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Intraperitoneal Magnesium Sulphate-Bupivacaine Vs Tramadol-Bupivacaine for Pain Relief Post Laparoscopic Cholecystectomy: A Comparative Cross-Sectional Study

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ABSTRACT

Background

Intraperitoneal analgesics in combination with local anesthetics are being widely used which leads to less rescue analgesic demand. This study aims to compare the effect of Magnesium Sulphate-Bupivacaine with Tramadol-Bupivacaine.

Methods

An analytical cross sectional study was conducted in the Department of Surgery of Chitwan Medical College from July 2024 to November 2024. Ethical approval was taken from Institutional review committee of CMC-TH (Ref No. CMC-IRC/080/081-145). The study included 82 cases in total, all of whom were admitted for laparoscopic cholecystectomy. Magnesium Sulphate-Bupivacaine patients were recruited into group MB, while Tramadol-Bupivacaine patients were recruited into group TB using lottery technique. Group MB was given 30 ml of 0.25% bupivacaine together with 30 mg/kg of magnesium sulphate, while Group TB was given 30 ml of 0.25% bupivacaine along with 100 mg tramadol and magnesium plus bupivacaine. The Visual Analogue Scale was used to measure post-operative pain, the demand and consumption for rescue analgesia.

Results

After 1, 2, 3, and 6 hours following surgery, the TB group's cumulative mean VAS pain score was higher than the MB group's ($p = 0.0001$), according to six VAS scores collected over a 24-hour period. The MB group consumed less rescue analgesia overall over the course of the 24-hour period ($p=0.0001$), and their mean time interval for the first rescue analgesia (paracetamol) demand was higher than that of the TB group.

Conclusions

In contrast to intraperitoneal administration of tramadol and bupivacaine during laparoscopic surgery, intraperitoneal administration of $MgSO_4$ and bupivacaine showed a longer duration of pain-free period and a lower post-operative intake of rescue analgesics.

Keywords: intraperitoneal $MgSO_4$; laparoscopic cholecystectomy; postoperative rescue analgesia.

INTRODUCTION

Laparoscopic cholecystectomy being a minimally invasive surgery, the visceral pain following it is highly unpredictable.[1,2] To manage perioperative and postoperative pain, numerous studies are being carried out, and different medications and methods have been employed as part of multimodal analgesia.[3] Newer multimodal analgesia being introduced are nonopioid drugs like lidocaine, ketamine, and magnesium sulfate ($MgSO_4$) which has been proven to reduce post-operative pain.[3,4] $MgSO_4$ has been given in subarachnoid space, as continuous infusion, epidural infusion, and intravenous bolus.[5] This multimodal approach will decrease opioid consumption like tramadol which has higher side effects and contributes to improved patient recovery.[6,7] Intraperitoneally, $MgSO_4$ inhibits a subtype of NMDA receptors on the gall bladder bed's peripheral

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nerve terminals, reducing nociceptive feeling.[4,8] This research aimed to compare the effectiveness of intraperitoneal magnesium sulphate-bupivacaine versus tramadol-bupivacaine in reducing the need for postoperative rescue analgesics after laparoscopic cholecystectomy.

METHODS

An analytical cross sectional study was conducted in the Department of Surgery of Chitwan Medical College from July 2024 to November 2024. Ethical approval was taken from Institutional review committee of CMC-TH (Ref No. CMC-IRC/080/081-145). The study comprised 82 cases that were admitted for laparoscopic cholecystectomy. For the cases that were part of the study, written informed consent was acquired. The study comprised patients with a Body Mass Index (BMI) of 18–30 kg/m2 who were between the ages of 20 and 60 and were part of American Society of Anesthesiologists (ASA) I and II. Patients having a history of autonomic dysfunction, neurological or renal diseases, chronic pain on opioids, beta-blocker users, and pregnant or lactating women were not allowed to participate in the study.

Sample size was calculated using the formula

$n = AB/(E/S)^2$

Where,

$A = (1/q_1 + 1/q_0) = 4.0000$

$B = (Z_\alpha + Z_\beta)^2 = 7.8489$

$E/S = 0.732$

Group sample size $= n = AB/(E/S)^2 = 31$

The calculated sample size was 31 and we included 82 cases in our study.

