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Research article

A comparison of oblique subcostal transversus abdominis plane block versus thoracic paravertebral block for postoperative analgesia after open cholecystectomy

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ABSTRACT

Background: A major challenge in the postoperative period is pain management which, if not adequately controlled, may contribute to patient discomfort and decreased patient satisfaction, and possibly increased morbidity and mortality. Both Thoracic paravertebral block and oblique subcostal transversus abdominis plane block can be used as analgesic techniques for abdominal surgeries. Our aim in this research was comparison of cumulative 24-h post-operative morphine consumption between ultrasound-guided oblique subcostal transversus abdominis plane block and ultrasound-guided thoracic paravertebral block in patients who underwent an open cholecystectomy under general anesthesia.
Patients and methods: This study was performed on 46 patients who underwent open cholecystectomy under general anesthesia. All patients were randomly allocated alternatively to one of two equal groups to either undergo ultrasound-guided unilateral oblique subcostal transversus abdominis plane block Group (I) or to undergo ultrasound-guided unilateral thoracic paravertebral block Group (II). Both groups were subjected to a similar analgesic regimen in the immediate post-operative period that involved intravenous patient-controlled morphine analgesia which was used in both groups.
Results: The total morphine consumption in the first postoperative 24 h was lower in thoracic paravertebral block Group (II) (9.9 mg in thoracic paravertebral block group vs. 15.4 mg in oblique subcostal transversus abdominis plane block Group (I) with $p < 0.001$). The mean time of first request of analgesia in Group (I) was 248.7 min compared to 432.1 for Group (II) with $p < 0.001$.
Conclusions: Both ultrasound-guided oblique subcostal transversus abdominis plain block and single injection ultrasound guided thoracic paravertebral block are effective analgesic techniques for upper abdominal surgeries and reduces postoperative opioid requirements. However, thoracic paravertebral block is more effective in reducing morphine consumption.

1. Introduction

Effective pain management in the post-operative period is not only essential to alleviate suffering but pain has also been with a potential negative impact on the rate and success of recovery, which in turn affects hospital stay duration and hospital costs [1]. Postoperative pain following abdominal surgery if severe enough may cause several side effects as "splinting, hypoventilation, atelectasis, immobility, hypercoagulability, thromboembolic events, vasoconstriction, tachycardia, increased systemic vascular resistance, dysrhythmias and cardiac ischemia in susceptible patients, insomnia, anxiety, feeling of helplessness" [2].

Regional blockade is one of the methods to control operative pain. Thoracic paravertebral (TPV) block originally was used to provide muscle relaxation and anesthesia for upper abdominal surgery [3]. Its use is now well established for abdominal, thoracic and breast surgery. The safety concerns from previous decades have proved to be unfounded with TPV block having a comparable rate of complications to thoracic epidurals and intercostals blockade [4].

A systematic review and meta-analysis of all relevant randomized trials comparing TPV block with epidural analgesia in thoracic surgery have demonstrated equally effective analgesic effects between paravertebral blockade and epidural analgesia, but with

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significantly fewer adverse effects in TPV block group such as respiratory complications, nausea and vomiting, hypotension and urinary retention [5]. Potential complications such as pain and pneumothorax caused by blind needle insertion can now be avoided by real-time guidance modalities such as ultrasound [6].

Ultrasound-guided transversus abdominis plane (TAP) blockade is a relatively novel method that has been promising with regards to post-operative pain control in abdominal surgeries. Injection of local anesthetic is performed through the lumbar triangle of Petit. In recent years, TAP blockade has been successful in the postoperative period with regards to requirement of opioid and patient comfort [7].

This rapid evolution has incorporated the oblique subcostal approach which provides wider sensory blockade and can be utilized with operations both superior and inferior to the umbilicus. Insufficient data is available regarding efficacy of this approach in post-operative analgesia [8].

This study was designed to compare the effect of two types of regional blocks in post operative pain control in upper abdominal surgeries. These are ultrasound-guided oblique subcostal transversus abdominis plane (USG-OSTAP) block and ultrasound-guided unilateral thoracic paravertebral (USG-TPV) block (see Figs. 1–7).

