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 Medicine\(^1\). 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 dogs\(^2\). The most frequently used epidural anesthetics are lidocaine; mepivacaine, bupivacaine, and procaine\(^3\). 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 recumbency\(^3\). 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 pain\(^15\). 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-MgSO\(_4\) 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 air\(^16\). 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% MgSO\(_4\) (Nasr Fariman, Iran) was added to 1ml/4.5 kg body weight 2% lidocaine without epinephrine (Lidocaine HCL, Pasteur, 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–MgSO\(_4\) and 6.7 for lidocaine–distilled water by digital pH meter,( NEL, Model 821, Ingold Electrod U457, Turkey ). There was no sedimentation in the lidocaine - MgSO\(_4\) 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 ± SEM) epidurally administered lidocaine–distilled water and lidocaine-MgSO4 in 5 dogs (min). |
|------------------|------------------|
| Indices          | lidocaine – distilled water | lidocaine-MgSO4 |
|                  | (min)              | (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       | ------          |

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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

<table>
<thead>
<tr>
<th>Indices</th>
<th>Time interval(min)</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>30</th>
<th>60</th>
<th>75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate</td>
<td>control</td>
<td>102.4 ± 10.8</td>
<td>89.8 ± 7.5</td>
<td>90 ± 7.1</td>
<td>88.8 ± 7.05</td>
<td>87.4 ± 6.01</td>
<td>93.2 ± 8.4</td>
<td>100 ± 10.2</td>
</tr>
<tr>
<td></td>
<td>experiment</td>
<td>102.4 ± 12.05</td>
<td>114 ± 9.2</td>
<td>116 ± 8.5</td>
<td>112.8 ± 8.13</td>
<td>111 ± 9.59</td>
<td>107.2 ± 10.36</td>
<td>104.6 ± 12.3</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>control</td>
<td>25.4 ± 0.74</td>
<td>24 ± 0.70</td>
<td>21.4 ± 0.74</td>
<td>22.8 ± 0.66</td>
<td>19.6 ± 0.74</td>
<td>22.6 ± 0.67</td>
<td>25.2 ± 0.58</td>
</tr>
<tr>
<td></td>
<td>experiment</td>
<td>25.2 ± 0.8</td>
<td>23.8 ± 1.6</td>
<td>22.4 ± 1.9</td>
<td>20 ± 1.09</td>
<td>22 ± 0.63</td>
<td>24 ± 0.63</td>
<td>23.8 ± 1.2</td>
</tr>
<tr>
<td>Rectal temperature</td>
<td>control</td>
<td>39.3 ± 0.1</td>
<td>39.4 ± 0.1</td>
<td>39.4 ± 0.2</td>
<td>39.2 ± 0.2</td>
<td>39.1 ± 0.16</td>
<td>39.1 ± 0.1</td>
<td>39.1 ± 0.1</td>
</tr>
<tr>
<td></td>
<td>experiment</td>
<td>39.48 ± 0.03</td>
<td>39.18 ± 0.09</td>
<td>38.7 ± 0.23</td>
<td>38.6 ± 0.15</td>
<td>38.8 ± 0.09</td>
<td>39.1 ± 0.08</td>
<td>39.1 ± 0.1</td>
</tr>
</tbody>
</table>

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. In clinical practice, dogs would normally be sedated as indicated to facilitate epidural puncture 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. MgSO₄ such as ketamine is a non competitive NMDA receptors antagonist. Injection of ketamine for perineal analgesia in the dogs, horses and cattle 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 CNS\textsuperscript{22}. Magnesium sulfate blocks calcium influx and non competitively antagonize NMDA excitatory receptors that cause prevention of central sensitization produced by peripheral nociceptive stimulation\textsuperscript{13,14,15,16,22,23}. Mizutani et al had reported prolongation of pain recognition after systemic administration of MgSO\textsubscript{4} in human\textsuperscript{24} however Thurnau et al reported that MgSO\textsubscript{4} could not cross the blood brain barrier following systemic administration\textsuperscript{25}. Prolonged duration of intrathecal analgesia following administration of fentanyl – magnesium combination has been reported in rat\textsuperscript{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 \textsuperscript{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 form\textsuperscript{28}.