Here,

q_1 and q_2 = proportion of participants in each group $= 0.5$

E = effect size = $\mu_1 - \mu_0$

$\mu_1 = 2.97$ = mean of pain score where first dose of analgesia was given in tramadol with bupivacaine[9]

$\mu_0 = 1.93$ = mean of pain score where first dose of analgesia was given in magnesium sulphate with bupivacaine[9]

S = 1.42 = standard deviation of pain score where first dose of analgesia was given in magnesium sulphate with bupivacaine[9]

$Z_\alpha = 1.96$ and $Z_\beta = 0.8416$

Laparoscopic cholecystectomy is the most performed surgery in surgery department of CMCTH. In this study 82 cases into group MB and group TB equally by using random lottery method. By using lottery method, the total sample size was divided into 2 groups and the allocated number received either magnesium sulphate with bupivacaine (MB) group or tramadol with bupivacaine (TB) group intraperitoneally. Group MB received 30 mg/kg of $MgSO_4$ and TB received 100 mg tramadol in addition to which both group received 30 ml of bupivacaine (not exceeding 2.0 mg/kg body weight). All the standard procedures of laparoscopic cholecystectomy were followed. Age, Sex, Height, Weight, ASA class, Duration of surgery, Heart rate (30 minutes after drug administration), assessment for incisional/visceral/shoulder pain using Visual Analogue score (VAS) at (1^{st} hour, 2^{nd} hour, 3^{rd} hour, 6^{th} hour, 12^{th} hour, 24^{th} hour), Total analgesic requirement in 1^{st} 24 hours, and first demand for analgesics, Postoperative nausea / vomiting, Any complications (allergic reactions / cardiovascular / respiratory / neurological) were recorded in the data collection sheet. Office Excel version 2016 was used to enter the data from the data collection sheet. Version 16 of the Statistical Package for the Social Sciences (SPSS) was used to analyze the data. Where appropriate, the variables were presented as mean ± standard deviation, frequency, and percentage. The independent t-test and chi-square test were used to compare the groups.

RESULTS

In our study 82 patients were included which was equally divided in to two groups, 41 each in TB and MB group. The percentage of female population (72%) was more in our study group (Figure 1). The mean age of patient included in the study was 45.85±15.59 years and the age of the participants in each group was similar with no statistical significance (p= 0.324). The mean duration of the surgery in our study was 66.15±18.76 min which was also similar in each group (Table 1).

Table 1. Demography and surgery duration in two groups.			
Parameters	**TB**	**MB**	**Total**
Age (years)	44.15±16.63	47.56±14.48	45.85±15.59
Heart rate (b/m)	66.44±3.62	67.02±5.53	66.73±4.66
Duration of surgery (min)	68.63±20.40	63.66±16.83	66.15±18.76

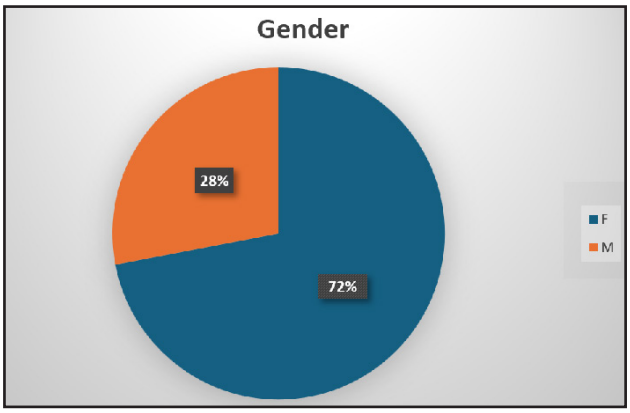

Figure 1. Gender distribution.

Six VAS scores were taken over the course of 24 hours, and the TB group's cumulative mean VAS pain score after 1, 2, 3, and 6 hours of surgery was higher than the MB group's, with a statistically significant difference (p = 0.0001) (Table 2).

Table 2. Visual analogue scale pain score of the groups at different time intervals.			
VAS score	**TB**	**MB**	**p-value**
1h	3.66±.938	2.34±.656	0.0001
2h	3.17±.771	2.02±.273	0.0001
3h	2.83±.863	1.83±.587	0.0001
6h	2.44±.594	1.66±.480	0.0001
12h	1.85±.615	1.61±.628	0.079
24h	1.76±.624	1.34±.48	0.001

Our study also assessed the mean time interval of the initial rescue analgesia (paracetamol) demand, which was statistically significant (p = 0.0001) and longer in the MB group than in the TB group. A comparison of the total amount of rescue analgesia consumed in a 24-hour period revealed that the TB group needed more doses than the MB group, which was also statistically significant (p = 0.0001) (Table 3).

