Magnesium is one of the most plentiful cation in the body and the second most common intracellular one. It has many physiological activities including, the presynaptic release of acetylcholine from nerve ending, neuronal activity, vasomotor tone and antinociceptive effects of chronic pain (Feria et al. 1993). The importance of magnesium in anaesthetic practice has been investigated (James 1992, Fawcett et al. 1999). It was suggested that magnesium (Mg) has the potential to treat and prevent pain by acting as an antagonist of N-methyl d-aspartate (NMDA) receptors (Woolf and Thompson 1991, Feria et al. 1993). The effects of magnesium sulphate (MgSO4) administered perioperatively on many anaesthetic and analgesic drugs were studied in animals (Anagnostou et al. 2008, Ray et al. 2010). MgSO4 administration reduced the dose of several anesthetics agents for induction and maintenance of anaesthesia (Gupta et al. 2006, Anagnostou et al. 2008). It was suggested that MgSO4 may be a useful adjuvant for perioperative anaesthetic and analgesic management in dogs (Kara et al. 2002, Mavrommati et al. 2004, Anagnostou et al. 2008, Ray et al. 2010). Gupta et al. (2006) also demonstrated that MgSO4 infusion reduced the dose of propofol for maintenance of anaesthesia. As well as a significant reduction in consumption of propofol and fentanyl used for balanced anaesthesia with both clonidine and MgSO4 was reported (Ray et al. 2010). The aim of this work was to evaluate the effect of pre- and intra-operatively administration of MgSO4 on the duration and dose of thiopental sodium anesthesia in dogs undergoing enterotomty.

**Key words:** Anesthesia, Dogs, Magnesium sulphate, Thiopental sodium

**MATERIALS AND METHODS**

This study was approved by the Institutional Ethical Committee. Adult mongrel dogs (15) of either sex, 1.8±0.7 year-old and weighing 15.56±0.06 kg (mean±SE) were used in the study to evaluate the effect of pre-and intra-operative administration of magnesium sulphate (MgSO4) on the duration and dose of thiopental sodium anesthesia undergoing enterotomy. All dogs were premedicated with intramuscular injection of chlorpromazine hydrochloride 15 min prior to the injection of 2.5% thiopental sodium in group 1. In group 2, i/v administration of chlorpromazine hydrochloride followed by a bolus of 50 mg/kg MgSO4 (10%) were used before injection of general anaesthesia. In group 3, the dogs received the same anesthetic protocol as in group 2 in addition to i/v infusion of MgSO4 (10%) @10 mg/kg/hr. Enterotomy model was created in all dogs and the mean operation time was 34 min. The results revealed that mean duration of anesthesia was significantly longer in groups 2 and 3 (43.40 and 57.60 min, respectively) as compared to group 1 (38.60 min). The mean total thiopental sodium dose in group 1 (32.10 mg/kg) was significantly greater than those of groups 2 and 3 (26.70 and 20.20 mg/kg respectively). It could be concluded that preoperative and intraoperative administration of MgSO4 prolong duration of anesthesia, decrease the total dose of thiopental sodium, and facilitate smooth recovery.

**ABSTRACT**

Adult mongrel dogs (15) of either sex, 1.8±0.7-year-old and weighing 15.56±0.06 kg (mean±SE) were used in the study to evaluate the effect of pre-and intra-operative administration of magnesium sulphate (MgSO4) on the duration and dose of thiopental sodium anesthesia undergoing enterotomy. All dogs were premedicated with intramuscular injection of chlorpromazine hydrochloride 15 min prior to the injection of 2.5% thiopental sodium in group 1. In group 2, i/v administration of chlorpromazine hydrochloride followed by a bolus of 50 mg/kg MgSO4 (10%) were used before injection of general anaesthesia. In group 3, the dogs received the same anesthetic protocol as in group 2 in addition to i/v infusion of MgSO4 (10%) @10 mg/kg/hr. Enterotomy model was created in all dogs and the mean operation time was 34 min. The results revealed that mean duration of anesthesia was significantly longer in groups 2 and 3 (43.40 and 57.60 min, respectively) as compared to group 1 (38.60 min). The mean total thiopental sodium dose in group 1 (32.10 mg/kg) was significantly greater than those of groups 2 and 3 (26.70 and 20.20 mg/kg respectively). It could be concluded that preoperative and intraoperative administration of MgSO4 prolong duration of anesthesia, decrease the total dose of thiopental sodium, and facilitate smooth recovery.
reflexes were abolished in group 1. In group 2, i/v bolus administration of 50 mg/kg MgSO4 (10%) solution performed and then general anesthesia was as in group 1. In group 3, dogs received the same anesthetic protocol as in group 2, additionally i/v infusion of MgSO4 (10%) solution 10 mg/kg/h was administered throughout the whole period of the surgical procedures. Anesthesia was maintained by further small doses of thiopental sodium 2.5% till the end of the operation. Balanced electrolyte (0.9% Sodium chloride) solution was administered (10 ml/kg/h) during surgery in all groups. Duration of anesthesia was defined as the time from administration of general anesthesia until the appearance of normal body reflexes after the end of operation. Total amount of thiopental sodium 2.5% required to complete the surgical procedure from induction till recovery was calculated as a total dose. Heart rate (HR) and ECG tracings were recorded. Respiratory rate (RR) was counted by observing thoracic wall movements. Animals were observed for any side effects from the beginning of administration of the treatments till the end of experiment. Blood samples were obtained just before, intraoperatively (20 min), immediately after surgery, 24 h and 48 h postoperatively from cephalic vein in centrifuges tube for serum separation in all groups to measure serum magnesium concentrations. Data obtained from the study were analyzed by analysis of variance (ANOVA - F-test) according to Snedecor et al. (1989) using SPSS version 16. For means comparison and Duncan’s Multiple Range Test (1995) were applied.

