Research Article

Analgesic effect of ultrasound guided regional block in laparoscopic cholecystectomy

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Abstract

Introduction: Laparoscopic cholecystectomy (LC) is a proven, gold standard surgical procedure for management of gallbladder stones. Early and easily recovery, less operative morbidities, less postoperative pain, earlier return of bowel function, improved cosmetics, an earlier return to full activity, less hospitalization day and decreased overall cost are the superiorities of laparoscopic cholecystectomies comparing with open surgical procedures (Rubert et al., 2016). **Aim of the work:** Comparison of the efficacy and advantages of Erector Spinae block versus Quadratus Lumborum block on post-operative pain in laparoscopic cholecystectomy operations. **Patients and methods:** After ethical committee approval and written informed consent were obtained from all patients, this prospective randomized double blind controlled study was carried out at El-Minia University Hospital during the period from April 2019 to December 2019 on 60 adult patients of both sex, their age ranged from 18-70 years of American society of anesthesiologists (ASA) physical status I and II scheduled for elective laparoscopic cholecystectomy under general anesthesia. The patients were randomly allocated into three parallel equal groups of 20 patients in each group by using computer generated table. Group Q "Quadratus lumborum block": Received bilateral ultra sound guided Quadratus Lumborum block using 20 ml Bupivacaine0.25% (on each side). Group E "Erector spinae block": Received bilateral ultra sound guided erector spinae block using 20 ml Bupivacaine0.25% (on each side). Group C "Control group": Didn't receive any of previous blocks neither Quadratus Lumborum nor Erector Spinae blocks. All groups undergo the same anesthetic technique. The following variables (SBP, DBP, MAP, HR, SpO2) were recorded just before induction, after block, intraoperative and at 5,10,20,30,40,50,60 min. after the block then every 15 min. until the end of the operation. Total intra operative fentanyl requirement, total number of patients needed fentanyl, Postoperative: Recovery score, HR, MAP and SaO2 at 1, 2, 4, 6, 8, 12, 16, 20, 24 hour post-operative, VAS at 1, 2, 4, 6, 8, 12, 16, 20, 24 hour post-operative, time of The first analgesic request.Total analgesic requirement of fentanyl.Incidence of any side effect and time of discharge from recovery room. Complications**:** injury to the underlying structures, hematoma formation as recorded under ultrasound guidance, post- operative nausea and vomiting., pruritis, urinary retention, Bradycardia and hypotension and respiratory depression. **Results:** Hemodynamic and VAS were the least in group E followed by group Q while it was the highest in group C. **Conclusion:** Ultrasound guided Erector spinae block before laparoscopic cholecystectomy operation was effective in fulfill analgesia post-operative and decrease intra and postoperative hemodynamics, VAS score postoperative and facilitate ambulance postoperative when compared to group Quadratus Lumborum and control group.

Key Words: Pain, analgesia, laparoscopic cholecystectomy, ultrasound guided Erector Spinae block, ultrasound guided Quadratus Lumborum block, VAS score at rest and at cough, bupivacaine 0.25%

Introduction

Laparoscopic cholecystectomy (LC) is a proven, gold standard surgical procedure for management of gallbladder stones. Early and easily recovery, less operative morbidities, less postoperative pain, earlier return of bowel function, improved cosmetics, an earlier return to full activity, less hospitalization day and decreased overall cost are the superiorities of laparoscopic cholecystectomies comparing with open surgical procedures (Rubert et al., 2016).

Nevertheless, about one-third of patients with uncomplicated symptomatic gallstone disease continue to have abdominal pain after chole-cystectomy. Moreover, up to 14% of patients may experience de novo upper abdominal pain

after the cholecystectomy (Lamberts M. et al., 2013).

Pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage. Postoperative pain is the major obstacle for early postoperative ambulation and increases the risk of venous thromboembolism and respiratory complications and prolongs the hospital stay. So, aggressive perioperative pain prevention can yield both short- term and long-term benefits which can pose a challenge to anesthesia providers (Urigel and Molter, 2014).

Preemptive analgesia has three objectives to reduce pain resulting from the activation of inflammatory mechanisms triggered by surgical incision. First, to decrease acute pain after tissue injury, both intraoperatively and postoperatively. Second, to prevent pain-related pathologic modulation of the central nervous system ‘‘pain memory’’. Third, to inhibit the persistence of postoperative pain and the development of chronic pain (Campiglia et al., 2010).

Bupivacaine is a local anesthetic drug belongs to the amino amide group. Administration of intraperitoneal bupivacaine has been used for pain relief after laparoscopic cholecystectomy. This might reduce adverse effects of systemic opioids (Choi et al., 2015).

Quadratus lumborum block (QLB) is a new abdominal truncal block for controlling somatic pain in both the upper and lower abdomen (Kadam V., 2013).

