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COMPARISON BETWEEN ULTRASOUND GUIDED TRANSVERSUS ABDOMINIS PLANE (TAP) BLOCK AND LOCAL ANESTHETIC INFILTRATION IN PATIENTS UNDERGOING LAPAROSCOPIC CHOLECYSTECTOMY

By

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ABSTRACT

Background: Post-laparoscopy analgesia of laparoscopic cholecystectomy is still a challenge. Many studies have been carried out to find the effect of different analgesic techniques in patients undergoing laparoscopic cholecystectomy including ultrasonic guided TAP block &wound infiltration of local anesthetic.

Objective: To assess degree of pain control, duration of action, duration of postoperative analgesia, the effect on postoperative analgesic requirements in patients undergoing laparoscopic cholecystectomy and compare between Transversus abdominis plane block and local wound infiltration.

Methods: 60 cases were enrolled for laparoscopic cholecystectomy and were divided randomly into two groups: TAP group: (n=30) patients of this group received TAP block performed by ultrasound guidance and LWI group (n=30) patients of this group received local anesthetic (ropivacaine).After surgery, Visual Analogue Score (VAS) was recorded at 1, 2,4,6,12,18 &24 hours. Requirement of rescue analgesia when VAS score ≥4, total dose of morphine received in 24 h were noted in both groups postoperatively.

Results: The overall VAS during the first postoperative 24 hours was significantly lower in TAP group (P <0.001at 6, 12, 18 and 24 hours after surgery) and total analgesic consumption (morphine in mg) was lower in TAP group (8.2 mg) compared to LWI (12.2 mg).

Conclusion: TAP block provides better postoperative pain control & reduce postoperative opioid requirement in comparison with local wound infiltration in patients undergoing laparoscopic cholecystectomy.

INTRODUCTION

Laparoscopy is a minimally invasive procedure allowing endoscopic access to peritoneal cavity after insufflations of a gas (usually CO2). Anesthetic approaches to laparoscopic surgery include either epidural or spinal anesthesia, or general anesthesia *(Yildırım et al., 2018)*.

Ultrasound guided transversus abdominis plane (TAP) block can be used as an analgesic supplement in procedures involving the abdominal wall, laparoscopic surgery, abdominal

cholecystectomy, renal transplantation, and prostatectomy *(Hytham Ks Hamid et al., 2020)*.

Recent studies suggested that wound infiltration by local anesthetic significantly reduces pain intensity scores in the early postoperative period after laparoscopic cholecystectomy surgery and helps in improving the postoperative recovery and outcome *(Yu JM et al., 2016)*.

PATIENTS AND METHODS

This prospective randomized clinical trial study was conducted in Al-azhar university hospital after obtaining approval from the medical ethical committee in Al-azhar university, this prospective randomized clinical trial study was conducted in Al-azhar university hospital. It included sixty adult patients undergoing laparoscopic cholecystectomy. The patients were randomly assigned to two equal groups:

- **Group TAP,** which will be given ultrasound guided TAP block,
- **Group LWI,** in which wound infiltration of local anesthetic.

Pre-operative settings: Routine preoperative investigations will be done to all patients including laboratory investigations as (complete blood picture, Bleeding Time, prothrombin time and partial thromboplastin time), age, weight, and sex will be recorded. The patient will be fasting for 8 hours preoperatively. The procedure is done in the operation rooms (OR), The TAP block was performed immediately post-operatively by the anesthesiologist under complete aseptic technique and the wound infiltration of local anesthetic was performed by the operating surgeon immediately after the end of the surgery -under vision- prior to removal of trocars.

Intra-operative Setting: Basic monitoring; including Electrocardiogram (ECG), pulse-oximetry (SpO2) and non-invasive blood pressure (NIBP), were applied to all patients, starting before anesthesia till end of surgery and then recovery. Intraoperative hemodynamic measurements for all patients in the two groups included heart rate, systolic and diastolic arterial blood pressure, spo2 and ET CO2. Postoperative hemodynamic measurements included heart rate and systolic and diastolic arterial blood pressure for all patients in the two groups as well.

At the end of surgery:

Group TAP: Bilateral TAP block was done with 20 mlof 0.25% bupivacaine on each side by midaxillary approach under ultrasound guidance with position, under aseptic conditions, the probe was placed transversely between the iliac crest and costal margin. Echogenic spinal needle, 22G, 8 cm, was advanced in-plane. After visualization of the tip of the needle reaching the plane, 2ml of anesthetic solution was instilled to view the hydro dissection, confirming the correct placement. Following this, the total volume of drug was instilled, creating a meniscus between the planes.

