Journal of Advances in Medicine and Medical Research

32(18): 81-90, 2020; Article no.JAMMR.60809
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

Intraperitoneal Versus Ultrasound Guided Transversus Abdominis Plane Block by Bupivacaine-Magnesium Sulphate for Pain Relieafter Laparoscopic Cholecystectomy

Nashwa I. Hamoda[1*], Hesham I. El Tatawy[1], Nagat S. El Shmaa[1] and Mohammad I. Okab[1]

[1]Anesthesia and Surgical ICU and Pain Management Department, Faculty of Medicine, Tanta University, Egypt.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMMR/2020/v32i1830660
Editor(s):
(1) Dr. Pietro Scicchitano, Hospital "F. Perinei", Italy.
(2) Dr. Sevgul Donmez, Gaziantep University, Turkey.
Reviewers:
(1) Dr. B. Satheesha Nayak, Manipal Academy of Higher Education, India.
(2) OJO Funmilola Mabel, Olusegun Agagu University of Science and Technology, Nigeria.
Complete Peer review History: http://www.sdiarticle4.com/review-history/60809

Original Research Article

Received 26 July 2020
Accepted 01 October 2020
Published 15 October 2020

ABSTRACT

Background and Aim: Intraperitoneal (IP) administration of local anesthetic is considered a method of control of visceral component of pain. This method cannot be used as sole agent for pain relief after laparoscopic cholecystectomy (LC). Transversus Abdominis Plane block (TAP) becomes a useful anesthetic technique in the treatment of postoperative pain after the LC surgery. The aim of the study was to compare between IP bupivacaine –Magnesiu;m Sulfate ($MgSO_4$) and TAP by bupivacaine- $MgSO_4$ for pain relief after LC.
Materials and Methods: This was a randomized double blinded study on sixty patients ASA I &II, age from 18 to 60 years old, undergoing elective LC surgery were randomly classified into two equal groups (30 patients in each group). Group I: IP instillation of 30 ml [15 ml bupivacaine 0.5% (75mg) plus 2.5ml $MgSO_4$ (250 mg) plus 12.5 normal saline].Group II: Ultrasound guided subcostal TAP block was performed by using total volume 20 ml on each side [10 ml bupivacaine %0.5 (50

**Corresponding author: E-mail: Nashwa-hamoda@gmail.com;*

mg) plus 1.5ml $MgSO_4$ (150 mg) plus 8.5 normal saline]. Heart rate (HR) and Mean Arterial Blood Pressure (MAP) were measured at 5 min before induction and every 15min after induction till the end of operation and then every 5 min for the first 20 mins after administration of study drugs then they recorded at interval of 30mins, 1hr, 2hrs, 4hr and 6hr postoperative. Numeric Rating Scale (NRS) at emergence, 2, 4, 8, 12, 18 and 24hr after recovery, first rescue analgesia time, postoperative analgesic consumption, length of hospital stay(LOS), patients' satisfaction and post-operative complications were recorded.

Results: There were insignificant differences in HR and MAP between the two groups. There was a significant decrease in NRS at 4hr and 8 hr in group II than group I. There was a significant decrease regarding to time of first rescue analgesia, total postoperative analgesic consumption and LOS in group II compared to group I. There was a significant increase of satisfaction in group II compared to group I. There was an insignificant difference between both groups in nausea, vomiting, hypotension, bradycardia, bradypnea or $MgSO_4$ toxicity.

Conclusion: TAP by bupivacaine-$MgSO_4$ has superior analgesia, longer duration, less postoperative analgesic consumption and more satisfaction in patients undergoing LC than IP block by bupivacaine-$MgSO_4$.

Keywords: Intraperitoneal; transversus abdominis plane; magnesium sulphate; laparoscopic cholecystectomy; bupivacaine.

1. INTRODUCTION

Postoperative pain remains the main complaint and the first reason for prolonged convalescence after laparoscopic cholecystectomy (LC) [1]. Intense acute pain after LC may be the reason of occurrence of chronic pain post- LC syndrome [2].

Magnesium sulphate ($MgSO_4$) has antinociceptive effect, so it is useful in chronic pain, also it reduces influx of calcium inside the cell, and antagonizes N-methyl-D-aspartate [NMDA] receptors, which are vital for pain processing and neuronal signaling in the central nervous system. $MgSO_4$ decreases postoperative pain by blocking both somatic and visceral pain fibers. Bupivacaine inhibits the compound nerve action potentials which markedly enhanced by $MgSO_4$ [3].

IP administration of local anesthetic is considered a method of control of visceral component of pain and they are used either during or after surgery by many surgeons to decrease postoperative pain. This method cannot be used as sole agent for pain relief after LC [4].