Although the concept of the block is similar to that of lateral transverses-abdominis plane block (TAPB), the extent of the effect has been suggested to be greater because the point of injection is more dorsal. Local anesthetics are administered into the space between the quadratuslumborum muscle and the medial layer of the thoracolumbar fascia to achieve QLB, which can spread to the paravertebral space (Borglum J., 2012).

Therefore, QLB might act as an indirect paravertebral block (PVB) with an analgesic effect of greater duration than TAPB. The extent of the dermatomal analgesic effect is suggested to be wider after QLB than after TAPB. If QLB can affect both the upper and lower abdomen, it could be quite advantageous for analgesia, not only after laparoscopic surgery but also after multiple types of abdominal 1surgery (Takeshi et al., 2016).

The ESP block has emerged as a valuable regional anesthesia technique for a range of thoracic, abdominal, and other procedures. The block is gaining popularity as it is easily performed and it has low risk for serious complications. Therefore, it seems to have a place as part of a successful multimodal analgesic regimen and comprehensive enhanced recovery post-surgery. Nevertheless, currently the extent of clinical applicability for ESP block has yet to be elucidated, there are limited clinical evidence due to most of the published articles are case reports. Randomized clinical trials are required To compare effectiveness of ESP block to other regional analgesia methods. Additionally, further research on confirming the optimal doses and volume of local anesthetic is necessary (Carlos L. et al., 2018).

Ultrasound guidance is rapidly becoming the gold standard for regional anesthesia. There is an evidence matched with improving technology to show that the use of ultrasound has significant benefits over conventional techniques, such as nerve stimulation and loss of resistance. The improved safety and efficacy that ultrasound brings to regional anesthesia helped promote its use and realize the benefits that regional anesthesia has over general anesthesia, such as decreased morbidity and mortality, superior post-operative analgesia, cost-effectiveness, decreased postoperative complications and an improved postoperative course (Griffin and Nicholls, 2010).

Aim of the work

Comparison of the efficacy and advantages of Erector Spinae block versus Quadratus Lumborum block on post-operative pain in laparoscopic cholecystectomy operations.

Primary outcome:

1. Time of first post operative analgesic request.

Secondary outcome:

1. Visual analogue pain score during the first postoperatively 24h.

2. Total analgesic requirement over 1st 24 hrs.
3. Incidence of any side effect.

Material and methods

After ethical committee approval and written informed consent were obtained from all patients, this prospective randomized double blind controlled study was carried out at El-Minia University Hospital during the period from April 2019 to December 2019 on 60 adult patients of both sex, their age ranged from 18-70 years of American society of anesthesiologists (ASA) physical status I and II scheduled for elective laparoscopic cholecystectomy under general anesthesia.

The patients were randomly allocated into three parallel equal groups of 20 patients in each group by using computer generated table. Upon ward admission, a random ID was assigned to each patient. Simple randomization in the operating room was performed using the closed envelope method to determine which group the patient would be included in. The random ID assigned to each patient was used when collecting all patient data in the ward postoperatively.

Group Q "Quadratus lumborum block":
Received bilateral ultra sound guided Quadratus Lumborum block using 20 ml Bupivacaine0.25 % (on each side), put in mind the safe dose of local anesthetic.

Group E "Erector spinae block":
Received bilateral ultra sound guided erector spinae block using 20 ml Bupivacaine0.25% (on each side), put in mind the safe dose of local anesthetic.

Group C "Control group":
Didn't receive any of previous blocks neither Quadratus Lumborum block nor Erector Spinae block.
Careful history taking was done from the patient for any medical disorder, therapeutic anticoagulant, allergy to chemical compounds or addiction problems and complete physical examination was done for CNS, chest, heart, abdomen for any abnormality. Examination of the back for any spine deformities or infection at site of the block.
Complete laboratory investigations were done including: Hb, CBC and coagulation profile.

On arrival to the operative room, all patients were monitored with five- lead ECG, non-invasive blood pressure, pulse oximetry and end tidal CO_2 using (Datex-Omedah monitor, model cardiocap/5 – china). Then a 20 gauge IV cannula was inserted and the patients received 300 cc of 0.9% saline and were pre-oxygenated with 100% oxygen via a well fitted face mask for 3 minutes.

Anesthesia was induced with 0.05 mg/kg midazolam, 1 μg/kg fentanyl and 2 mg/kg of 1% propofol. Endotracheal intubation was facilitated with 0.5 mg/kg of atracurium. Isoflurane 1-2% with oxygen was used for anesthetic maintenance and 0.15 mg kg Intermittent doses of atracurium when needed to maintain adequate muscle relaxation throughout the procedure. Ventilation was controlled to maintain end tidal CO_2 at 35-40 mmHg and SaO_2 between 95-100. Nasogastric tube was inserted for all patients after intubation and was removed at the end of the surgery Then after stabilization of the patient's hemodynamics and before surgical incision, Quadratus Lumborum and Erector Spinae block were performed according to patient's group by the same anesthetist with the patient in laterlal or prone position respectively.

