

Comparison of Lidocaine-Distilled Water and Lidocaine-Mgso4 Mixture in Epidural Anesthesia of Dog

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Abstract

Objective- To compare the lidocaine-MgSO₄ combination with lidocaine-Distilled water in the epidural of indigenous awake dogs.

Design- Prospective experimental study.

Animals- Five young (12±2 months) female indigenous dogs weighting (10.74 ± 0.44 kg).

Procedures- Epidural anesthesia was produced in all dogs with 2% lidocaine (1ml/4.5 kg body weight) with 1 ml distilled water and two weeks later repeated by lidocaine (1ml/4.5 kg) with 1 ml of 10% MgSO₄. Time to recumbency, onset time, duration of analgesia and cranial spread of analgesia and standing time were recorded. Heart rate, Respiratory rate and body temperature were recorded at 0 minute prior to epidural administration of each treatment as a base line values and at 5, 10, 15, 30, 60 and 75 minutes afterwards. Statistical analysis included paired student t-test and ANOVA (Spss, soft ware of windows). p<0.05 was considered as significant level.

Results- Significant difference (p<0.05) was noted for onset of analgesia between Lidocaine-Distilled water (2.04 ± 0.14 min) and Lidocaine-MgSO₄ (4.70 ± 0.20 min). Lidocaine-MgSO₄ produced analgesia of significantly longer duration (185 ± 5.13 min) than that of Lidocaine - Distilled water (49 ± 4.5 min). Lidocaine-Distilled water produced recumbency at 1.48 ± 0.106 min after epidural administration but Lidocaine-MgSO₄ did not produce any recumbency throughout the study. Time to standing after epidural injection of Lidocaine-Distilled water was 49.8 ± 1.56 min.

Conclusion and clinical relevance The combination of Lidocaine-MgSO₄ produced analgesia longer than Lidocaine-Distilled water. Long lasting obstetrical and surgical procedures could commence relatively soon after epidural injection of Lidocaine-MgSO₄ and could be completed without re-administration of anesthetic agent.

Key words: MgSO₄, lidocaine, canine, epidural anesthesia.

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Introduction

The administration of local anaesthetic into epidural space is an established technique of producing regional anaesthesia in Veterinary Medicine¹. Furthermore, epidural administration of local anaesthetics, opioids and alpha2-adrenergic agonists is an effective method of controlling postoperative pain, particularly after surgery involving the hind limb, pelvic or perineal region in dogs². The most frequently used epidural anesthetics are lidocaine; mepivacaine, bupivacaine, and procaine³. With the exception of bupivacaine, this group of agents provides analgesia of relatively short duration and may necessitate re-administration of the agent to allow completion of the procedure. Also, local anesthetic agents indiscriminately block motor, sensory and sympathetic fibers causing ataxia, hind limb weakness, and occasionally recumbency³. Epidural and intrathecal administration of agents with greater duration of action may be more appropriate for procedures requiring long duration of analgesia. These agents include opioids and alpha-2 agonist^{4,5}. Epidural use of ketamine has been reported in horse, cattle, and dogs with short duration of analgesia without recumbency or ataxia^{6,7,8, 9,10}. Recently magnesium sulfate, which blocks N-Methyl-D-Aspartate (NMDA) receptors, similar to ketamine, was used in intrathecal anesthesia in rat^{11,12,13}. As magnesium blocks the NMDA receptors and ions channels, it can prevent central sensitization caused by peripheral nociceptive stimulation^{13, 14}. Magnesium also has antinociceptive effects in animal and human models of pain¹⁵. These effects are primarily based on the inhibition of calcium influx into the cell and antagonism of NMDA receptors^{14, 15}. The purpose of this study was to investigate the effects of epidural injection of Lidocaine-MgSO₄ mixture in dogs, to assay onset time, duration time, and monitor its effect on the heart rate, respiratory rate and body temperature.