Transversus abdominis plane block (TAP) become a useful anesthetic technique in the treatment of postoperative pain after the LC surgery [5].

The aim of the study was to compare between IP bupivacaine - $MgSO_4$ and TAP by bupivacaine-$MgSO_4$ for pain relief after LC.

2. SUBJECTS AND METHODS

This was a randomized double blinded study in Tanta University Hospitals in general surgery department on sixty patients ASA I & II, age from 18 to 60 years old, scheduled to undergo elective LC surgery.

The exclusion criteria included: Body mass index ≥35, drugs allergy and patients with peritoneal drain, cardiac history, alcohol abuse, major psychiatric disorder, chronic pain syndrome and previous abdominal surgery.

Sixty patients were randomly classified into two equal groups (30 patients in each group). Group I: IP instillation of total volume 30 ml [15 ml bupivacaine 0.5% (75 mg) plus 2.5ml $MgSO_4$ (250 mg) plus 12.5 normal saline].Group II: Ultrasound guided subcostal TAP was performed by using total volume 20 ml on each side [10 ml bupivacaine 0.5% (50 mg) plus 1.5ml $MgSO_4$ (150 mg) plus 8.5 normal saline].

Patient preoperative evaluation: history, clinical examination and laboratory investigations were conducted. In the pre-induction room, a 20-G intravenous cannula was inserted and the patients were premedicated with antibiotic prophylaxis and midazolam [0.02 mg/kg IV]. Standard intraoperative monitors were applied, in the form of continuous ElectrocardioGram(ECG), pulse oximetry, arterial blood pressure monitor, and EtCO2 monitor. GA with intravenous fentanyl 1 mic/kg, propofol 2 mg/kg and cis-atracurium 0.1 mg/kg to facilitate endotracheal intubation. Maintenance of anesthesia was by isoflurane

and positive pressure ventilation. The surgical technique was similar for all patients. carbon dioxide (CO_2) insufflation was performed with the patients placed in the supine position. During laparoscopy, intra-abdominal pressure was maintained at 12–14 mmHg. Trendelenburg position was adjusted at 30° when needed. CO_2 was carefully evacuated at the end of surgery by manual compression of the abdomen with open trocars. In the TAP group, after the end of the surgery and before the patient's recovery from general anesthesia, an ultrasound-guided bilateral TAP block was given. 22 G short beveled block needle is inserted in-plane with the transducer, The needle tip was directed into the plane between the internal oblique and the transversus abdominis muscle followed by injection of the full dose of local anesthetic using total volume 20 ml on each side [10 ml bupivacaine 0.5% (50 mg) plus 1.5ml $MgSO_4$ (150 mg) plus 8.5 normal saline].

In the IP group, IP instillation of total volume 30 ml [15 ml bupivacaine 0.5% (75mg) plus 2.5ml $MgSO_4$ (250 mg) plus 12.5 normal saline] was instilled into the peritoneal cavity by the surgeon through the laparoscopic trocar entry sites at the end of surgery while the instillation port was directed towards the abdominal side of the diaphragm using a laparoscopic camera.

2.1 Measurements

Vital signs [Heart rate (HR) and mean arterial blood pressure (MAP)] were measured at 5 min before induction (baseline parameters) and every 15min after induction till the end of operation as a routine monitoring and then every 5 min for the first 20 min after administration of study drugs till recovery then they recorded at interval of 30min, 1hr, 2hrs, 4hr and 6hr postoperative.

Assessment of postoperative pain was done by NRS at emergence, 2, 4, 8, 12, 18 and 24h respectively after recovery. Records were taken for the following; first rescue analgesia time, postoperative analgesic consumption, length of hospital stay, patient satisfaction with analgesia at postoperative day using 4-point verbal and post-operative complications [as nausea, vomiting, bradycardia (HR< 60 bpm), $MgSO_4$ toxicity and hypotension (MAP<65 mmHg)].

2.2 Statistical Analysis

The sample size calculation was performed using EPI-INFO 2002 Software Statistical Package designed by World Health Organization (WHO) and by Centers for Disease Control and Prevention (CDC). The sample size was calculated as N>27 based on the following considerations; 95% level of significance, 80% power of the study, 1:1 for each study groups and based on a previous report to detect a clinically significant reduction in NRS pain scores from 4-2 mm.