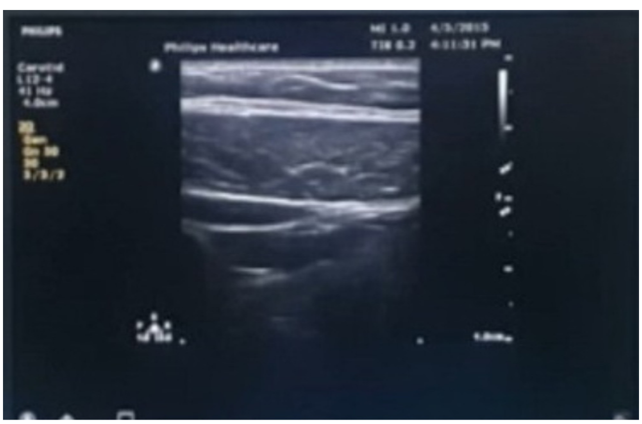


Fig. 1. Transversus abdominal muscle (TAM) appears just below Rectus abdominal muscle (RAM).

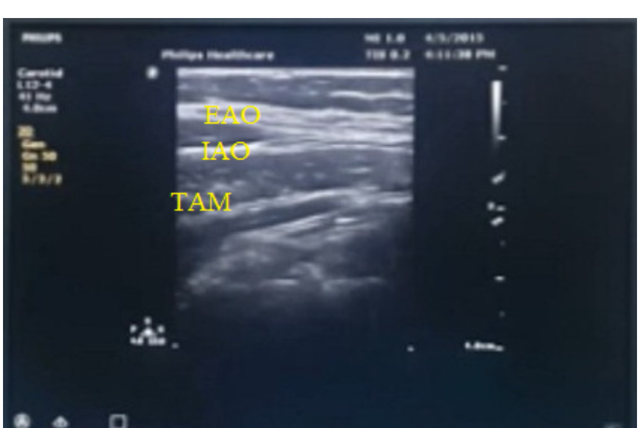


Fig. 2. Three anterolateral abdominal wall muscles External abdominal oblique (EAO), Internal abdominal oblique (IAO), and Transversus abdominal muscle (TAM).

Fig. 3. The needle has reached the plane injection between Rectus abdominal muscle (RAM) and (TAM).

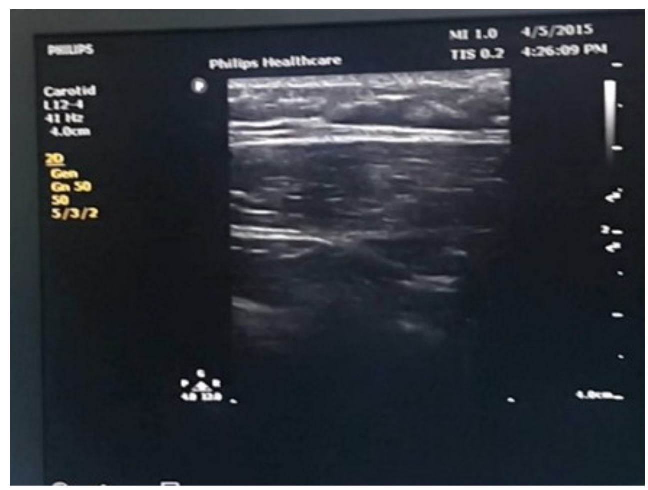


Fig. 4. Injection of LA causing opening of the fascial plane between RAM and TAM.

2. Patients and methods

After obtaining approval by the Hospital Ethics Committee, and written informed patient consent with an explanation regarding the purpose, methods, effects, and complications, we have studied 46 American Society of Anesthesiologists (ASA) physical statuses I and II patients undergoing open cholecystectomy under general anesthesia at Suez Canal University Hospital.

Patients were randomly divided by a closed envelope method into 2 groups randomization was performed by a member of our research team; Group I (23 patients): received unilateral ultrasound-guided thoracic paravertebral block (USG-TPVB). Group II (23 patients): received ultrasound-guided oblique subcostal transversus abdominis plane (USG-OSTAP) block.