Quadratus lumborum block group:
Bilateral ultrasound guided posterior quadrates lumborum block was done in lateral decubitus position and probe (linear 25N multi-frequency 13-6 MHz transducer) or curvilinear probe (60N multi-frequency 5-2 MHz transducer) according to the depth was placed in the midaxillary line in the transverse plane immediately above the iliac crest and then it was slided dorsally until the "Shamrock sign" was clearly identified. In "Shamrock sign" The quadratus lumborum (QL) muscle is seen as a superior leaf of the Shamrock at the apex of the transverse process (TP) of L4, erector spinae (ES) muscles make up the posterior leaf, psoas major (PM) muscle makes the anterior leaf and the transverse process (TP) represents the stem connecting the 3 leaves

A 22 mm gauge spinal needle made in Germany, was inserted from the posterior end of the probe and directed for the fascial plane between the QL and PM muscles through the QL muscle (QL3). Once needle was confirmed

at correct location the solution was injected (after repeated negative aspiration of blood). Other side was also injected in a similar manner as done previously. The surgical intervention was started 15 min after QL block.

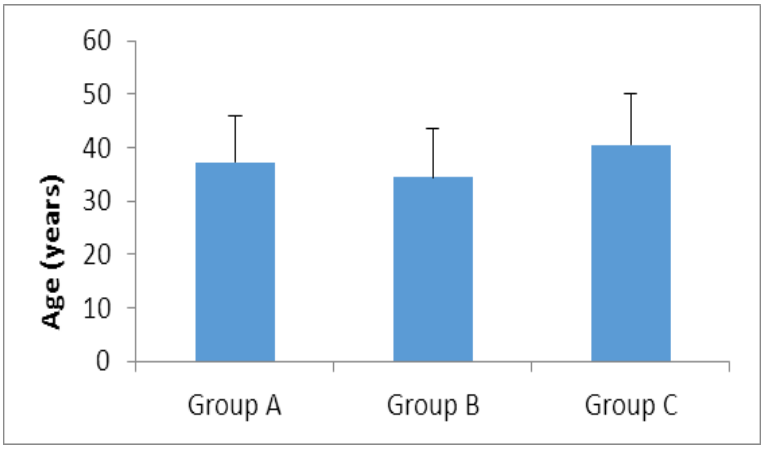
Erector Spinae block group:
The patient was placed in a prone position, sterilization, draping and local infiltration of 3 cm 1% lidocaine, then a high-frequency linear ultrasound transducer (25N multi-frequency 13-6 MHz transducer) or low frequency curvilinear probe (60N multi-frequency 5-2 MHz transducer) according to depth were placed in a longitudinal orientation 3 cm lateral to the T8-T9 spinous process. Three muscles were identified superficial to the hyperechoic transverse process shadow as follows: trapezius, rhomboid major, and erector spinae. A 22 mm gauge spinal needle made in Germany was inserted in a cephalad-to-caudal direction until the tip lay in the interfascial plane between transverse process and erector spinae muscles on both sides, as evidenced by visible linear spread of fluid between the muscles upon injection, repeated aspiration was done while injection to avoid injury of any vascular structure. A total of 20mL of 0.25% bupivacaine was injected here for each side. Postoperatively, patients were transferred to the recovery unit according to modified Aldrete score.

Ketorolac 30 mg ampoule was given by intravenous infusion to all cases and then every 8 hours. Postoperatively pain will be assessed using a 0-10 cm visual analog scale (VAS 0-10, with 0 - No pain at all and 10 - Worst pain imaginable). Postoperatively, fentanyl boluses 1μg /kg will be given if VAS is more than 3 and it might be repeated after 30 minutes until VAS is ≤ 3.

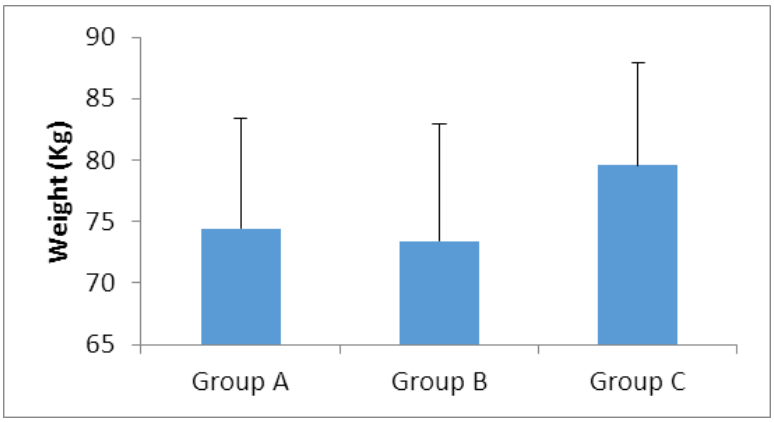
Parameters assessed:
1- Hemodynamic parameters arterial oxygen saturation:
A) Intraoperative: HR, MAP and SaO2 were recorded immediately before and after induction of anesthesia, and at 5,10,20,30,40,50,60 min. after the block then every 15 min. until the end of the operation. Total intra operative fentanyl requirement. Total number of patients needed fentanyl.
B) Postoperative: Recovery score, HR, MAP and SaO_2 at 1, 2, 4, 6, 8, 12, 16, 20, 24 hour postoperative, VAS at 1, 2, 4, 6, 8, 12, 16, 20, 24 hour post-operative, Time to first analgesic request, Total analgesic requirement of fentanyl, Incidence of any side effect, Time of discharge from recovery room.

