

Comparison of Caudal Epidural Anesthesia with Lidocaine-distilled Water and Lidocaine-MgSO₄ Mixture in Horses

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ABSTRACT

This study was performed to compare the onset and duration of analgesia produced by either a lidocaine–MgSO₄ or lidocaine–distilled water combination administration in the caudal epidural space of horse. Seven healthy adult horses, aged 11.7 ± 1.4 years (mean \pm SD), body weight (kg) 567 ± 32.5 (mean \pm SD), were selected for this study. Caudal epidural anesthesia was produced in all horses by administering 2% lidocaine (0.22 mg/kg) diluted in 1 mL distilled water and repeated with 2% lidocaine (0.22 mg/kg) diluted in 1 mL 10% MgSO₄ 2 weeks later. Time to onset (minutes), duration (minutes), and cranial spread of epidural analgesia were recorded. Heart rate (HR), respiratory rate (RR), and body temperature (°C) were recorded. Measurements were taken at 0 (as a baseline value before epidural administrations) and at 5, 10, 15, 30, 60, and 75 minutes after the epidural administrations of each treatment. Statistical analyses included paired Student *t* test and analysis of variance (computer program SPSS, Analytical Software, version 15.00). Statistical significance was set at $P < .05$. Onset of analgesia was significantly different ($P < .001$) between lidocaine-distilled water (2.38 ± 0.47 minutes) and lidocaine–MgSO₄ (4.62 ± 0.54 minutes). Duration of analgesia after lidocaine–MgSO₄ (186.0 ± 7.0 minutes) was longer than lidocaine-distilled water (54.5 ± 7.3 minutes). No significant differences were recorded for HR, RR, and body temperature in comparison with baseline values for each group. Using the lidocaine–MgSO₄ combination for obstetric and surgical procedures could commence relatively soon after epidural injection and could be completed without readministration of anesthetic agent.

Keywords: MgSO₄; NMDA; Lidocaine; Horse; Epidural anesthesia

INTRODUCTION

Caudal epidural anesthesia in the horse was first described in 1925 by Pape and Pitzschk using local anesthetic solution.¹ The technique provides analgesia of the perineal, sacral, lumbar, and caudal thoracic regions. It is a simple and inexpensive technique and requires no sophisticated equipment.² Caudal epidural anesthesia is used commonly in veterinary medicine to allow diagnostic, obstetric, and surgical intervention in the perineal region of large animals.^{3,4} The most frequently used epidural anesthetics are lidocaine, mepivacaine, and bupivacaine. Procaine is also used.⁴ With the exception of bupivacaine, this group of agents provides analgesia of relatively short duration and may necessitate readministration of the drug to finish the procedure. In addition, local anesthetic agents indiscriminately block motor, sensory, and sympathetic fibers,⁴ which causes ataxia, hind-limb weakness, and occasionally recumbency. Epidural and intrathecal administration of drugs with greater duration of action may be more appropriate for procedures that require long-lasting analgesia. These agents include opioids and alpha-2 agonists.^{5,6} Epidural use of ketamine has been reported in horses, cattle, and dogs, but it has a short duration of analgesia without producing recumbency or ataxia.^{7–11} Recently magnesium sulfate, which antagonizes N-methyl-D-aspartate (NMDA) receptors, similarly to ketamine, was used in intrathecal anesthesia in rat.^{12–14} Because magnesium blocks the NMDA receptors at its ion channels, it can prevent central sensitization caused by peripheral nociceptive stimulation.^{14,15} Magnesium has been shown to have antinociceptive effects in animal and human models of pain.¹⁶ These effects are primarily based on the inhibition of calcium influx into the cell and antagonism of NMDA receptors.^{15,16} The purpose of this study was to investigate the effects of epidural injection of lidocaine–MgSO₄ mixture in horse, to assay the onset and duration time, and monitor heart rate, respiratory rate, and body temperature.

MATERIALS AND METHODS

One milliliter 10% MgSO₄ (Nasr Fariman, Iran) was added to 0.22 mg/kg 2% lidocaine without epinephrine

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Table 1. Onset and Duration of Analgesia after Epidural Administration of Lidocaine with or without MgSO₄ in Seven Horses (min)

Indices	Lidocaine—distilled water (min)	
	Lidocaine—MgSO ₄ (min)	
Onset of analgesia	2.38 ± 0.47	4.62 ± 0.54 ^a
Duration of analgesia	54.5 ± 7.3	186.0 ± 7.0 ^b

^{a,b} Means within a column are significantly different ($P < .05$).