2.1. Sample size justification

Sample size was calculated using PASS ® version 11 program, setting the type-1 error (α) at 0.05 (95% Confidence interval) and the power (1-β) at 0.8 [9]. Results from a previous study showed that the mean cumulative PCA morphine requirement in the PVB

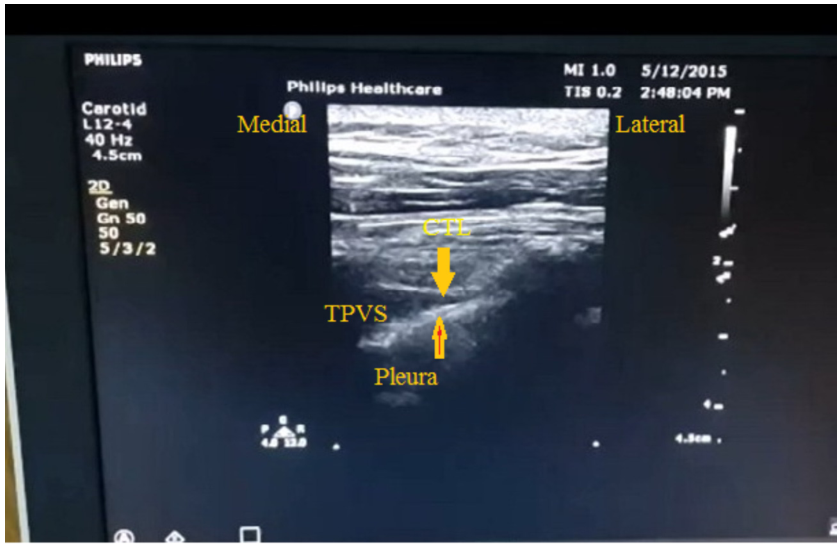


Fig. 5. Wedge shape of Thoracic paravertebral space (TPVS) bounded by pleura and costotransverse ligament (CTL).

Fig. 6. The needle is approaching the costotransverse ligament.

group was 16.80 ± 3.37 mg [10]. While in TAP group it was 45.9 ± 33.9 mg [11]. Calculation according to these values produced a minimal sample size of 11 cases per group, taking in consideration 20% drop out rate the sample become 15 per group. We included higher numbers of participants (23 per group) for attaining more power for the study.

Inclusion criteria: Adults ≥21 years and ≤60 years of age of both genders, patients are ASA I or ASA II (American Society of Anesthesiologists physical status Grade I or II), open cholecystectomy under general anesthesia, patients of Body Mass Index (BMI) ≥20 and ≤40.

Exclusion criteria: Patients with any of the following criteria were excluded from the study, refusal of participation in the study, patients with contraindication to TPV blocks or OSTAP, patients who are uncooperative to the limit that interferes with perioperative follow-up or usage of PCA, history of drug dependency or substance addiction or patients with a known sensitivity to study drugs.

2.2. Pre operative assessment

The patient's age, sex, ASA status, and duration of surgery were recorded. All patients were assessed clinically by: Medical history, Physical examination and investigations.

2.3. Intra-operative measures

The whole technique and anesthetic procedures were performed by the same researcher anesthesiologist to avoid as much as possible the inter-individual variations in skills. The patient was reassured and the procedure was explained. An 18-gauge intravenous cannula was inserted into the patient's forearm to all patients. No premedication was given. Airway devices and anesthesia machine, ventilator, flowmeters and equipments were checked promptly.

Routine monitoring equipment was attached to the patients to obtain the following measurements: 5-lead ECG, capnography,

Fig. 7. LA spread in TPVS.

pulse oximetry and blood pressure. The following baseline values were recorded: heart rate (HR), mean arterial pressures (MAP), systolic blood pressure (SBP) and diastolic blood pressure (DBP). The patients were pre-oxygenated with 100% oxygen for at least 3 min using a face mask of the appropriate size, after which they were subjected to a standard general anesthetic regimen including IV fentanyl (1 mcg/kg), IV propofol (2 mg/kg) and IV cis-atracurium (0.15 mg/kg) prior to endotracheal intubation. The lung was ventilated using a volume controlled mode, aiming to maintain end tidal carbon dioxide from 35 to 40 mmHg. Anesthesia maintenance was performed by isoflurane at 1–2.5% in air/oxygen. Top up doses of cis-atracurium 0.03 mg/kg was given 50–60 min following initial dose to maintain appropriate muscle relaxation during surgery.

All intra-operative hemodynamic parameters were monitored. If any of them increased by ≥15% above pre-induction values, fentanyl 0.5 mcg/kg IV was given. The anesthetic blocks in both groups were administered after completion of the surgery and skin closure.