Group LWI: In the operating room, after end of the surgery & removal of the gall bladder and haemostasis, residual blood, fluid; the surgeon infiltrates the wound with 150 mg of ropivacaine with 8 mg of dexamethasone in 6 mL of 0.9% saline-under vision- around surgical field prior removal of trocars.

Recovery:

At the end of surgery, the residual neuromuscular block was reversed with injection neostigmine 0.05 mg/kg and atropine 0.01mg /kg, awake extubation, in a semi-sitting position, was done when the patient can follow verbal commands, sustain head lift or hand grasp for 5seconds, and achieve tidal volume of more than 6 ml/kg and respiratory rate of less than 35 breaths/min, with stable hemodynamics. Then, the patient was transferred to the PACU. Postoperative analgesia was prescribed in the form of 100ml vial paracetamol (1000mg) IV 8 hrs after the operation and every 8 hrs.

Visual analogue score (VAS), 1-10 was recorded at 1, 2, 4, 6, 12, 18 and 24 hours during rest, BP were monitored at the time interval. Patients with VAS score or > 4 at any point of time, received 2 mg morphine intravenous and to be repeated after 30 minutes if VAS remains >3 (until a maximum dose of 4 mg /hr.

Outcomes The primary outcome measure of the study was visual analogue scale (VAS) and effect on hemodynamic (HR and BP) at time interval 1, 2, 4, 6, 12, 18 and 24 h postoperatively. The secondary outcome was requirement of rescue analgesia when VAS score ≥4, total dose of morphine received in 24 h were noted in both groups postoperatively.

Ethical Considerations: Permission was obtained from the department of anesthesia and the ethical committee at Al-Azhar university. An informed verbal consent from every participant was taken and confidentiality of information were assured.

Statistical presentation:

Analysis of the present study was conducted, using the mean, standard Deviation, unpaired student t-test and chi-square tests by (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.). Unpaired Student T-test was used to compare between two groups in quantitative data, Chi-square test was used to compare between groups in qualitative data.

Significant level:

- >0.05 non-significant
- <0.05* significant
- <0.001* High significant.

RESULTS

Among the 60 cases enrolled in the study, there was no significant differences between the two studied groups with respect of basic characteristics (namely age, body mass index (BMI& ASA) **(Table 1)**.

Table (1): Comparison between two groups according to demographic data

	TAP (N=30)		**LWI (N=30)**		**P-value**
Age	53.97±	4.10	54.23±	3.13	> 0.05
BMI	33.93±	2.89	35.03±	2.17	> 0.05
ASA					> 0.05
I	18	60	15	50	
II	12	40	15	50	

●: Independent t-test *: Chi-square test

This table shows no statistically significant difference between groups regarding demographic data.

Heart Rate (beats/min):
Heart rates compared between the two studied groups are shown in (Table 2). There was significant difference between groups as regarding heart rate [HR] at 12,18 & 24 hrs monitored in beats per minute at fixed times interval post-operatively.

Table (2): Comparison between two groups as regards heart rate

Heart rate (Beat/min)	**Groups**						**P-value**
	TAP (N=30)			**LWI (N=30)**			
	Mean	±	SD	Mean	±	SD	
1hr.	71.33	±	4.64	72.43	±	5.09	> 0.05
2hrs.	71.87	±	4.85	72.93	±	5.04	> 0.05
4hrs.	71.77	±	4.65	73.13	±	4.89	> 0.05
6hrs.	72.00	±	4.78	73.07	±	4.71	> 0.05
12hrs.	75.83	±	8.24	81.80	±	6.41	< 0.05
18hrs.	77.60	±	7.16	85.67	±	6.93	<0.001*
24hrs.	78.43	±	7.10	86.93	±	7.41	<0.001*

●: Independent t-test

This table shows no statistically significant difference between two groups at time 1-6 hrs. post operatively where P value >0.05 and statistically highly significant difference between two groups according to heart rate at 12, 18, & 24hrs postoperatively where P value < 0.001.

Arterial Blood Pressure (ABP):

Arterial blood pressure (systolic and Diastolic) was compared between the studied groups and shown in **(Table 3 &4)**. There was no statistically significant difference between the studied groups regarding ABP.

Table (3): Comparison between two groups according to systolic blood pressure

Systolic BP (mmHg)	Groups						P-value
	TAP (N=30)			LWI (N=30)			
	Mean	±	SD	Mean	±	SD	
1hr.	134.00	±	10.37	130.67	±	9.35	> 0.05
2hrs.	134.50	±	10.20	133.00	±	9.06	> 0.05
4hrs.	135.83	±	10.01	134.50	±	9.32	> 0.05
6hrs.	134.00	±	11.02	131.17	±	8.78	> 0.05
12hrs.	133.67	±	9.99	132.83	±	8.68	> 0.05
18hrs.	133.17	±	10.71	132.83	±	10.23	> 0.05
24hrs.	135.00	±	11.06	131.17	±	8.78	> 0.05

●: Independent t-test

This table shows no statistically significant difference between two groups according to systolic blood pressure (P value > 0.05).