Materials and Methods

Five young (12±2 months) female indigenous dogs weighting (10.74 ± 0.44 kg) were used in this study. The lumbosacral area of each dog was clipped and scrubbed with povidone iodine (10%). Lidocaine was infiltrated subcutaneously over the lumbosacral joint space. An 18-gauge, 3.5-cm long needle was inserted into the epidural space with the bevel pointed forward. Proper placement of the needle was determined by loss of resistance and by ease of injection of a small volume (2-3 ml) of air¹⁶. The selection of the dogs for this study, were based on excluding paediatric, geriatric, obese and pregnant animals. In addition, the treated dogs were supported in sternal recumbency for a few minutes immediately following drug injection to obviate posture-related unilateral block. Each dog received each of two treatments at two weeks intervals in the cross over design. All medications were administered over approximately 30 seconds in each dog. In treatment group 1ml of 10% MgSO₄ (Nasr Fariman, Iran) was added to 1ml/4.5 kg body weight 2% lidocaine without epinephrine (Lidocaine HCL, Pasture, Iran). And in control group 1ml distilled water was added to 2% lidocaine (1ml/4.5 kg body weight) without epinephrine. pH values was determined as 5.7 for lidocaine–MgSO₄ and 6.7 for lidocaine–distilled water by digital pH meter, (NEL, Model 821, Ingold Electrode U457, Turkey). There was no sedimentation in the lidocaine - MgSO₄ mixture. All drugs were administered over approximately 30 seconds in each dog. Time to onset [time interval (min) between epidural injections of drug to loss of pain response inflicted by a hemostat], duration [time interval (min) between loss and reappearance of pain response inflicted by a hemostat] and cranial extension of analgesia were recorded. Analgesia was defined as lack of a response to pin prick and hemostat pressure (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 pin prick or hemostat pressure) was observed. Responses were measured each minute until no reaction occurred and then at 5 minutes intervals until a response occurred. The dogs were evaluated throughout the study for presence of recumbency and standing time. Heart rate, respiratory rate and body temperature were recorded for each animal prior to administration of each treatment protocol at 0 minute (base line value) and at 5, 10, 15, 30, 60, and 75 minutes after administration.

Statistical Analysis

Student's t –test was used for analysis of paired data between two groups (onset time and analgesia duration data) and ANOVA test was used for comparison of paired data with base line values (heart rate, respiratory rate and body temperature data). $p < 0.05$ was considered as significant level (Spss, software of windows).

Results

Epidural analgesia was produced in all dogs following administration of lidocaine-distilled water and lidocaine-MgSO₄. Following the administration of lidocaine-distilled water, recumbency occurred (1.48 ± 0.10 min) but no recumbency observed following epidural administration of Lidocaine-MgSO₄. Time to onset of analgesia was significantly longer in lidocaine-MgSO₄ (4.70 ± 0.20 min) in comparison to lidocaine-distilled water (2.04 ± 0.14 min). Lidocaine-MgSO₄ produced significantly ($p < 0.05$) longer duration of analgesia (185 ± 5.13 min) than that produced by lidocaine-distilled water (49 ± 4.5 min), standing time was 49.8 ± 1.56 minutes in the control group (Table1). Cutaneous analgesia ranged from coccyx vertebral to approximately L₁ in the control and experimental groups. The cutaneous analgesia included the perineal region and was similar in spread on both sides of the spine to level of L₁ in both control and experimental groups.

Statistical analysis revealed that there were no differences in heart rate, respiratory rate and body temperature in comparison to the base line value in the control and experimental groups during the study (Table 2).

Table 1: Anesthetic indices (mean \pm SEM) epidurally administered lidocaine–distilled water and lidocaine-MgSO₄ in 5 dogs (min).