2- Complications: Injury to the underlying structures, Hematoma formation as recorded under ultrasound guidance, Post operative nausea and vomiting, Pruritis, Urinary retention, Bradycardia and hypotension, Respiratory depression, Intrathecal or Epidural injection.

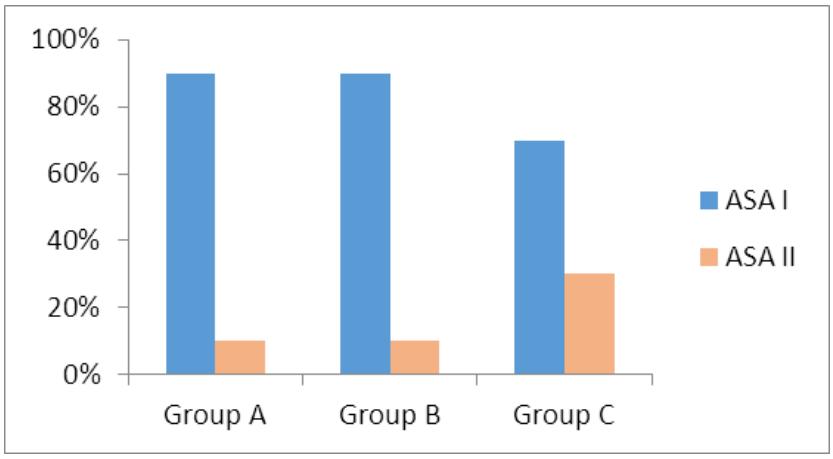
Results
Analysis of data between 3 groups regarding mean of age, weight, sex and ASA status in each group revealed no statistical difference among studied groups (p >0.05), therefore all groups were statistically comparable.



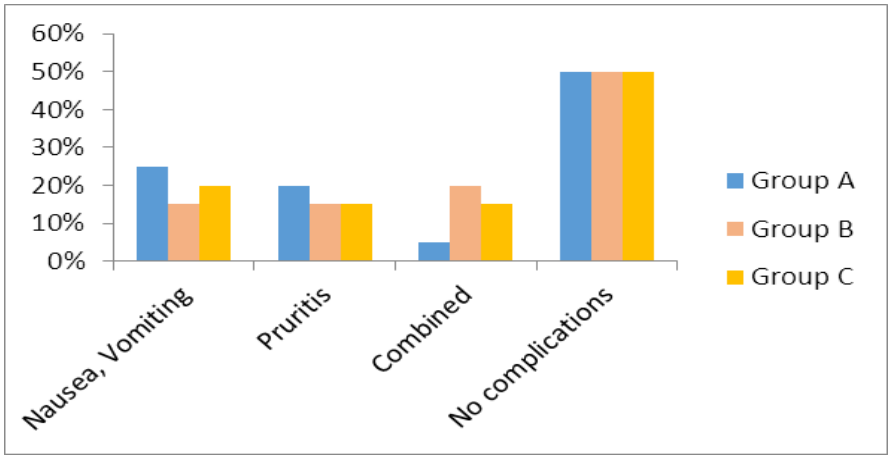
Distribution of age among groups.



Distribution of weight between both groups



ASA classification among groups.



Comparison of postoperative complaint among groups

Hemodynamic changes

1- Heart rate: the changes in heart rate before induction till the end of surgery. There was no statistically significant difference before induction, after induction, after block or at 30 min and at the end of surgery between the studied groups. However, after 5 and 20 min after block there was significant difference in the mean heart rate between group C and both of group A and group B at time of recording.