RESULTS AND DISCUSSION

Some disorders could occur after sudden administration of MgSO4 including hypotension, severe muscle relaxation and improper cardiac conductivity (Telci et al. 2002, Levaux et al. 2003, Jackson and Drobatz 2004, Movроммати et al. 2004). For these reasons and to avoid the previously mentioned problems, a dose of MgSO4 was calculated in this study based on Anagnostou et al. (2008).

Duration of anesthesia and total dose of thiopental are presented in Table 1. The duration of anesthesia was significantly different among the groups. Mean duration of anesthesia was significantly longer in groups 2 and 3 as compared to group 1. This may be attributed to depressant effects of MgSO4 on the central nervous system. The dose sparing action of MgSO4 appears to be attributed to at least 3 mechanisms, antagonism of NMDA receptors in the CNS, general anesthetic property and depressant effects on the central nervous system of animals (Woolf and Thompson 1991, James et al. 1992, Feria et al. 1993).

Administration of MgSO4, reduced the total dose of thiopental required for anesthesia in dogs undergoing enterotomy. The mean total thiopental sodium dose in group 1 was significantly greater than those of groups 2 and 3. These results conformed to the observations of Ray et al. (2010) who investigated the effect of MgSO4 on propofol requirements during surgery.

Mean serum magnesium concentrations are shown in Table 2. In group 1, the intra-operative value of magnesium decreased significantly than the baseline value. This value increased to approach the normal value 24 h postoperatively and completely returned to the baseline value 48 h postoperatively. This decrease in serum magnesium levels may be associated with the increase in anesthetic requirements in the control group. Nearly similar results were obtained by Koinig et al. (1998). Kara et al. (2002) added that, an inverse relationship was demonstrated between the severity of pain and the serum magnesium concentration. As well as, Schulz-Stubner et al. (2001) and Kara et al. (2002) mentioned that, magnesium blocks the NMDA receptor and its associated ion channels and it can prevent central sensitization caused by peripheral nociceptive stimulation. Magnesium has antinociceptive effects in animals models of pain. These effects are primarily based on the regulation of calcium influx into cell i.e. natural physiological calcium antagonism and antagonism of the NMDA receptor.

In groups 2 and 3 serum magnesium concentration increased significantly intra-operatively and just after the end of the surgery and reached to the base line values after 24 h to 48 h postoperatively. These results supported the observation of Jackson and Drobatz (2004) who found that animals in their study developed severe hypermagnesaemia. Anagnostou et al. (2008) found that, mean postoperative serum magnesium concentration in dogs receiving MgSO4 was just above the upper reference range. Akazawa et al. (1997) and Nakaigawa et al. (1997) mentioned that, intravenous administration of MgSO4 in anaesthetized dogs produced acute hypermagnesaemia at 1–2 min after administration with a 4- to 12-fold increase in total plasma magnesium concentrations.

### Table 1. Duration of anaesthesia and total thiopental sodium dose in different groups (mean±SE)

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration (min)</td>
<td>38.60±0.87</td>
<td>43.40±0.24</td>
<td>57.60±1.72</td>
<td></td>
</tr>
<tr>
<td>Total dose (mg/kg)</td>
<td>32.10±0.19</td>
<td>26.70±0.46</td>
<td>20.20±0.51</td>
<td></td>
</tr>
</tbody>
</table>

Means carrying different superscripts are significant (P<0.01).

### Table 2. Serum magnesium concentration (mg/dl) in all groups in different times (mean±SE)

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base line</td>
<td>2.21c±0.04</td>
<td>2.16±0.05</td>
<td>2.07±0.07</td>
<td>2.15f±0.06</td>
</tr>
<tr>
<td>Intraoperative</td>
<td>1.95±0.03</td>
<td>2.54±0.05</td>
<td>2.71±0.14</td>
<td>2.40±0.15</td>
</tr>
<tr>
<td>Postoperative</td>
<td>1.95±0.02</td>
<td>2.49±0.04</td>
<td>2.70±0.04</td>
<td>2.38±0.15</td>
</tr>
<tr>
<td>24 h</td>
<td>2.11d±0.04</td>
<td>2.28±0.04</td>
<td>2.28±0.03</td>
<td>2.22±0.05</td>
</tr>
<tr>
<td>48 h</td>
<td>2.22±0.04</td>
<td>2.29±0.06</td>
<td>2.11±0.06</td>
<td>2.18±0.05</td>
</tr>
<tr>
<td>Total</td>
<td>2.08±0.06</td>
<td>2.33±0.08</td>
<td>2.37±0.13</td>
<td></td>
</tr>
</tbody>
</table>

Means carrying different superscripts are significant (P<0.01).
magnesium concentrations compared to control values. Nakayama et al. (1999) reported that, in anaesthetized dogs, the plasma half-life of magnesium after a bolus injection of MgSO₄ was approximately 13 min. On the contrary, Nastou et al. (1996) reported that serum concentration of MgSO₄ was lower during anesthesia and became normomagnesemic on the 1–3 days after surgery.

During the monitoring period, no adverse events were observed in heart rate and respiratory rate in all groups. The anesthetic protocols were well tolerated by all the animals. Hypersalivation was observed in groups 2 and 3 in 2 dogs (1 in each group) 2 min after bolus injection of magnesium sulphate solution. The dogs showed hypersalivation without vomiting. This might be attributed to use of 10% MgSO₄ and long fasting period before administration of MgSO₄.

In conclusion, use of MgSO₄ preoperatively and intraoperatively prolong duration of anesthesia, decrease the requirements of total dose of thiopental sodium, and facilitate smooth recovery.

REFERENCES