Tabulation, presentation, organization, and analysis of data were performed by SPSS v25 (IBM®, Chicago, IL, USA). Normality of data (Parametric or not) was checked with Shapiro-Wilks test. Quantitative parametric variables were presented as mean and standard deviation (SD). They were compared between the two groups by unpaired student's T- test and within the same group by paired T-test. Quantitative non-parametric variables were presented as median and range, compared between the two groups by Mann Whitney (U) Test and within the same group by Wilcoxon test. Qualitative variables were presented as frequency and percentage (%), they were analysed utilizing the Chi-square test or Fisher's exact test when appropriate. The level of significance was adopted at $p<0.05$.

3. RESULTS

In this study, 68 patients were assessed for eligibility, 8 patients did not meet the inclusion criteria and excluded. The remaining 60 patients were randomly allocated into two groups (30 patients in each one); Group I and Group II. In each of the two groups, all patients completed the follow-up and their data were analyzed statistically as shown in Fig. 1.

As regard to demographic data, there were insignificant differences between the two groups. (Table 1).

Regarding to hemodynamic changes, there were insignificant differences in HR and MAP between the two groups. [Figs. (2,3)].

Regarding to NRS, there was statistically significant decrease in NRS at 4 and 8 h in Group II than Group I. [Table (2)].

Regarding to time of first rescue analgesia and total postoperative analgesic consumption, there were statistically significant decrease in group II as compared with group I. [Figs. (4, 5)]. There was statistically significant decrease in group II as compared with group I group (range 24 – 36 hr and median 24 hr in group I, II with p value 0.045).