(Lidocaine Hydrochloride, Pasture, Iran), and 1 mL distilled water was added to 2% lidocaine (0.22 mg/kg) without epinephrine. Digital pH meter (NEL, Model 821, Turkey with Ingold Electrode U457, French) was used to determine pH values for lidocaine-MgSO₄ (pH 5.7) and lidocaine-distilled water (pH 6.7). There was no sedimentation observed between lidocaine and MgSO₄ during the mixing.

Seven healthy adult (11.7 ± 1.4 years of age) horses weighing 567 ± 32.5 kg were used for this study. No surgery was performed in the horses. The horses were restrained in stanchions and the sacrococcygeal area clipped and scrubbed with povidone iodine (10% Betadine). Lidocaine was infiltrated subcutaneously over the first and second coccygeal interspace, identified as the first obvious midline depression caudal to the sacrum.¹⁷ An 18-gauge, 3.5-cm needle was inserted into the epidural space with the bevel pointed rostrally. Proper placement of the needle was determined by loss of resistance test and ease of injection of a small volume (2–3 mL) of air.¹⁸ Each horse received two treatments 2 weeks apart in a Latin square design. Treatment 1 was 2% lidocaine hydrochloride without epinephrine (0.22 mg/kg) with 1 mL distilled water (control study), and treatment 2 was 2% lidocaine hydrochloride (0.22 mg/kg) with 1 mL 10% sulfated magnesium (experimental study). All drugs were administered over approximately 30 seconds epidurally.

Time to onset, duration, and anatomic distribution of the analgesia were recorded. Time from injection to loss of sensation was considered as time of onset of the analgesia. Time between loss and reappearance of pain response was considered as duration time of analgesia. Analgesia was defined as lack of a response to pinprick test and pressure from hemostat clamp (closed to the first ratchet) applied first in the perineal area and then moved cranially toward the thoracic region until a response (movement associated with pinprick test or hemostat pressure) was observed. The observer assessing analgesia was blind to treatment. Response was measured each minute until no reaction occurred and then at 5-minute intervals until a response reoccurred (lidocaine-distilled water) or every 5 minutes starting approximately 45 minutes before expected return of

Table 2. Ataxia Scoring between Groups

Groups	Ataxia Scoring		
	I	II	III
Lidocaine-distilled water	7	-	-
Lidocaine-MgSO ₄	-	-	-

Ataxia scores:

I. Mild (slight stumbling, easily able to continue walking).

II. Moderate (marked stumbling, walking but very ataxic).

III. Severe (falling).

sensation (lidocaine-MgSO₄). The horses were evaluated during the study for presence of ataxia by walking them out of the stanchions. Ataxia was graded as mild (slight stumbling, easily able to continue walking), moderate (marked stumbling, walking but very ataxic), or severe (falling).¹⁹ Heart rate, respiratory rate, and body temperature were recorded for each animal before administration of treatments at 0 minute (baseline value) and at 5, 10, 15, 30, 60, and 75 minutes after administration.

Student's *t* test was used for analysis of paired data between the two groups (onset time and analgesia duration data), and analysis of variance test was used for comparison of paired data with baseline values (heart rate, respiratory rate, and body temperature data). Statistical significance was set at $P < .05$ (computer program SPSS, Analytical Software, version 15.00).

RESULTS

Caudal epidural analgesia was produced in all horses after administration of lidocaine-distilled water and lidocaine-MgSO₄. Time to onset of analgesia was significantly prolonged ($P < .001$) after lidocaine-MgSO₄ (4.62 ± 0.54 minutes) in comparison with lidocaine-distilled water (2.38 ± 0.47 minutes). Lidocaine-MgSO₄ produced significantly ($P < .05$) longer duration of analgesia (186.0 ± 7.0 minutes) than lidocaine-distilled water (54.5 ± 7.3 minutes) (Table 1). Cutaneous analgesia ranged from coccyx vertebral to approximately L6 in the control and experimental groups. The cutaneous analgesia included the perineal region at the spinal level of L6 (similar in both groups). Mild ataxia was noted in horses receiving lidocaine-distilled water but not in the lidocaine-MgSO₄ group. Neither group of horses experienced ataxia in the control study (Table 2). Body temperatures, heart rates, and respiratory rates were not significantly different throughout the study for the control and experimental groups compared with their baseline values (Table 3).

DISCUSSION

MgSO₄ has been used previously as an epidural analgesia, similar to ketamine, in the rat.^{13,20} MgSO₄ is a noncompetitive NMDA receptor antagonist similar in action to

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