Indices	lidocaine – distilled water (min)	lidocaine - MgSO ₄ (min)
Time to recumbency	1.48 ± 0.10	-----
Onset of analgesia	2 ± 0.14	4.7 ± 0.2^a
Duration of analgesia	49 ± 4.5	185 ± 5.13^b
Time to stand	49.8 ± 1.56	-----

Table 2: Heart rates (beats/min), respiratory rate (breath/min) and rectal temperature (°C) of 5 dogs under epidural anesthetic with lidocaine–distilled water and lidocaine-MgSO₄

Indices		Time interval(min)			
		0	5	10	15
Heart rate	control	102.4 ± 10.8	89.8 ± 7.5	90 ± 7.1	88.8 ± 7.05
	experiment	102.4 ± 12.05	114 ± 9.2	116 ± 8.5	112.8 ± 8.13
Respiratory rate	control	25.4 ± 0.74	24 ± 0.70	21.4 ± 0.74	22.8 ± 0.66
	experiment	25.2 ± 0.8	23.8 ± 1.6	22.4 ± 1.9	20 ± 1.09
Rectal temperature	control	39.3 ± 0.1	39.4 ± 0.1	39.4 ± 0.2	39.2 ± 0.2
	experiment	39.48 ± 0.03	39.18 ± 0.09	38.7 ± 0.23	38.6 ± 0.15

Indices		Time interval(min)		
		30	60	75
Heart rate	control	87.4 ± 6.01	93.2 ± 8.4	100 ± 10.2
	experiment	111 ± 9.59	107.2 ± 10.36	104.6 ± 12.3
Respiratory rate	control	19.6 ± 0.74	22.6 ± 0.67	25.2 ± 0.58
	experiment	22 ± 0.63	24 ± 0.63	23.8 ± 1.2
Rectal temperature	control	39.1 ± 0.16	39.1 ± 0.1	39.2 ± 0.1
	experiment	38.8 ± 0.09	39.1 ± 0.08	39.1 ± 0.1

Discussion

The spread of anaesthetic solution within the epidural space is known to be influenced by a number of factors including age, obesity, pregnancy and body position^{17,18,19}. In clinical practice, dogs would normally be sedated as indicated to facilitate epidural puncture^{20,21}. The use of a sedative drug was deliberately omitted in this study in order to avoid the possible confounding effects of a sedative agent on the physiological variables that were measured. It was, however, recognized that failure of block might result if the needle tip was dislodged from the epidural space in a struggling awake dog following epidural puncture. The likelihood of this complication occurring was lessened by the application of firm manual restraint by an assistant. From the humane viewpoint, lidocaine solution was infiltrated into the injection site to minimize pain of epidural puncture.

MgSO₄ such as ketamine has been used in the rat epidural analgesia^{11,22}. MgSO₄ such as ketamine is a non competitive NMDA receptors antagonist¹⁵. Injection of ketamine for perineal analgesia in the dogs⁷, horses⁶ and cattle¹⁰ has been reported in the literature. Pain stimulation can cause release of Aspartate and Glutamate neurotransmitters that bind to N-Methyl Amino acids receptors and cause calcium, sodium ions inflow and potassium out flow

that results pain stimulation sensation in the CNS²². Magnesium sulfate blocks calcium influx and non competitively antagonize NMDA excitatory receptors that cause prevention of central sensitization produced by peripheral nociceptive stimulation^{13,14,15,22,23}. Mizutani et al had reported prolongation of pain recognition after systemic administration of MgSO₄ in human²⁴ however Thurnau et al reported that MgSO₄ could not cross the blood brain barrier following systemic administration²⁵. Prolonged duration of intrathecal analgesia following administration of fentanyl – magnesium combination has been reported in rat^{11,22}. Recently Marzouk et al and Haagi-Mohammadi et al had used fentanyl-Mgso₄ and lidocain-MgSo₄ in spinal anaesthesia in the human being , respectively showing significantly prolonged duration of analgesia^{26, 27} their results support the prolonged duration of analgesia observed in our study after epidural injection of lidocaine–MgSO₄ (109.2 ± 5.2 min) in comparison to control group (75.8 ± 1.42 min). Catteral et al, have correlated the delayed in the beginning of anaesthesia due to lowered non ionized form which is cellular permeable form²⁸ . Recumbency is expected following epidural administration of lidocaine because local anesthetics block both sensory and motor fibers³. Recumbency was observed after epidural administration of lidocaine- distilled water in this study but no recumbency was observed following the lidocaine-MgSO₄ administration. Marzouk et al also used MgSO₄–fentanyl intratechally in the human being and did not report any motor nerve affection²⁶. Probably lidocaine-MgSO₄ with unknown mechanism had less effect on motor nerve fibers in comparison to lidocaine-distilled water. There were no significant differences in the heart rate, respiratory rate and body temperature between control and experimental group in comparison to base line value throughout the study. Haaji-Mohammadi et al did not observe any respiratory or cardiovascular side effects after intratechal injection of lidocaine- MgSO₄ in the human being²⁷. Further research is necessary to determine the various dose of MgSO₄ in epidural administration and its histopathological effects on neuron fibers in epidural space.