2.3.1. Technique of thoracic paravertebral TPV block in this study

- The patient was placed in the left lateral position.
- The skin was prepared aseptically and selected level was localized (rib at T8 level) in the Right side, on which the ultrasound probe was placed with the medial edge of probe in contact with the spinous process perpendicular to midline. The probe was then moved caudally into the intercostal space between adjacent ribs. Then, the visceral and parietal pleura were identified during positive pressure ventilation which causes a visible movement of the visceral and parietal pleura over each other.
- Rotation of the probe in this position followed by tilting it allowed the intercostal muscles to be identified deep and inferior to the rib.
- A 22G, 50 mm Stimuplex D Plus needle (B. Braun, Melsungen AG, Germany) was then inserted in-plane at the lateral end of the probe. The needle was gradually advanced until it reached the space between the internal and innermost intercostal muscles.
- After identification of the space between the muscles, and confirmation that there was a negative blood and air aspiration test, 20 ml of 0.5% bupivacaine was injected.
- Spread of local anesthetic with depression of the pleura would be clearly visualized.
- The same investigator performed the block to avoid variation between block performers.

2.3.2. Technique of oblique subcostal TAP block in this study

- After skin closure, ultrasound-guided unilateral OSTAP block was performed aseptically.
- Following identification of the rectus abdominis and transverses abdominis muscles in proximity to the Right costal margin and xyphoid, a 22G, 120 mm Stimuplex D Plus needle (B. Braun, Melsungen AG, Germany) was introduced via the rectus muscle just medial to the probe.
- Following negative pressure aspiration, 20 ml of 0.5% bupivacaine was injected in increments in TAP.

After completing the OSTAP technique in the OSTAP group, and injection of the local anesthetic in the TPV block, isoflurane was closed and patients were given 100% oxygen and IV atropine 0.02 mg/kg and neostigmine 0.05 mg/kg were administered as a reversal of muscle relaxant. Once they demonstrated spontaneous eye opening, effective breathing and able to generate tidal volume patients were extubated.

2.4. Postoperative measures for the two study groups

- Intravenous Patient-Controlled morphine Analgesia (IV-PCA) was commenced on admission to the post anesthesia care unite (PACU) in all groups.
- The PCA solution contained morphine 0.5 mg/ml (as rescue analgesia) and the pump device was programmed to deliver 1 mg of morphine as a demand dose (bolus) with 12 min lockout time, a maximum dose of 5 mg/h and no basal rate infusion.
- First time to ask for analgesia, and total consumption of morphine (mg) were reported in the first 24 h postoperatively.

2.5. Pain assessment

- The visual analogue scale was chosen as a method of pain assessment in this study. A 10-point VAS was recorded every 3 h (during cough and at rest) for the first 24 h postoperatively by anesthesiologist who was blind to the type of block. The patients were asked to make a vertical mark on the line between 0 and 10 to indicate the intensity of their pain. Zero (0) at the left extremity indicated that patient had no pain, and ten (10) at the right means that the pain can't be imagined.

2.6. Recognition of side effects

- Incidence of nausea and vomiting were recorded.
- IV metoclopramide 10 mg was administered to patients who had vomiting. Sedation scores were assigned by the investigator over the first 24 h postoperatively using the Riker Sedation-Agitation Scale (SAS) [12] as following:

Score	Category	Description
7	Dangerous agitation	Pulling at endotracheal tube, trying to remove catheters, climbing over bedrail, striking at staff, thrashing side-to-side
6	Very agitated	Does not calm despite frequent verbal reminding of limits, requires physical restraints, biting endotracheal tube
5	Agitated	Anxious or mildly agitated, attempting to sit up, calms down on verbal instructions
4	Calm, cooperative	Calm, easily arousable, follows commands
3	Sedated	Difficult to arouse, awakens to verbal stimuli or gentle shaking but drifts off again, follows simple commands
2	Very sedated	Arouses to physical stimuli but does not communicate or follow commands, may move spontaneously
1	Unarousable	Minimal or no response to noxious stimuli, does not communicate or follow commands

- Very sedated patients who were arouses to physical stimuli but does not communicate or follow commands, and may move spontaneously were recorded.