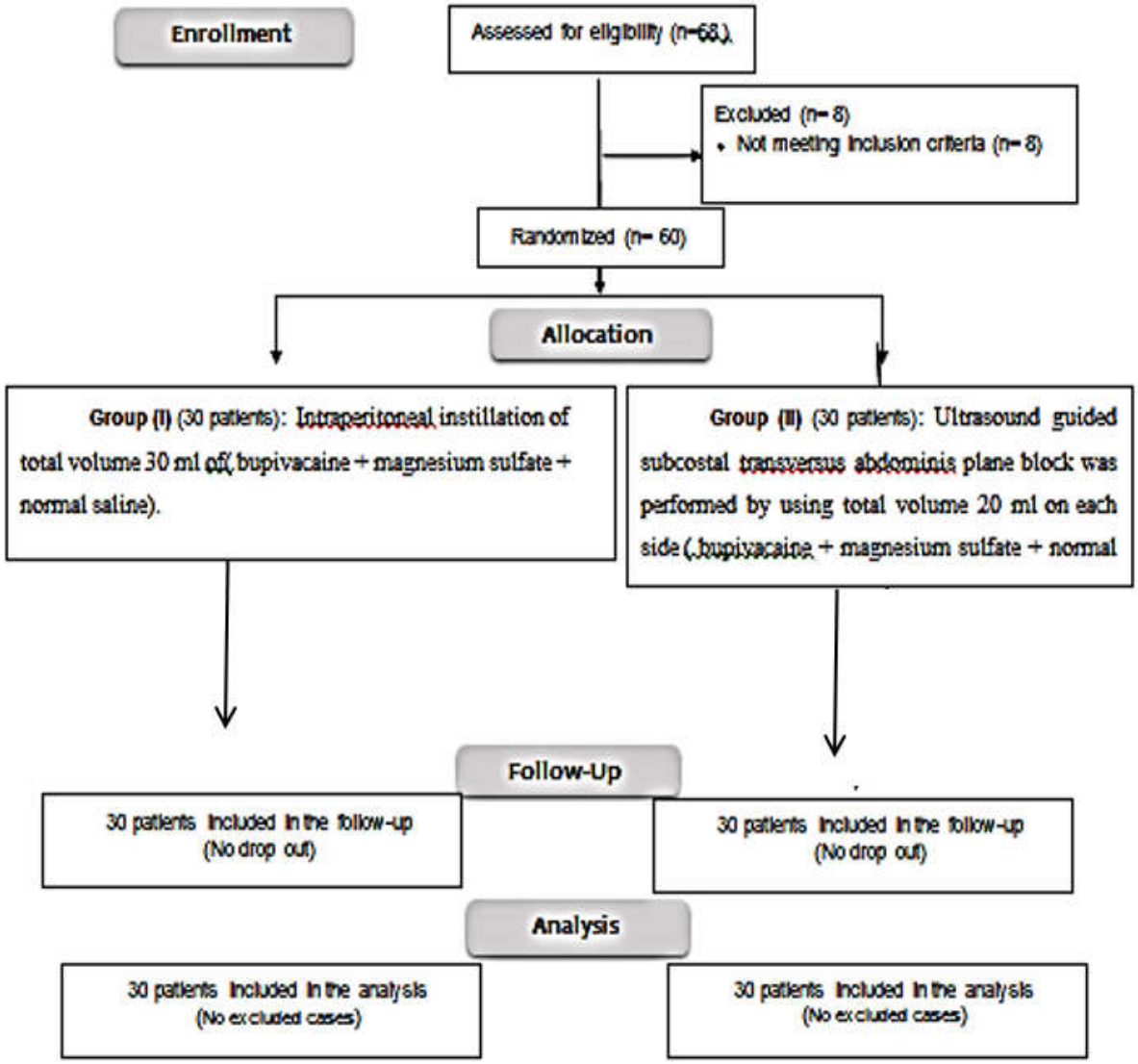

Fig. 1. CONSORT flowchart of the studied groups

Table 1. Demographic data and surgery duration in the two studied groups

	Group I	Group II	P value
Age (years)			
Mean SD	33.5 ± 8.1	35.9 ± 7.6	0.256
Range	20 – 57	18 – 55	
Sex			
Male	16 (53.3%)	13 (43.3%)	0.605
Female	14 (46.7)	17 (56.7)	
ASA physical status			
ASA I	20 (66.7%)	18 (60%)	0.789
ASA II	10 (33.3%)	12 (40%)	
Duration of surgery(minutes)			
Mean ± SD	65.6 ± 3.9	67.7 ± 4.1	0.058
Range	60-75	61-74	

Data represented as range, mean, SD, p value (p value <0.05) denotes statistically significant difference

Table 2. NRS changes between the two studied groups

	Group II		P1	Group I		P2	P value
	Median	Range		Median	Range		
0	0	0-1		1	0-1		0.442
2 hr.	1	0-2	0.119	0.5	0-2	0.839	0.411
4 hr.	4	3-5	<0.001*	1	0-2	0.542	<0.001*
8 hr.	5	4-5	<0.001*	0	0-1	0.465	<0.001*
12 hr.	5	4-6	<0.001*	5	4-6	<0.001*	0.625
18 hr.	1	0-2	0.173	1	0-2	0.548	0.921
24 hr.	0	1-2	0.469	1	0-2	0.374	0.377

**p value < 0.05 denotes statistically significant difference between both groups, P1 value < 0.05 denotes statistically significant difference in group I, P2 value 0< 0.05 denotes statistically significant difference in group II*

Table 3. Patients satisfaction with analgesia in the both studied groups

	Group I	Group II
Extremely Satisfied	10 (33.3%)	16 (53.3%)
Satisfied	6 (20%)	10 (33.3%)
Unsatisfied	9 (30%)	3 (10%)
Extremely unsatisfied	5 (16.7%)	1 (3.3%)
P value	0.013*	

**p value < 0.05 denotes statistically significant difference between both groups*

Table 4. Postoperative complications in the two studied groups

	Group I	Group II	P value
Nausea	9 (30%)	8 (26.7%)	0.775
Vomiting	1 (3.3%)	2 (6.7%)	0.553
Shoulder pain	2 (6.7%)	5 (16.7%)	0.424
Hypotension	0	0	-----
Bradycardia	0	0	-----
Bradypnea	0	0	-----
$MgSO_4$ toxicity	0	0	-----