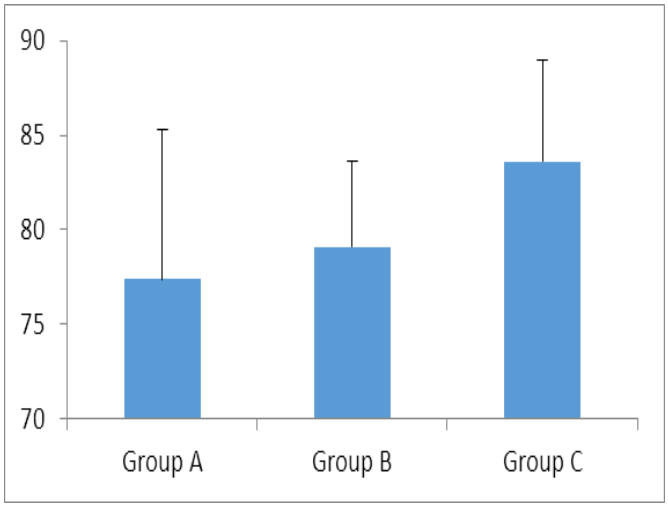
As regard comparison between groups showed significant difference in heart rate in group B at 10 min after block than group C (P value 0.001), also group A significant difference was recorded when compared to group C in heart rate only at 40 min after block (P value0.007). In comparison of group A with group C and group B with group C there was a significant difference at 5 min. and 20 min. after block as P value was respectively P2 (0.0001 and 0.0001) while P3 (0.0001 and 0.004).

According to the comparison inter the same group preoperative and intraoperative, there was a significant difference in group A, group B and group C at the end of surgery (P value 0.0001 for all groups),

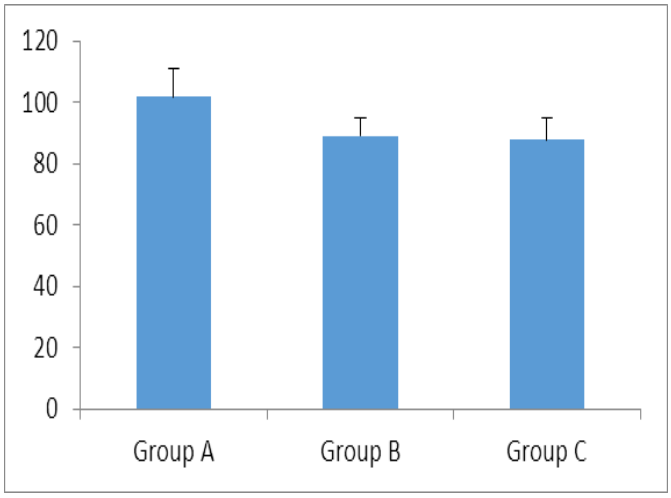
Postoperatively, there was significant difference among groups at 1, 2,4 8, 12 & 16hr. Intergroup comparison showed a significant increase in heart rate in group C than both groups A and B at 1 & 2hr postoperative. At 8 & 12hr group B was significantly lower than group C, however, at 16hr group A showed significant lower recordings than C group.

As regard comparison inter the same group, group A showed a significant difference at 8 and 16hr (P value 0.0001), group B had an increase in heart rate at 8 and 12hr while in group C the increase in heart rate was at the 1st and 2nd hour postoperative.

When comparing group A and B there was significant difference appeared at 4, 12 & 16 hr. At 4 & 12, group A was significantly lower, while at 16 group B was lower in heart rate recording.



Heart rate at 40 minutes



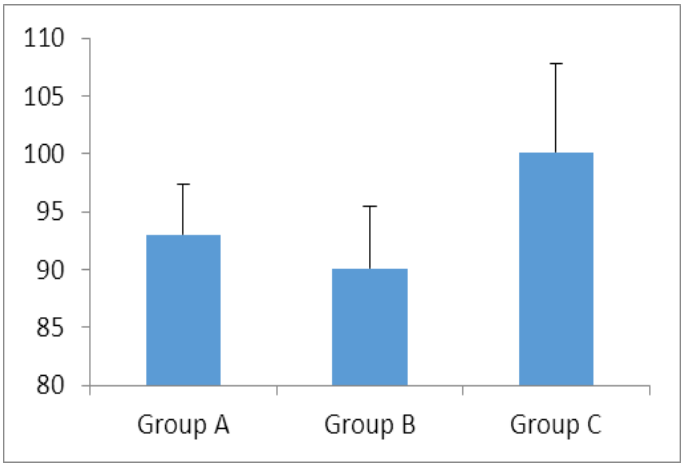
Heart rate 16 hour postoperative

Mean arterial blood pressure

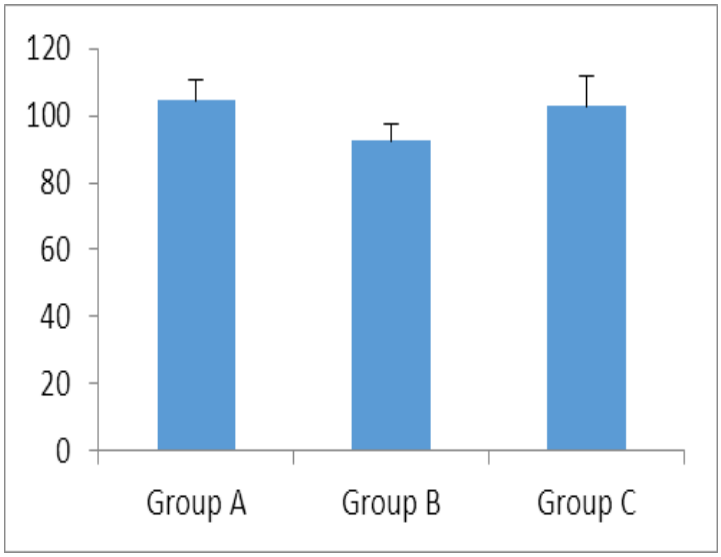
There was no statistically significant difference in the mean arterial blood pressure before and after intubation between the studied groups.