2.7. Statistical analysis

The statistical analysis was performed using the Statistical Package for the Social Sciences SPSS® version 15 (SPSS Inc., Chicago, IL, USA) for windows operating system. Descriptive data were expressed as mean and SD for continuous variables, and count and percentages (%) for dichotomous variables. Unless stated otherwise, results are mean ± SD.

Independent-samples student T test was used to analyze continuous variables between groups. One-way ANOVA was used to analyze the parametric follow-up data within the same group. Discrete (categorical) variables were analyzed using the Chi-square. The level of statistical significance was considered to be $p < 0.05$.

Presentation of the statistical outcomes in form of tables and graphs were performed using the "Microsoft Office Excel® 2007" program

3. Results

The two groups were *comparable* with regards to age, gender, body mass index (BMI) American Society of Anesthesiologist (ASA) status and surgery duration, with no statistically significant difference (p value >0.05). (Table 1).

The study showed that there was no significant difference in VAS scores between the two groups at rest during the first 24 h postoperatively. On the other hand, assessing the VAS score at coughing showed that scores at 21 h and 24 h postoperative, the patients of the TPV block group showed significantly better scores. Mean VAS score at coughing at 21 h was 4.5 ± 0.5 for OSTAP group and 4.1 ± 0.5 for TPV group ($p = 0.019$), and at 24 h was 4.5 ± 0.5 for OSTAP group and 3.5 ± 0.5 for TPV group ($p < 0.001$) (Tables 2 and 3).

Regarding comparing the first request of morphine and total post operative morphine consumption between the two groups as a measure of the analgesic effect of the blocks the study shows that results of the TPV group are better than that of the OSTAP group. The total morphine consumption over the first 24 postoperative hour was statistically significant with mean of 15.4 mg in OSTAP group and 9.9 mg in TPV group ($p < 0.001$) (Table 4).

Table 1
Basic characteristics among the studied patients in both groups:

			OSTAP n = 23	TPV n = 23	p-Value
Age		Mean ± SD	47.43 ± 6	49.52 ± 8	0.327
Sex	Male	N (%)	9 (39.1)	10 (43.5)	0.765
	Female	N (%)	14 (60.9)	13 (56.5)	
ASA	ASA I	N (%)	11 (47.8)	13 (56.5)	0.555
	ASA II	N (%)	12 (52.2)	10 (43.5)	
Weigh (kg)		Mean ± SD	86.13 ± 7.4	86.3 ± 8	0.939
Height (M)		Mean ± SD	1.66 ± 0.05	1.64 ± 0.03	0.317
BMI		Mean ± SD	31.22 ± 3.22	31.79 ± 3.5	0.577
Surgery duration (Minutes)		Mean ± SD	70.4 ± 16.2	71.3 ± 14.1	0.821

Table 1 shows that basic characteristics between both groups (age, sex, ASA score, weight, height, and BMI) are matched with no statistically significant differences (P-value >0.05). Also there was no difference in the duration of the surgery in both groups.

Table 2
Postoperative scores of visual analogue scale (VAS) between the two study groups at rest (Mean ± SD).

Time of Measurement	OSTAP n = 23	TPV n = 23	p-value
1 h	0	0	1.00
3 h	1.6 ± 0.4	1.4 ± 0.5	0.145
6 h	1.8 ± 0.5	1.9 ± 0.5	0.561
9 h	2.4 ± 0.5	2.2 ± 0.4	0.121
12 h	2.5 ± 0.5	2.4 ± 0.5	0.773
15 h	3.5 ± 0.5	3.3 ± 0.8	0.290
18 h	3.8 ± 0.7	4.1 ± 0.6	0.092
21 h	4.2 ± 0.6	4.3 ± 0.7	0.545
24 h	4.2 ± 0.4	4.0 ± 0.9	0.318

Table 2 show that no statistically significant difference is found between the two groups (P-value >0.05) regarding postoperative visual analogue scale (VAS) at rest.

Table 3
Postoperative scores of visual analogue scale (VAS) between the two study groups at cough (Mean ± SD).