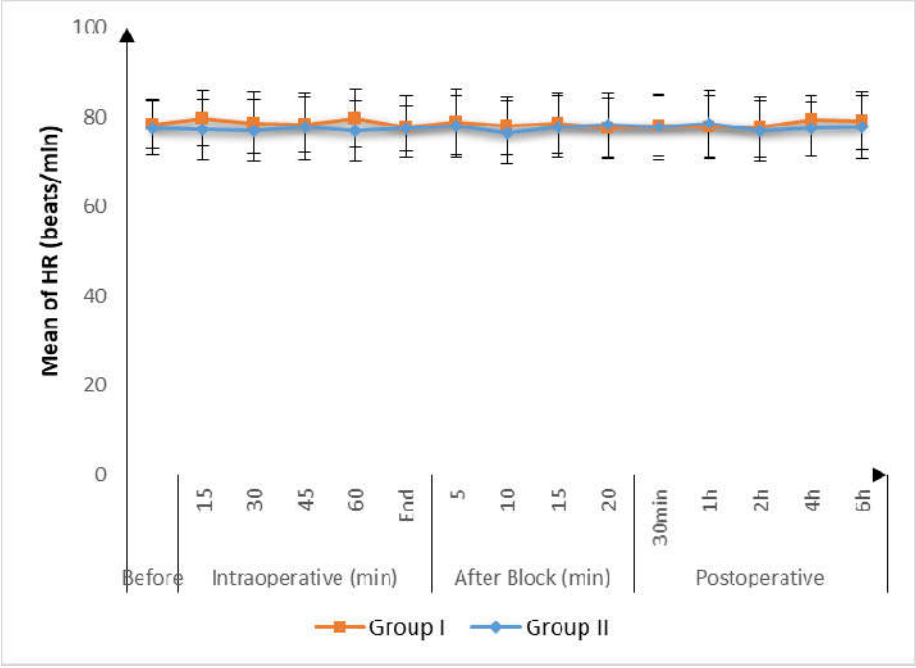

Fig. 2. Heart rate (HR) changes in both groups

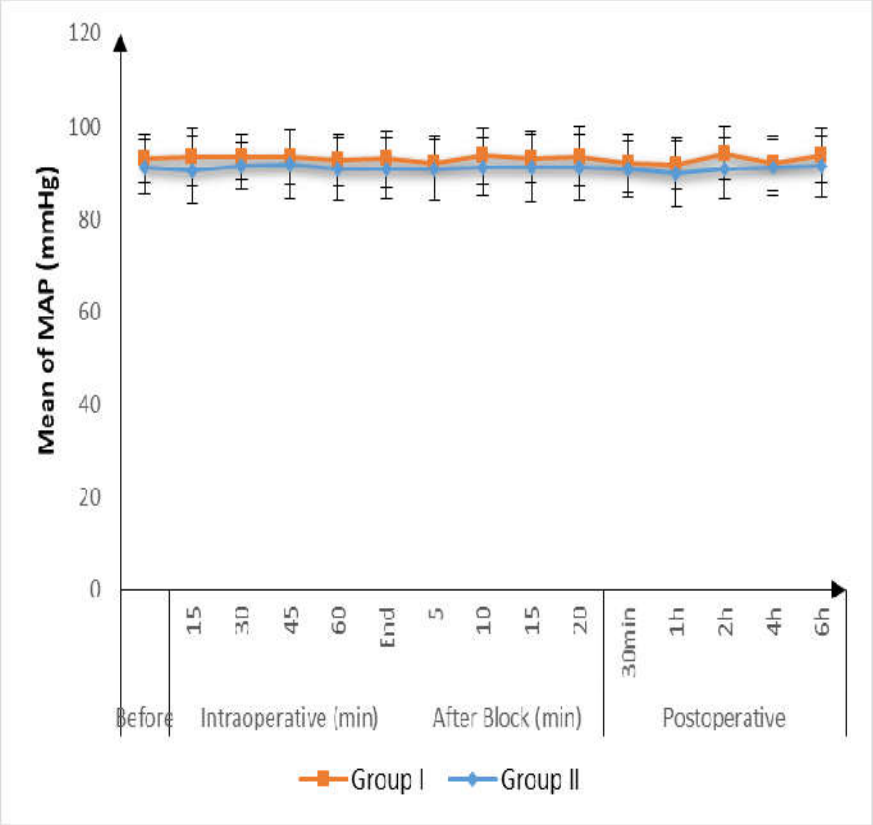

Fig. 3. MAP changes in both groups

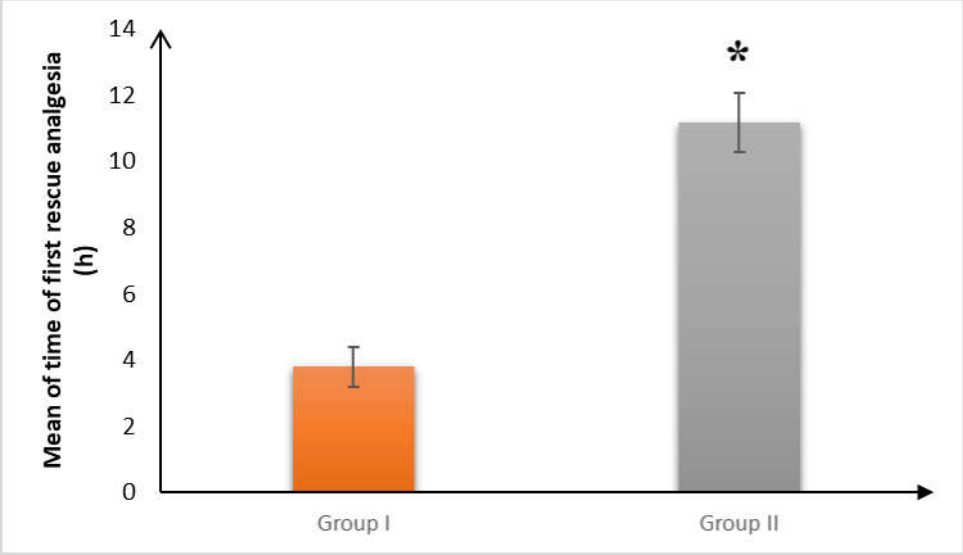

Fig. 4. Time of first rescue analgesia in the two studied groups (hrs)

Regarding to post-operative patient satisfaction, there was a significant increase of satisfaction in group II as compared with group I. [Table (3)].

