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## SCIENTIFIC ARTICLE

# Effects of ketamine and midazolam on emergence agitation after sevoflurane anaesthesia in children receiving caudal block: a randomized trial<sup>☆</sup>

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### KEYWORDS

Caudal block;  
Children;  
Emergence agitation;  
Sevoflurane  
anaesthesia;  
Ketamine;  
Midazolam

### Abstract

**Background and objectives:** Emergence agitation is a common postanesthetic problem in children after sevoflurane anaesthesia. We aimed to compare the effects of ketamine and midazolam administered intravenously, before the end of surgery, for prevention of emergence agitation in children who received caudal block for pain relief under sevoflurane anaesthesia. **Methods:** 62 American Society of Anesthesiologists patient classification status I children, aged 2–7 years, scheduled for inguinal hernia repair, circumcision or orchidopexy were enrolled to the study. Anaesthesia was induced with sevoflurane 8% in a mixture of 50% oxygen and nitrous oxide. After achieving adequate depth of anaesthesia, a laryngeal mask was placed and then caudal block was performed with 0.75 mL kg<sup>-1</sup>, 0.25% bupivacaine. At the end of the surgery, ketamine 0.25 mg kg<sup>-1</sup>, midazolam 0.03 mg kg<sup>-1</sup> and saline were given to ketamine, midazolam and control groups, respectively. Agitation was assessed using Paediatric Anaesthesia Emergence Delirium scale and postoperative pain was evaluated with modified Children's Hospital of Eastern Ontario Pain Scale.

**Results and conclusions:** Modified Children's Hospital of Eastern Ontario Pain Scale scores were found higher in control group than in ketamine and midazolam groups. Paediatric Anaesthesia Emergence Delirium scores were similar between groups. Modified Children's Hospital of Eastern Ontario Pain Scale and Paediatric Anaesthesia Emergence Delirium scores showed a significant decrease by time in all groups during follow-up in postanesthesia care unit. The present study resulted in satisfactory Paediatric Anaesthesia Emergence Delirium scores which are below 10 in all groups. As a conclusion, neither ketamine nor midazolam added to caudal block

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**PALAVRAS-CHAVE**

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Anestesia com  
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Cetamina;  
Midazolam

under sevoflurane anaesthesia did show further effect on emergence agitation. In addition, pain relief still seems to be the major factor in preventing emergence agitation after sevoflurane anaesthesia.

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## Efeitos de cetamina e midazolam sobre a incidência de agitação pós-anestesia com sevoflurano em crianças submetidas ao bloqueio caudal: estudo randomizado

### Resumo

**Justificativa e objetivos:** A incidência de agitação é um problema pós-anestésico comum em crianças após a anestesia com sevoflurano. Nosso objetivo foi comparar os efeitos de cetamina e midazolam administrados por via intravenosa, antes do término da cirurgia, para prevenir a incidência de agitação em crianças submetidas ao bloqueio caudal para alívio da dor sob anestesia com sevoflurano.

**Métodos:** Foram inscritos no estudo 62 pacientes pediátricos, entre 2-7 anos, estado físico classificado de acordo com a Sociedade Americana de Anestesiologistas (ASA: I), programados para correção de hérnia inguinal, circuncisão ou orquidopexia. A anestesia foi induzida com sevoflurano a 8% em uma mistura de oxigênio (50%) e óxido nitroso (50%). Depois de atingir a profundidade adequada da anestesia, uma máscara laríngea foi colocada e, em seguida, o bloqueio caudal foi feito com bupivacaína a 0,25% (0,75 mL kg<sup>-1</sup>). No fim da cirurgia, cetamina (0,25 mg kg<sup>-1</sup>), midazolam (0,03 mg kg<sup>-1</sup>) e solução salina foram administrados aos grupos cetamina, midazolam e controle, respectivamente. A incidência de agitação foi avaliada com a escala *Paediatric Anaesthesia Emergence Delirium* (PAED) e a dor no período pós-operatório avaliada com a escala modificada *Children's Hospital of Eastern Ontario Pain Scale* (mCHEOPS).

**Resultados e conclusões:** Os escores de dor da escala modificada mCHEOPS foram maiores no grupo controle do que nos grupos cetamina e midazolam. Os escores PAED foram semelhantes entre os grupos. Os escores dessas duas escalas mostraram uma diminuição significativa do tempo em todos os grupos durante o acompanhamento em sala de recuperação pós-anestesia. O presente estudo resultou em escores satisfatórios da escala PAED, que ficaram abaixo de 10 em todos os grupos. Como conclusão, tanto cetamina quanto midazolam, adicionados ao bloqueio caudal sob anestesia com sevoflurano, não mostraram efeitos adicionais sobre a incidência de agitação. Além disso, o alívio da dor ainda parece ser o principal fator na prevenção da incidência de agitação após anestesia com sevoflurano.

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## Introduction

Emergence agitation (EA) is a common postanesthetic problem in children after sevoflurane anaesthesia.<sup>1-4</sup> However, the aetiology of EA has not yet been identified clearly. The predisposing factors are preschool age, preoperative anxiety, lack of premedication, type of surgery, awakening in a strange environment.<sup>4,5</sup> The incidence of EA had been reported between 10% and 80% in different studies.<sup>5,6,7</sup> Although EA is also seen in pain-free procedures, pain is thought to be the major contributing factor for EA. In addition to pain treatment, benzodiazepines, opioids, ketamine, alpha-2 agonists and propofol have also been used to prevent EA.<sup>8</sup>

In the present study, we aimed to compare the effects of ketamine and midazolam for prevention of EA after sevoflurane anaesthesia, in children who received caudal block for pain relief.

## Methods

The study was approved by the Institutional Ethics Committee of Ankara Research and Training Hospital (Chairperson Assoc Prof Y. Aral) with protocol number 00165 on 13 March 2008. Written informed consents were obtained from parents of the children. Sixty-two ASA I children, aged 2-7 years who were scheduled for inguinal hernia repair, circumcision or orchidopexy were enrolled in the study. Exclusion criteria were mental retardation, physical developmental delay, preoperative agitation and contraindication for caudal block.

The children did not receive any premedication. Anaesthesia was induced with inspired sevoflurane 8% in a mixture of 50% oxygen and nitrous oxide. After loss of consciousness, a peripheral vein was cannulated. ECG, SpO<sub>2</sub>, NIBP, temperature, end-tidal CO<sub>2</sub> and anaesthetic gases were monitored during anaesthesia. After achieving adequate

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