Time of Measurement	OSTAP n = 23	TPV n = 23	p-value
1 h	0.6 ± 0.4	0.5 ± 0.5	0.380
3 h	1.6 ± 0.5	1.5 ± 0.5	0.562
6 h	2.4 ± 0.6	2.4 ± 0.5	0.619
9 h	2.7 ± 0.5	2.6 ± 0.5	0.581
12 h	3.8 ± 0.6	3.7 ± 0.6	0.481
15 h	4.4 ± 0.5	4.2 ± 0.5	0.400
18 h	4.4 ± 0.5	4.0 ± 0.8	0.053
21 h	4.5 ± 0.5	4.1 ± 0.5	0.019*
24 h	4.5 ± 0.5	3.5 ± 0.5	<0.001*

Table 3 shows that no statistically significant difference is found between the two groups regarding postoperative visual analogue scale (VAS) at cough except in scores of VAS at 21 h ($p = 0.019$) and 24 h ($p < 0.001$) postoperative where the patients of the TPV block showed significantly better scores.
* Significant difference (P-value <0.05).

Table 4
Comparison between the two study groups regarding the timing of the 1st morphine request and total morphine consumption (Mean ± SD).

	OSTAP n = 23	TPV n = 23	p-value
1st morphine request (Minutes)	248.7 ± 44.0	432.1 ± 45.6	<0.001*
Total morphine consumption (mg)	15.4 ± 1.4	9.9 ± 2.4	<0.001*

Table 4 compare the timing of the 1st morphine request postoperatively in minutes and total morphine consumption in the 24 h postoperatively in milligrams between the two groups as a measure of the analgesic effect of the blocks and shows that results of the TPV group are better than that of the OSTAP group with a statistically significant difference ($p < 0.001$).
* Significant difference (P-value <0.05).

Table 5
Incidence of postoperative nausea, vomiting, and over sedation among the studied patients in both groups, values = N (%).

	OSTAP n = 23	TPV n = 23	P
Nausea	3 (13%)	2 (8%)	0.55
Vomiting	1 (4%)	0 (0%)	0.312
Over Sedation	2 (8%)	1 (4%)	0.400

Table 5 show the incidence of occurrence of complications (nausea, vomiting, and over sedation) among the patients of the two groups and shows that the incidence of nausea, vomiting, and over sedation is slightly higher in the OSTAP group but the difference is non-significant statistically.

All the three postoperative complications that were observed in this study (nausea, vomiting and over sedation) were statistically non significant (Table 5 and Graph 1).

4. Discussion

The present study was designed to compare the analgesic and opioid-sparing effects of unilateral oblique subcostal transversus abdominis plane (OSTAP) block with unilateral thoracic paravertebral (TPV) block in patients undergoing open cholecystectomy under general anesthesia. Ultrasound guidance was chosen in both techniques to ensure the accuracy of needle placement and minimize damage to surrounding structures [13].

The results of our study show that there was no significant difference in VAS scores between the two groups at rest during the first 24 h postoperatively. On the other hand, assessing the VAS score at coughing showed that scores at 21 h and 24 h postoperative, the patients of the TPV block group showed significantly better scores.

This can be explained with the fact that OSTAP is a superficial block that only controls pain from the surgical site, while the TPV block successfully blocks both the somatic and visceral pain. By time, the somatic pain decreases in intensity while the visceral pain continues for more time and that is when the TPV block becomes more beneficial to patients.

Melnikov et al. [14] in their study where they compared TPV block with TAP block in gynecological surgery, they demonstrated that TPV block had better results in postoperative pain management as it reduced VAS scores in the first 48 h postoperatively except at 6 h postoperatively.

Shin et al. [15] compared ultrasound guided OSTAP with conventional intravenous opioid administration for patients undergoing laparoscopic cholecystectomy using VAS scores and found that the block OSTAP reduced scale scores of verbal numerical pain postoperatively than the standard treatment at 10 min (2 [1–4] vs. 7 [5–8]), 30 min (2 [1–5] vs. 6 [5–8]), 1 h (2 [1–3] vs. 5 [4–6]), and 3 h (2 [2–3] vs. 4 [3–5]) postoperatively.