Regarding to post-operative complications, there were insignificant difference between group I, group II in nausea, vomiting, hypotension, bradycardia, bradypnea or $MgSO_4$ toxicity. Regarding shoulder pain, there was also insignificant difference between the two groups but there was higher number of patients in group II than group I. [Table (4)].

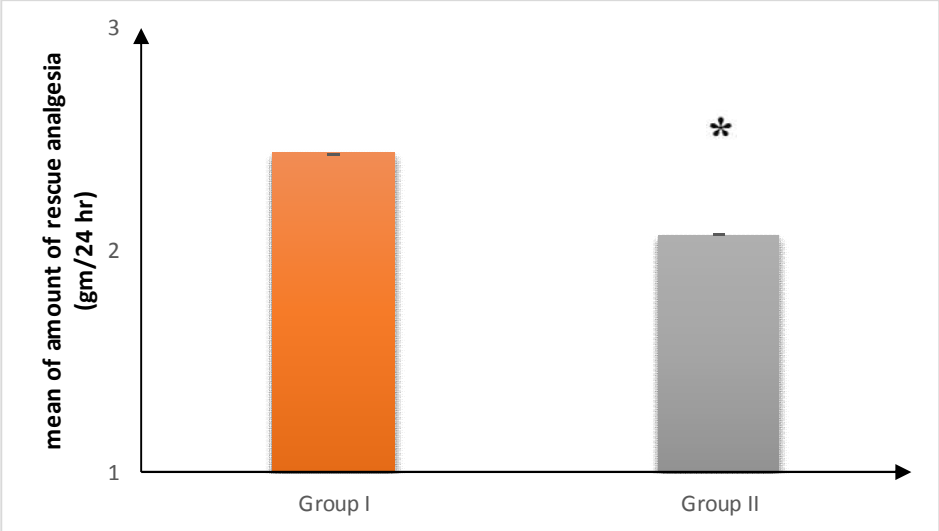

Fig. 5. Postoperative analgesic consumption (paracetamol in gm)

4. DISCUSSION

As laparoscopic cholecystectomy is usually considered as an outpatient procedure, decreasing the intensity of postoperative pain is a major clinical challenge [6]. IP instillation of local anesthetics and TAB block have great popularity for effective pain relief after laparoscopic surgery, also they reduce shoulder pain, nausea, vomiting and the length of hospital stay [7].

Outcomes of our study were: hemodynamic changes were insignificant difference between the two groups. There were statistically significant decrease in NRS at 4 and 8 in group II than group I. Time of first rescue analgesia, total postoperative analgesic consumption and length of hospital stay, there were statistically significantly decreased in group II as compared with group I. Post-operative patient satisfaction was significant increased in group II as compared with group I.

The present study has shown the same results with Kadam R.V, et al. [8]. Found that lower pain scores in the TAP group with decreased post-operative opiate and oral analgesic consumption. .Also in accordance with Shoukry A.A, et al. [9]. Found that there were statistically significant decreased postoperative rescue analgesia doses and total analgesic consumption in TAP block group than in the IP group, with significantly longer time for the first dose of rescue analgesia required. In agreement with our study, Yadava A, et al. [10]. Found that IP instillation of MgSO4 alone or with local anesthetics during laparoscopic surgeries has been shown to be beneficial in enhancing the quality of postoperative analgesia as well as decreasing postoperative analgesic requirements.

Our results corroborated the research of Maharjan S. et al. [11]. Who found that patients who were given IP bupivacaine plus MgSO4 at the end of surgery had better pain relief for a period of 2 - 5 hr compared with patients who were given IP bupivacaine alone. In agreement with our study, Khandelwal H, et al. [12]. Found that transversus abdominis block group had lower pain scores, lower postoperative rescue analgesic requirement and significantly longer time for the first dose of rescue analgesia required in subcostal transversus abdominis group in the first 6 hr as compared to IP group. In agreement with our study, Korkmaz Toker M, [13] who concluded that bilateral ultrasound guided TAP blocks by bupivacaine reduce 24th hour tramadol requirements and VAS scores so TAP block is a promising technique for producing effective and prolonged postoperative analgesia in patients undergoing laparoscopic hysterectomy surgeries. Also, in accordance with the present study, Calle G.A, et al. [14]. who found that there was decrease in the pain score in TAB block with bupivacaine groupas compared with placebo.