There was significant difference in the MAP at 5, 10, 20, 30, 40 min after block and at the end of surgery between group C and both of group A and group B with higher readings recorded in group C.

Intergroup comparison of MAP detected significant difference (P value 0.001) increase of MAP at end of the surgery at group B more than A and at 20.40 min. and at end of the surgery at group C. The changes in MAP postoperative in the three groups at different periods. There is significant difference in comparison between group A with group B and group B with group C at 1h, 2h & 16hr with (P value 0.0001), at 4hr with (P value 0.02) difference was between group A and C and at 8hr with (P value 0.008) difference was between group B with group C. In group A, MAP was (94.4±5) at 1h that increased at 16h to (104.5±6.2) & decreased significantly at 6h to (93.9±4.5) with (P value 0.0001). In group B, MAP was (89.1±5.8) at 1h that increased up to (102.8±10) at 12h &a significant decrease occurred at 2h to (91.7±6.5) with (P value 0.0001). In group C, MAP was (106.5±12.4) at 1h that increased & decreased significantly at different post-operative periods with (P value 0.0001).

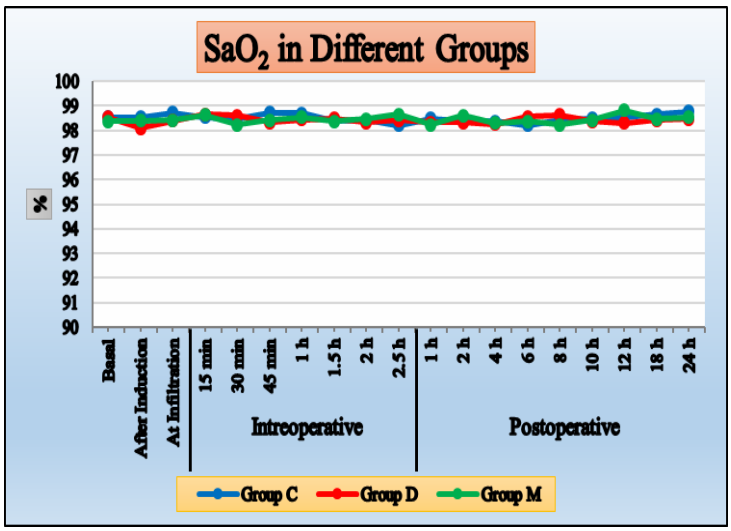


MAP 20 minutes after block



MAP 16 hour postoperative

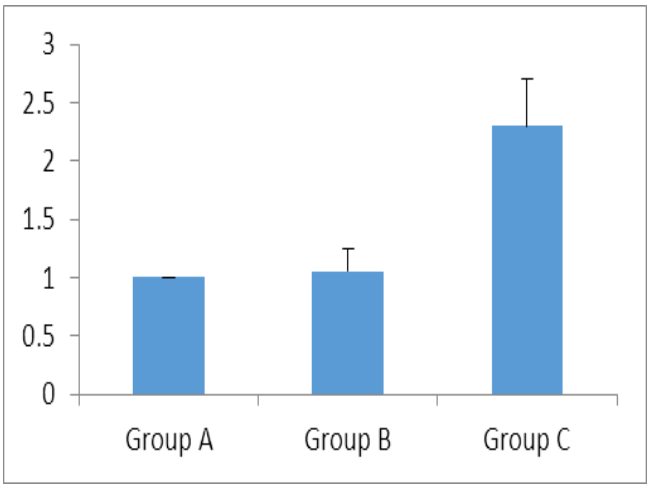
3- Oxygen saturation: the changes in the Oxygen saturation among groups. There was no statistically significant difference pre, intra or postoperative.



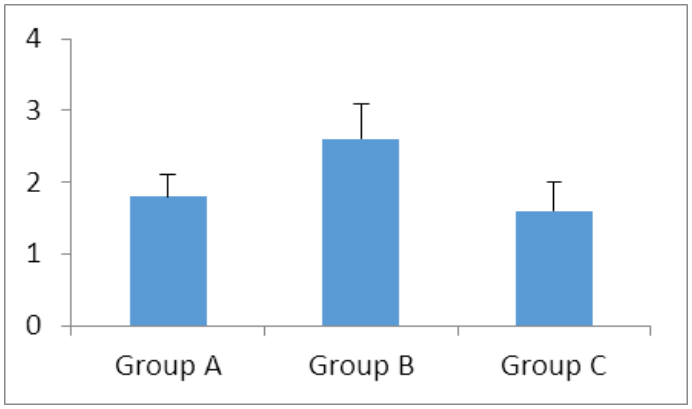
Changes in the oxygen saturation in the studied groups.