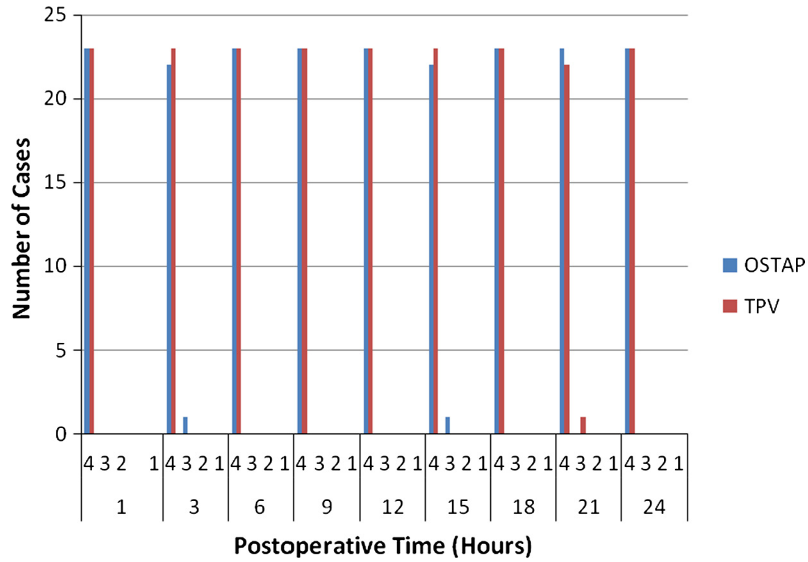
The lower VAS scores found in this study compared to ours is mostly because that the open surgical approach is much more painful than laparoscopic one.

Ibrahim and El Shamaa [16] reported lower VAS scores in patients receiving OSTAP block at rest after laparoscopic sleeve gastrectomy (mean score at 12 and 24 h postoperative was 2.9 and 2 respectively) and comparable scores to our study at coughing (mean score at 12 and 24 h postoperative was 4.3 and 3.6 respectively) which can be explained by the use of bilateral blocks in patients who underwent laparoscopic surgery, and the larger volume of local anesthetic injected in their study (30 ml bupivacaine compared to 20 ml in our study).

In the current study as regard total consumption of morphine we found that over the first 24 postoperative hours TPV block group was significantly lower than that of TAP block group. These results are consistent with the ones reported in other studies. Eldawlaty et al. [17] found that patients received transverses abdominis plain block required much less total morphine consumption (10.5 mg) than the control group (22.8 mg) with $p < 0.005$. The lower morphine dose found in this study compared to ours is simply because the open surgical approach is much more painful.

Our results are also comparable to the results of Ibrahim and El Shamaa [16] found that the mean of total consumption of morphine in the initial 24 h postoperative in patients receiving OSTAP block was 16.76 mg compared to 24.76 mg in the control group ($p < 0.001$). Shin et al. [15] used fentanyl as postoperative analgesic and found that the amount of fentanyl demand was less in the group treated with OSTAP ($p = 0.005$).

In current study as regard the time to first request of analgesia, it showed that TPV block group was significantly longer than that in TAP block group.



Graph 1. Postoperative over sedation among the studied patients in the two study groups. Graph (1) Compare the occurrence of sedation according to the Riker Sedation-Agitation Scale (SAS) in patients of both groups and shows that there is no difference at 1,6,12,18, and 24 h postoperative and that the difference at 3, 9, 15, and 21 h is statistically non significant. *1: Unarousable, 2: Very sedated, 3: Sedated, 4: Calm, cooperative.*

Supporting current study, Melnikov et al. [14] found that TPV block group was significantly increased the time for first request analgesia in comparison with TAP block group.

During our study we didn't observe any case of systemic local anesthetic complication which is probably the result of real time ultrasound guidance. All the three postoperative complications that were observed in this study (over sedation, nausea and vomiting) were statistically insignificant.

This is because the two blocks used in the study reduce the total postoperative morphine requirement to tolerable doses that usually do not produce side effects. This is comparable to the result of the studies done by Shin et al. [15] and Tawfic et al. [18]. Also these results agree with that obtained from Davies et al. [5] and Joshi et al. [19] meta-analyses that state that paravertebral block has much lower incidence of adverse effects than epidural analgesia including hemodynamic instability and pulmonary complications.

5. Conclusion

We concluded that both ultrasounds guided unilateral oblique subcostal transverses abdominis plain (OSTAP) block and single injection ultrasound guided unilateral thoracic paravertebral (TPV) block were safe and effective analgesic techniques for open cholecystectomy surgeries and reduces postoperative opioid requirements. The thoracic paravertebral (TPV) block technique was found to be more superior in pain management for post cholecystectomy patients.