Recumbency is expected following epidural administration of lidocaine because local anesthetics block both sensory and motor fibers\textsuperscript{3}. 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 affection\textsuperscript{26}. 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 intrathecal injection of lidocaine- MgSO4 in the human being\textsuperscript{27}.

Further research is necessary to determine the various dose of MgSO4 in epidural administration and its histopathological effects on neuron fibers in epidural space.

References


چکیده:
مقایسه اثر لیدوکائین- آب مもちろ و لیدوکائین- سولفات منیزیم
در بی حس ایپیورال سگ

دکتر سیف‌الدین برهانی و دکتر امین بهمن صادقی

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هدف: بی‌حسی ایپیورال به‌عنوان یکی از روش‌های بی‌حسی ناخی ای در دامپزشکی مطرح می‌باشد. در مطالعات متعددی از داروهای و ترکیبات مختلف برای ایجاد بی‌حسی ایپیورال استفاده شده است. این تحقیق تأکیدی را افزایش دهنده به سرعت ایجاد بی‌حسی را تغییر دهنده. هدف از انجام این مطالعه مقایسه اثر لیدوکائین- آب م المختلف و لیدوکائین- سولفات منیزیم در بی حسی ایپیورال سگ‌های بومی هوشیر می باشد.

طرح: مطالعه تجريبي.

چیزات: در این مطالعه 5 قطاع سگ ماده بومی(۲±۱۲)ماهه و وزن (۷۴±۷۰) کیلوگرم مورد استفاده قرار گرفت.

روش: بی‌حسی ایپیورال در تمام سگ‌ها با لیدوکائین ۲٪ با 1 میلی لتر آب مطلق انجام گرفت و همانند با ترکیب لیدوکائین ۲٪ و ۱ میلی لتر سولفات منیزیم ۱۰٪ تکرار شد. زمان زمان سنگین و سروه بی‌حسی، طول بی‌حسی و کسترش بی‌حسی به طرف قلم مورد ارزیابی و تبیت می‌شده. تعداد ضربان قلب، تعداد تنفس و دمای بدن در زمان صفر قبل از تجویز ایپیورال به‌عنوان اطلاعات پایه و در زمان‌های ۵، ۱۰، ۱۵، ۳۰، ۶۰ و ۱۲۵ دقیقه بعد از تجویز هر دارو تبیین شده و مورد مقایسه قرار گرفتند. تجزیه و تحلیل آماری با نرم‌افزار SPSS وندوز انجام گرفت.

نتایج: تایپ نشان داد که شروع بی‌سرعت به شکل معنی‌داری در استفاده از ترکیب لیدوکائین- سولفات منیزیم (۱۲۰/۳۵ دقیقه) بیشتر از کنترل (۳۰/۱۰ دقیقه) بوده است. طول ایجاد بی‌سیندرم در ترکیب لیدوکائین- سولفات منیزیم (۱۲۰/۳۵ دقیقه) به شکل معنی‌داری بیشتر از ترکیب لیدوکائین- آب مطلق (۴۹/۴۷ دقیقه) بوده است.

نتیجه گیری: چنین نتایج نشان داد که ترکیب لیدوکائین- سولفات منیزیم به‌درد و درد اکستراUSTED به ترکیب لیدوکائین- آب مطلق بیشتر ایجاد می‌کند. این نتایج نشان می‌دهد که لیدوکائین- سولفات منیزیم بهتر است در بیماران بی‌حسی ایپیورال استفاده شود.

کلید واژگان: سولفات منیزیم، لیدوکائین، بی‌حسی ایپیورال، سگ.