Comparison of visual analogue scale at cough and at rest among three groups:

Comparison between the three groups detected a statistically significant difference in the VAS at 1, 2, 4, 8, 12 & 16hrs. After extubation where it was significantly lower in group A and B in comparison to group C at 1, 2, 8 &16hrs. after extubation, but at 4 there was significance between group A with group C, also, at 12 hour there was significance only between group B and C. In comparing A group with B group, the VAS was significantly lower in group A at 4hr. Postoperative. Due to the high basal VAS in group C which necessitates the use of analgesic, intergroup comparison detected no significant difference at 6, 20 & 24hrs. of recording. Also there was a significant difference between VAS at cough intergroup (P value 0.0001) specially at 16hr. At group A and at 4 and 16hr. at group B while at 6hr. at group C. Regarding VAS at rest there was a significant difference intergroup, group A showed increase in VAS score at 16hr., group B at 12hr. ang group C at 1st & 2nd hr. after extubation.



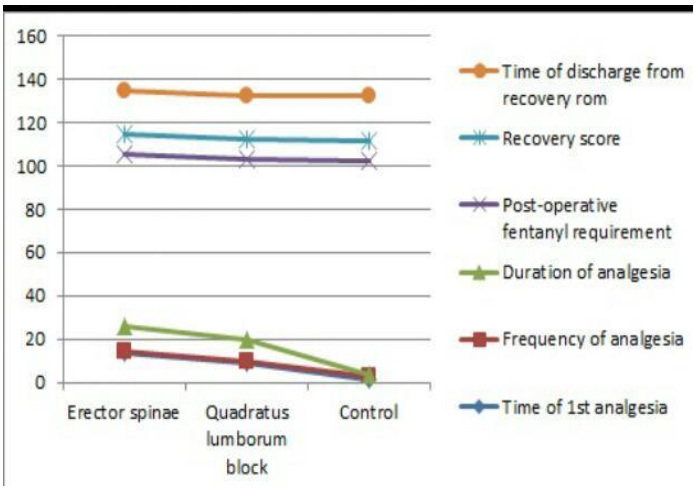
VAS at cough 2 hour postoperative



VAS at rest 12 hour postoperative

The time to first analgesic request, frequency of analgesia, the total postoperative 24hr. analgesic requirement, recovery score and time of discharge from recover room:

Analysis of data regarding1st analgesic request (hrs.) that the time to first analgesic request was significantly longer in groups A and B when compared to group C with P value 0.0001. In comparing the duration of analgesia the statistical analysis showed significant difference between groups (P value 0.0001); that the duration of analgesia was shorter in group C when compared with groups A and B. Also, the postoperative fentanyl requirement which was significantly higher at group C (P value 0.04). There was no significant difference among groups at frequency of analgesia, recovery score and time of discharge from recovery room.



Discussion

Several studies evaluated the efficacy of ultrasound guided anterior Quadratus Lumborum block versus Erector Spinae block in providing analgesia in patients undergoing laparoscopic cholecystectomy. The results obtained in this study are consistent with those reported by others. Korgün et al., 2018 studied the effect of Quadratus Lumborum block on post-operative pain in laparoscopic cholecystectomy using ultrasonography. They concluded that The VAS scores between the two groups were found to be statistically significantly lower in Group B. The mean values of the quantity of tramadol used at the 6th, 12th, and 24th hours were found to be statistically significantly lower in Group B. There was no statistically significant difference in the rate of side effects, so they thought that posterior QLB admini-stered for pain palliation after laparoscopic cholecystectomy operation is an effective analgesia technique. Rafael et al., 2016 who studied the effect of quadratus lumborum block versus transversus abdominis plane block for post-operative pain after cesarean delivery, 76 patients randomized into 2 groups: QLB and TAP block. Both groups received 0.125% bupivacaine at 0.2 mL/kg in each side for a total

of 0.4 mL/kg. Both block procedures were performed at the end of surgery before transfer to the recovery area. They concluded that, the quadratus lumborum block was more effective in reducing morphine consumption and demands than transversus abdominis plane blocks after cesarean section. This effect was observed up to 48 hours postoperatively. Elsharkawy et al., 2018 recommended the application of QLB for laparoscopic cholecyst-ectomy. The aim of his study was to evaluate the effect of pre-operative ultrasound guided trans-muscular QLB versus ultrasound guided anterior oblique subcostal TAP block on acute postoperative pain intensity and opioid consum-ption in patients underwent laparoscopic cholecystectomy. They founded that QL blocks can provide somatic as well as visceral analgesia of both the abdominal wall and the lower segments of the thoracic wall and therefore could be a useful analgesic modality for selected abdominal surgeries.