Conflict of interest

We have no conflict of interest to declare.

References

[1] Shiloh S, Zukerman G, Butin B, et al. Postoperative patient-controlled analgesia (PCA): How much control and How much analgesia? Psychol Health 2003;18 (6):753–70.
[2] Lubenow TR, McCarthy RJ, Ivankovich AD. Management of acute postoperative pain. In: Barish PG, Cullen BF, Stoelting RK, editors. Clinical anesthesia. Philadelphia, PA: JB Lippincott; 1992. p. 1551–2.
[3] Richardson J, Lonnqvist PA. Thoracic paravertebral block. Br J Anaesth 1998;81 (2):230–8.
[4] Lonnqvist PA, MacKenzie J, Soni AK, et al. Paravertebral blockade. Failure rate and complications. Anaesthesia 1995;50(9):813–5.
[5] Davies RG, Myles PS, Graham JM. A comparison of the analgesic efficacy and side-effects of paravertebral vs epidural blockade for thoracotomy, a systematic review and meta-analysis of randomized trials. Br J Anaesth 2006;96(4):418–26.
[6] Pusch F, Wildling E, Klimscha W, et al. Sonographic measurement of needle insertion depth in paravertebral blocks in women. Br J Anaesth 2000;85 (6):841–3.
[7] Hebbard P, Fujiwara Y, Shibata Y, et al. Ultrasound-guided transversus abdominis plane (TAP) block. Anaesth Intensive Care 2007;35(4):616–7.
[8] Hebbard PD, Barrington MJ, Vasey C. Ultrasound-guided continuous oblique subcostal transversus abdominis plane blockade: description of anatomy and clinical technique. Reg Anesth Pain Med 2010;35(5):436–41.
[9] Greenberg RS. Estimation of sample size requirements for randomized controlled clinical trials. In: Greenberg RS, editor. Medical epidemiology, vol. ix. New York: Lange Medical Books/McGraw-Hill; 2005. p. 254.
[10] Agarwal A, Batra RK, Chhabra A, et al. The evaluation of efficacy and safety of paravertebral block for perioperative analgesia in patients undergoing laparoscopic cholecystectomy. Saudi J Anaesth 2012;6 (4):344–9.
[11] Milan ZB, Duncan B, Rewari V, et al. Subcostal transversus abdominis plane block for postoperative analgesia in liver transplant recipients. Transplant Proc 2011;43(7):2687–90.
[12] Riker RR, Fraser GL, Simmons LE, et al. Validating the sedation-agitation scale with the bispectral index and visual analog scale in adult ICU patients after cardiac surgery. Intensive Care Med. 2001;27(5):853–8.
[13] McDermott G, Korba E, Mata U, et al. Should we stop doing blind transversus abdominis plane blocks? Br J Anaesth 2012;108(3):499–502.
[14] Melnikov AL, Bjoergo S, Kongsgarrd UE. Thoracic paravertebral block versus transverses abdominis plane block in major gynecological surgery: a prospective randomized, controlled, observer-blinded study. Local Reg Anesth 2012;5:55–61.
[15] Shin HJOAY, Baik JS, Kim JH, et al. Ultrasound-guided oblique subcostal transversus abdominis plane block for analgesia after laparoscopic cholecystectomy: a randomized, controlled, observer-blinded study. Minerva Anestesiol. 2014;80(2):146–8.
[16] Ibrahim M, El Shamaa H. Efficacy of ultrasound-guided oblique subcostal transversus abdominis plane block after laparoscopic sleeve gastrectomy: A double blind, randomized, placebo controlled study. Egypt J Anaesth 2014;30 (3):285–92.
[17] El-Dawlatly A, Turkistani A, Kettner S, et al. Ultrasound-guided transversus abdominis plane block: description of a new technique and comparison with conventional systemic analgesia during laparoscopic cholecystectomy†. Br J Anaesth 2009;102(6):763–7.
[18] Tawfic TA, Khalil MM. Single dose preemptive thoracic paravertebral block for postoperative pain relief after cholecystectomy. AJAIC 2006;9 (3):10–6.
[19] Joshi GP, Bonnet F, Shah R, et al. A systematic review of randomized trials evaluating regional techniques for postthoracotomy analgesia. Anesth Analg 2008;107(3):1026–40.