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مقایسه اثر لیدوکائین - آب مقطر و لیدوکائین - سولفات منیزیم در بی حسی اپیدورال سگ

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هدف: بیحسی اپیدورال بعنوان یکی از روشهای بیحسی ناحیه ای در دامپزشکی مطرح می باشد. در مطالعات متعددی از داروها و ترکیبات مختلف برای ایجاد بیحسی اپیدورال استفاده شده است تا طول بیحسی را افزایش دهند یا سرعت ایجاد بیحسی را تغییر دهند. هدف از انجام این مطالعه مقایسه اثر لیدوکائین - آب مقطر و لیدوکائین - سولفات منیزیم در بی حسی اپیدورال سگهای بومی هوشیار می باشد.
طرح: مطالعه تجربی.

حیوانات: در این مطالعه ۵ قلابه سگ ماده بومی (۱۲±۲) ماهه و به وزن (۱۰/۷۴±۰/۴۴) کیلوگرم مورد استفاده قرار گرفت.
روش: بیحسی اپیدورال در تمامی سگها با لیدوکائین ۲٪ با ۱ میلی لیتر آب مقطر انجام گرفت و ۲ هفته بعد با ترکیب لیدوکائین ۲٪ و ۱ میلی لیتر سولفات منیزیم ۱۰٪ تکرار شد. زمان زمین گیری، شروع بیحسی، طول بیحسی و گسترش بیحسی به طرف قدام مورد ارزیابی و ثبت می شدند. تعداد ضربان قلب، تعداد تنفس و دمای بدن در زمان صفر قبل از تجویز اپیدورال بعنوان اطلاعات پایه و در زمانهای ۵، ۱۰، ۱۵، ۳۰، ۶۰ و ۷۵ دقیقه بعد از تجویز هر دارو ثبت شده و مورد مقایسه قرار گرفتند. تجزیه و تحلیل آماری با نرم افزار SPSS تحت ویندوز انجام گرفت.

نتایج: نتایج نشان دادند که شروع بیدردی به شکل معنی داری در استفاده از ترکیب لیدوکائین - سولفات منیزیم (۴/۷۰±۰/۲۰ دقیقه) بیشتر از گروه کنترل (۲/۰۴±۰/۱۴ دقیقه) بوده است. طول ایجاد بیدردی در ترکیب لیدوکائین - سولفات منیزیم (۱۸۵±۵/۱۳ دقیقه) به شکل معنی داری بیشتر از ترکیب لیدوکائین - آب مقطر (۴۹±۴/۵ دقیقه) بوده است.

نتیجه گیری: چنین به نظر می رسد که ترکیب لیدوکائین - سولفات منیزیم بیدردی طولانی تری نسبت به ترکیب لیدوکائین - آب مقطر ایجاد میکند بنابراین می توان در روندهای طولانی مدت جراحی، مامایی و ایجاد بیدردیهای طولانی مدت بعد از عمل از این ترکیب به شکل بالینی استفاده کرد.

کلید واژگان: سولفات منیزیم، لیدوکائین، بیحسی اپیدورال، سگ