Tulgar S. and Thomas D., 2018 published a randomized controlled clinical trial to evaluate the ESP block for postoperative analgesia in laparoscopic cholecystectomy. In the ESP block group they performed the block at T9 level and they have shown that ESP decreases in postoperative pain intensity in addition to requirement for opioids and other analgesic agents in the first 12 hours after a laparoscopic cholecystectomy. They also studied the Evaluation of ultrasound-guided Erector Spinae plane block for postoperative analgesia in laparoscopic cholecystectomy, two groups of 15 patients each: control group (Group C) and ESPB group (Group B). They found that bilateral ultrasound guided ESPB leads to effective analgesia and a decrease in analgesia requirement in first 12 h in patients undergoing LC, in which both somatic and visceral pain occurs. Aygun H. et al., 2019 alike our study compared ultrasound guided Erector Spinae Plane Block and quadratus lumborum block for postoperative analgesia in laparoscopic cholecystectomy patients, two groups of 40 patients randomized into ESPB and QLB-II groups. ESPB applied 2.5-3 cm lateral to the spinous process of the 9th thoracic vertebra in the parasagital plane, 30 mL of LA was applied between the erector spinae muscles in the interfascial plane. QLB-II applied by injection of 30 mL of LA (on each side) between the posterior aspect of the quadratus lumborum muscle and the latissimus dorsi muscle in the interfascial plane. They found that the effect of ultrasound guided bilateral QLB-II and ESPB in patients undergoing LC were found to be similar in regards to postoperative pain and opioid requirement. Further studies are required to determine the best choice between these two blocks.

In contrast to our results in Quadratus Lumborum group Suri et al., 2017 who studied the effect of ultrasound guided continuous type 1 QLB on patients underwent laparoscopic nephrectomy, they reported failure of QLB as effective technique for postoperative analgesia. This failure occurred secondary to damage to thoracolumbar fascia (TLF) during the surgical dissection would probably have caused the drug to spread beyond the plane, resulting in block failure.

Also, there had been a study consistently reported that the ESP block produced additional spread to intercostals spaces over 5 to 9 levels and was associated with a greater extent of craniocaudal spread along the paraspinal muscles such as Adhikary S. et al., 2018 demonstrated with cadaveric observations.

Nevertheless, Elsharkawy H. et al., 2019 in a cadaveric study comparing two posterior quadratus lumborum block approaches with low thoracic erector spinae plane block. Left-sided ESP blocks were performed in six cadavers at T10–11. Three of these cadavers received right-sided posteromedial QL block at L2, while the other three received right-sided posterolateral QL block at L2. All injections were composed of 20 mL methylcellulose 0.5 % mixed with India ink and 10 mL of Omnipaque (Iohexol) 240 mg/mL. CT 24 hours after injection and cadaver dissection were used to evaluate injectate spread.

The conclusion of that study is that the posteromedial QL block at L2 produces more cranial spread beyond the lumbocostal ligament than the posterolateral QL block, and this spread is comparable with a low thoracic ESP block. Both posterior QL and ESP blocks show unreliable spread of injectate to the para-vertebral space and ventral rami, but the dorsal rami were frequently covered.

This conclusion might be due to usage of different injectant (20 mL methylcellulose 0.5% mixed with India ink and 10mL of Omnipaque (Iohexol) 240 mg/mL) other than the one we use (20 ml Bupivacaine 0.25%), different level of Erector Spinae block (T10-T11) was applied in that study and the approach of QLB II (posterior approach) was used while our appr-oach was QLB III (intramuscular approach).

Taketa et al., 2018 reported in a case series in thoracoscopic lobectomy that ESP block provides tolerable analgesia in thoracoscopic surgery but provides weak dermatomal spread toward the anterior cutaneous branch region, rather than the lateral cutaneous branch region. Thus, the author presumes that ESP block has the properties of a strong lateral cutaneous branch block that are similar to PECS block, but not to paravertebral or intercostal nerve blocks. The cause of lesser spread of local anesthetic probably cause of unilateral block, bilateral blocks would be required for incisions crossing the midline (López M. et al., 2018).

In addition, failure of Erector Spinae in two case reports and their explanation is based on the cadaveric study by Ivanusic et al., 2018 where the authors did not find extension of the dyed contrast to the paravertebral space and dyed only posterior and lateral branched of thoracic nerve.This conclusion might be due to differentiation in composition and concentration of the dye from that of Bupivacaine 0.25 %. Also applying on cadavers might differ from a living human being.

Recommendations

1. Ultrasound guided Erector Spinae block is recommended as effective, safe and easy technique for post-operative analgesia in laparoscopic cholecystectomy.
2. Further studies probably are required on a larger sample size to confirm our results.
3. Future studies may be needed to assess pain beyond 24 hours.

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