In agreement with our study, the study performed by El-Dawlatly A, et al. [15] who found statistically significant reduction in post-operative opioid consumption in patients who received TAP

block than in patients who received conventional systemic analgesia.The present study has shown similar results with a study of Tolchard S, et al. [16] who found there were reduction of pain scores and opioid consumption in the first 4 h in TAP block group as compared with port-site infiltration of local anesthetic.

In contrast with our study, Ghisi D, et al. [17] who found that TAP block did not reduce morphine consumption during the first 24 hours postoperative after laparoscopic hysterectomy surgery. This can be explained by that TAP block only relieves the (somatic) incisional component of the pain but not visceral pain which is the main component of pain after laparoscopic surgeries. In contrast with our study, Bava EP, et al. [18] who found that ultrasound guided bilateral TAP blocks were not effective in decreasing 24 h morphine requirement as compared to local anesthetic infiltration. This can be explained by that TAP block only relieves the somatic component of the pain. In LC surgery, pain is because of peritoneal stretch, visceral dissection and the residual gas under the diaphragm which causes shoulder pain. Also umbilical incision in the other group was locally infiltrated with bupivacaine. In contrast with our result, the study of Imani F, et al. [19] who found that addition of $MgSO_4$ to ropivacaine in TAP block does not affect the post-hysterectomy pain, This result may related to the dosage of drug, the quality of block and the way of performance. In contrast to our study, Arden D, et al. [20] found out no improvement in pain control, narcotic use, length of hospital stay, or overall patient satisfaction in the two groups. Difference of this result from the present work may be due to insertion of drain.

The study of Kanazi G.E, et al. [21] in disagreement with the present study. They found that subarachnoid morphine produced higher analgesia as compared with ultrasound-guided TAP. Subarachnoid morphine delays the request for supplemental analgesic, less tramadol requirement during the first 12 hours postoperatively, and lower postoperative VAS pain scores during the first 4 hours in comparison with TAP group. Subarachnoid morphine affects both superficial and deep visceral postoperative pain, whereas the TAP block affects only the superficial incisional pain, and this can explain the superiority of subarachnoid morphine in comparison with TAP block for post cesarean pain management. In disagreement with our study, the study done by Bacha UQ, et al. [22] They found that intra-incisional infiltration of bupivacaine is more effective than IP infiltration for postoperative pain relief. It is easier to apply and there is less requirement of postoperative analgesics. This difference may be due to drain application that lead to loss of local anesthetic through it and decrease analgesic effect in patients receiving IP bupivacaine.

Limitations of the study were that the pain scores at movement have not been taken into consideration although laparoscopic surgeries aimed to facilitate early ambulation, the optimal dose and concentration of injected local anesthetics need to be investigated in larger outcome studies as local anesthetics used in the TAP blocks varied according to recommended doses and volumes which are not yet established so the study needed to be repeated on larger sample size and the block needed to be done before starting the surgery.

5. CONCLUSION

TAP by bupivacaine-$MgSO_4$ has superior analgesia, longer duration, less postoperative analgesic consumption, more satisfaction in patients undergoing LC than IP block by bupivacaine-$MgSO_4$.

CONSENT AND ETHICAL APPROVAL

As per international standard or university standard guideline participant consent and ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Bisgaard T, Kehlet H, Rosenberg J. Pain and convalescence after laparoscopic cholecystectomy. The European Journal of Surgery. 2001;167:84-96.
2. Bisgaard T, Rosenberg J, Kehlet H. From acute to chronic pain after laparoscopic cholecystectomy: A prospective follow-up analysis. Scandinavian Journal of Gastroenterology. 2005;40:1358-64.
3. Shoeibi G, Sadegi M, Firozian A, Tabassomi F. The additional effect of magnesium sulfate to lidocaine in spinal