Similarly side effects were also present in more patients in TB group as compared to MB group. But there was no statistical significance in the presentation of side effects.

Table 3. Analgesia time and total analgesics required for the two groups.			
Parameter	**Drug used**	**Mean ± SD**	**p-value**
Call for 1st analgesia (hours)	TB	3.89±1.081	0.0001
	MB	6.27±1.073	
Total analgesics (paracetamol) required 24 hr (grams)	TB	3.02±.52	0.0001
	MB	2.37±.49	

Table 4. Comparison of side effects of the groups.			
Side effects	**TB**	**MB**	**p-value**
Post op nausea	6	2	0.137
Post op vomiting	3	1	0.305

DISCUSSION

Intraperitoneal analgesics such as ropivacaine and bupivacaine effectively reduce postoperative pain and minimize the need for extra analgesics following laparoscopic cholecystectomy.[10,11] Enhancing post-operative pain management with opioid-sparing strategies can greatly improve the success rate of outpatient laparoscopic cholecystectomy.[12] By reducing the use of opioids, these treatment plans lower the chances of opioid-related nausea and other side effects, leading to quicker recovery and allowing patients to go home on the same day.[12] In addition to parenteral analgesic administration, intraperitoneal injection of local anesthetics and opioids is becoming more and more common as a means of reducing pain during laparoscopic cholecystectomy..[13] By this single step, the drug has direct local effects on the surgical site, therefore decreasing the use of systemic opioids, and as a result decreasing its associated side effects like nausea and vomiting.[14]

In this study, we compared the analgesic effects of intraperitoneal $MgSO_4$ with bupivacaine versus tramadol with bupivacaine in patients undergoing laparoscopic cholecystectomy. In our study total of 82 patients undergoing laparoscopic cholecystectomy were included among which 41 each were divided into tramadol-bupivacaine (TB) group and $MgSO_4$-bupivacaine (MB) group. Among the total participants 72% were female. The average age of the patients was 44.15±16.63 and 47.56±14.48among TB group and MB group respectively. Similarly, the mean

duration of study for TB group and MB group was 68.63±20.40 and 63.66±16.83 respectively. The TB group's call for first analgesia was 3.89±1.081 hours, while the MB group's was 6.27±1.073 hours and was highly significant (p=0.0001). This outcome was comparable to the research conducted by Yadava et al. [9]. The requirement for the postoperative analgesics was also less in MB group (2.37±0.49) grams when compared with TB group (3.02±0.52) which was also highly significant (p=0.0001). This result shows that the administration of $MgSO_4$ is highly effective in controlling the postoperative pain when compared to tramadol. Similar result was seen in the study done by Yadava et al.[9] Our study included six analyses of the VAS score over a 24-hour period. The cumulative mean of the VAS pain score after 1, 2, 3, and 6 hours of surgery was higher in the TB group than in the MB group, and the difference was statistically significant (p=0.0001). The VAS score was also significantly high at 24 hours. This outcome is consistent with the research conducted by Yadava et al.[9] There was no statistical significance in VAS score among the group at 12h (p = 079). In our study postoperative nausea was seen in 6 and 2 patients among the TB and MB group respectively and 2 and 1 patient complained of postoperative vomiting in the TB and MB group respectively both of with was not statistically significant. (p= 0.137 and 0.305 respectively). This result was also similar to by Yadava et al. [9] Magnesium sulfate ($MgSO_4$) is effective in attenuating post-operative pain from laparoscopic cholecystectomy by inhibiting calcium entry and antagonizing NMDA receptors - both implicated in pain sensation. [5] $MgSO_4$ also blocks NMDA receptors in emetic pathways and tissues associated with the last common pathway for vomiting.[15] However there are no studies showing the effect of $MgSO_4$ in postoperative nausea and vomiting.

CONCLUSIONS

When compared to intraperitoneal use of tramadol with bupivacaine in laparoscopic surgery, intraperitoneal use of $MgSO_4$ with bupivacaine demonstrated a longer duration of pain-free period and a lower intake of rescue analgesics in the post-operative period.

Conflict of interest: None

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