocated into 3 groups: group C (control) received saline infusion, group D dexmedetomidine 1 g/kg and then 0.4 g/kg/hr, and group M magnesium sulphate 2g and then 15 g/kg/min. There was a non-significant (p>0.05) difference between studied groups with regard to demographic data.

As regard Preoperative investigations, the current study revealed that the mean Hb was 13.6 (SD 1.1) and 13.5 (SD 1.2) among the two studied groups. The mean platelet was 212.8 (SD 14.1) and 214.5 (SD 16.3) among the two studied groups. The mean PT was 12.0 (SD 0.8) and 12.1 (0.7) among the two studied groups. There was no statistically significant difference between the two studied groups regarding Hb, platelet, and PT.

In agreement with our results the study by Rashwan *et al.* ⁽¹²⁾ reported that there was no statistically

significant difference between the two studied groups regarding preoperative Hb.

Regarding heart rate baseline and intraoperative among the two studied groups, we found that at baseline the mean heart rate was not statistically significant differ among the two studied groups. During induction the mean heart rate was not statistically significant differ among the two studied groups. While the mean heart rate was statistically significant difference among the two studied groups at different points of time intraoperatively (5, 10, 15, 25, 30, 35, 40, 45, 50, 55, 60, 65 minutes).

Our results were supported by of **Sabra**⁽⁹⁾ as they reported that at baseline the mean heart rate was not statistically significant differ among the two studied groups. Also, they found that there was higher significant differences heart rate in control group compared with dexmedetomidine group at all times during the observation period ($p < 0.001$). This was in agreement with our results as we found that dexmedetomidine significantly decreasing the heart rate.

Similarly, the study by **Rashwan et al.**⁽¹²⁾ reported that at baseline the mean heart rate was not statistically significant different among the two studied groups. Intraoperative heart rate was statistically significantly lower in dexmedetomidine group than in placebo group except at 60 min.

Regarding Systolic blood pressure among the two studied groups, we found that at baseline the mean systolic blood pressure was not statistically significant differ among the two studied groups. During induction the mean systolic blood pressure was not statistically significant different among the two studied groups.

Similarly, regarding diastolic blood pressure among the two studied groups, we found that at baseline the mean diastolic blood pressure was not statistically significant differ among the two studied groups. During induction the mean diastolic blood pressure was not statistically significant differ among the two studied groups.

Our results were supported by of **Sabra**⁽⁹⁾ as they reported that at baseline the mean arterial blood pressure was not statistically significant differ among the two studied groups. Also, they found that there were higher significant differences mean arterial blood pressure in control group compared with dexmedetomidine group at all times during the observation period ($p < 0.001$). This was in agreement with our results as we found that dexmedetomidine significantly decreasing the mean arterial blood pressure.

In agreement with our results **Rashwan et al.**⁽¹²⁾ reported that at baseline the mean systolic arterial blood pressure and diastolic arterial blood pressure was not statistically significant differ among the two studied groups. However intraoperative systolic arterial blood pressure was statistically significantly lower in D group than in P group at 60, 105, 120, and 135 min. Intraoperative diastolic arterial blood pressure was statistically significantly lower in D group than in P group except at 75 and 135 min.

Also, a study by **Yacout et al.**⁽¹³⁾ showed that intravenous dexmedetomidine infusion in patients scheduled for elective major abdominal surgery under general anesthesia was associated with significantly lower heart rate and mean arterial blood pressure compared to the placebo group.

Our results were also supported by **Elsersy et al.**⁽⁷⁾ who reported that there was no statistically significant differ among the two studied groups as regard mean arterial blood pressure at pre-, intra- and post-operatively.

In agreement with our results **Sabra**⁽⁹⁾ reported that postoperatively there was no statistically significant difference between the studied groups regarding heart rate, and mean arterial blood pressure.

Also, in harmony with our results **Rashwan et al.**⁽¹²⁾ reported that there was no statistically significant difference between the studied groups regarding heart rate, systolic blood pressure and diastolic blood pressure.

In addition, **Zarif et al.**⁽¹¹⁾ reported that that there was no statistically significant difference between the studied groups regarding heart rate, systolic blood pressure and diastolic blood pressure.

Regarding RASS and VAS pain scale among the two studied groups, our results showed that there were statistically significant difference between both groups regarding RASS and VAS.

Our results were supported by **Sabra**⁽⁹⁾ who concluded that The EA incidence and sevoflurane requirement among patients experiencing PCNL are significantly decreased by dexmedetomidine infusion. Moreover, dexmedetomidine was associated with delayed extubation time, residual sedation, and prolonged post-anesthesia care unit stay

CONCLUSION

Intraoperative infusion of either dexmedetomidine or magnesium sulfate after sevoflurane in adult patients undergoing PCNL decreased postoperative agitation and pain intensity with the superiority of dexmedetomidine. However, the magnesium sulfate gives hemodynamic stability so it was preferred for patients with severe comorbidities. While, there were limited studies compared dexmedetomidine and magnesium sulfate in children, this was the first study compared the study compared them for prevention of EA after sevoflurane in adult patients undergoing PCNL.

Conflict of interest: The authors declare no conflict of interest.

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Author contribution: Authors contributed equally in the study.

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