anesthesia for cesarean section. Journal of Int Pharmacol. 2007;3:425-7.
4. Golubović S, Golubović V, Cindrić-Stančin M, Sotošek Tokmadžić V. Intraperitoneal analgesia for laparoscopic cholecystectomy: Bupivacaine versus bupivacaine with tramadol. Collegium antropologicum journal. 2009;33:299-302.
5. Hebbard PD, Barrington MJ, Vasey C. Ultrasound-guided continuous oblique subcostal transversus abdominis plane blockade: description of anatomy and clinical technique. Regional anesthesia, pain medicine journal. 2010;35:436-41.
6. Skattum J, Edwin B, Trondsen E, Mjåland O, Raeder J, Buanes T. Outpatient laparoscopic surgery: Feasibility and consequences for education and health care costs. Surgical Endoscopy And Other Interventional Techniques Journal. 2004; 18:796-801.
7. Cruz JJ, Diebolder H, Dogan A, Mothes A, Rengsberger M, Hartmann M, et al. Combination of pre-emptive port-site and intraoperative intraperitoneal ropivacaine for reduction of postoperative pain: A prospective cohort study. European Journal of Obstetrics & Gynecology and Reproductive Biology. 2014;179:11-6.
8. Kadam RV, Field J. Ultrasound-guided continuous transverse abdominis plane block for abdominal surgery. Journal of Anesthesiology, Clinical Pharmacology. 2011;27:333.
9. Shoukry AA, Nofal WH, Elfawal SM. Comparative study evaluating the efficacy of ultrasound-guided transversus abdominis plain block versus intraperitoneal injection of local anesthetics in pain control following laparoscopic colectomy. Ain-Shams Journal of Anesthesiology. 2016;9:358.
10. Yadava A, Rajput SK, Katiyar S, Jain RK. A comparison of intraperitoneal bupivacaine-tramadol with bupivacaine-magnesium sulphate for pain relief after laparoscopic cholecystectomy: A prospective, randomised study. Indian journal of anesthesia. 2016;60:757.
11. Maharjan S, Shrestha S. Intraperitoneal magnesium sulphate plus bupivacaine for pain relief after laparoscopic cholecystectomy. Journal of Kathmandu Medical College. 2012;1:21-5.
12. Khandelwal H, Parag K, Singh A, Anand N, Govil N. Comparison of subcostal transversus abdominis block with intraperitoneal instillation of levobupivacaine for pain relief after laparoscopic cholecystectomy: A prospective study. Journal of Anesthesia, essays researches. 2019;13:144.
13. Korkmaz Toker M, Altiparmak B, Uysal Aİ, Demirbilek SG. The analgesic efficacy of oblique subcostal transversus abdominis plane block after laparoscopic hysterectomy: A randomized, controlled, observer-blinded study. Medicine Journal. 2019;98:e13994-e.
14. Calle GA, López CC, Sánchez E, De Los Rios JF, Vásquez EM, Serna E, et al. Transversus abdominis plane block after ambulatory total laparoscopic hysterectomy: Randomized controlled trial. Journal of Acta Obstetricia Gynecological Scandinavica. 2014;93:345-50.
15. El-Dawlatly A, Turkistani A, Kettner S, Machata A-M, Delvi M, Thallaj A, et al. Ultrasound-guided transversus abdominis plane block: Description of a new technique and comparison with conventional systemic analgesia during laparoscopic cholecystectomy. British Journal of Anesthesia. 2009;102:763-7.
16. Tolchard S, Davies R, Martindale S. Efficacy of the subcostal transversus abdominis plane block in laparoscopic cholecystectomy: Comparison with conventional port-site infiltration. Journal of Anesthesiology, Clinical Pharmacology. 2012;28:339.
17. Ghisi D, Fanelli A, Vianello F, Gardini M, Mensi G, La Colla L, et al. Transversus abdominis plane block for postoperative analgesia in patients undergoing total laparoscopic hysterectomy: A randomized, controlled, observer-blinded trial. Journal of Anesthesia, Analgesia. 2016;123:488-92.
18. Bava EP, Ramachandran R, Rewari V. Analgesic efficacy of ultrasound guided transversus abdominis plane block versus local anesthetic infiltration in adult patients undergoing single incision laparoscopic cholecystectomy: a randomized controlled trial. Journal of Anesthesia, Essays Researches. 2016;10:561.
19. Imani F, Rahimzadeh P, Faiz H-R, Abdullahzadeh-Baghaei A. An evaluation of the adding magnesium sulfate to ropivacaine on ultrasound-guided transverse abdominis plane block after abdominal hysterectomy. Anesthesiology Pain Medicine Journal. 2018;8.

20. Arden D, Seifert E, Donnellan N, Guido R, Lee T, Mansuria S. Intraperitoneal instillation of bupivacaine for reduction of postoperative pain after laparoscopic hysterectomy: A double-blind randomized controlled trial. Journal of Minimally Invasive Gynecology. 2013;20: 620-6.
21. Kanazi GE, Aouad MT, Abdallah FW, Khatib MI, Adham AM, Harfoush DW, et al. The analgesic efficacy of subarachnoid morphine in comparison with ultrasound-guided transversus abdominis plane block after cesarean delivery: A randomized controlled trial. Anesthesia & Analgesia Journal. 2010;111:475-81.
22. Bacha UQ, Mushtaque M, Tahir S. Comparison of intraincisional vs intraperitoneal bupivacaine for the control of postoperative pain after laparoscopic cholecystectomy. International Surgery Journal. 2019;6:1509-13.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/60809