Table (4): Comparison between two groups according to diastolic blood pressure

Diastolic BP (mmHg)	Groups						P-value
	TAP (N=30)			LWI (N=30)			
	Mean	±	SD	Mean	±	SD	
1hr.	81.17	±	5.83	81.17	±	4.29	> 0.05
2hrs.	80.67	±	5.53	81.50	±	5.44	> 0.05
4hrs.	81.50	±	6.32	82.50	±	5.21	> 0.05
6hrs.	82.50	±	6.53	82.17	±	4.86	> 0.05
12hrs.	83.17	±	4.45	81.17	±	4.29	> 0.05
18hrs.	83.50	±	4.94	82.83	±	4.49	> 0.05
24hrs.	82.50	±	4.69	83.17	±	4.82	> 0.05

●: Independent t-test

This table shows no statistically significant difference between two groups according to diastolic blood pressure (P value > 0.05).

Assessment of pain:

Pain score was compared between the two studied groups using the visual analogue scale (VAS) and the results are displayed in **(Table 5)**.

There was statistically significant difference between the studied groups regarding VAS at 6,12,18& 24 hrs postoperatively.

Table (5): Comparison between two groups according to VAS

VAS	Groups						P-value
	TAP (N=30)			LWI (N=30)			
	Mean	±	SD	Mean	±	SD	
1hr.	1.43	±	0.50	1.37	±	0.49	> 0.05
2hrs.	1.60	±	0.72	1.43	±	0.50	> 0.05
4hrs.	1.57	±	0.63	1.93	±	0.83	> 0.05
6hrs.	2.00	±	0.83	4.10	±	0.96	<0.001*
12hrs.	4.03	±	0.93	6.13	±	0.90	<0.001*
18hrs.	4.20	±	1.52	6.50	±	1.01	<0.001*
24hrs.	4.03	±	0.93	6.83	±	1.39	<0.001*

●: Independent t-test

This table shows no statistically significant difference between two groups according to VAS at time 1-4 hrs. post operatively, and highly significant difference between two groups according to VAS at 6, 12, 18hrs and 24hrs, postoperatively where P value < 0.001.

Total morphine consumption:

Morphine consumption during first 24 hours postoperatively was compared between the studied groups regarding the total dose required, and shown in **(Table 6)**.

Table (6): Comparison between TAP group and LWI group regarding total dose of morphine during first 24 hours

Groups	Morphine consumption						
	Range			Mean	±	SD	P-value
TAP	4	-	12	8.60	±	1.94	<0.001*
LWI	9	-	14	12.23	±	1.28	

●: Independent t-test

This table shows highly significant difference between groups according to total dose of morphine consumption during highly significant difference between groups according to total dose of morphine consumption during first 24 hours postoperatively (P-value <0.001).

As regard total doses of rescue analgesia, higher total dose of Morphine (with mean 12.23 ± 1.28) was given to patients of LWI group than total dose of morphine (with mean 8.60 ± 1.94) given to patients of TAP block group.

DISCUSSION

Cholecystectomy is one of the most common major surgical procedures performed. The laparoscopic approach is increasingly used, as it is associated with reduced postoperative pain and morbidity, as well as earlier recovery and a shorter hospital stay when compared with open Cholecystectomy.

Laparoscopic Cholecystectomy may cause different types of pain that result from various perioperative predicaments, including pneumoperitoneum, stretching of the intra-abdominal cavity, blood left in the abdomen, and dissection of the pelvic region. Moreover, patients undergoing laparoscopic approaches, that have the reputation of being less painful, were found to receive inadequate pain relief and experience high levels of postoperative pain rather than aggressive major surgeries As such, the postoperative pain after laparoscopic Cholecystectomy is often difficult to control, which leads to increased opioid use and delayed discharge from hospital, despite being a minimally invasive laparoscopic surgery *(Mario et al., 2013).*

A significant proportion of pain experienced by patients undergoing abdominal surgeries is related to somatic pain signals derived from the abdominal wall *(Shian et al., 2018).*

A variety of unwanted post operative consequences following poorly controlled pain after abdominal surgery includes prolonged hospital stay besides patient suffering and distress, respiratory complications, delirium, myocardial ischemia, prolonged hospital stay and an increased likelihood of chronic pain.

The benefits of good postoperative analgesia include a reduction in the postoperative stress response and morbidity, better patient satisfaction and improved outcome *(Mishra et al., 2016).*

In this study, 60 female patients scheduled for laparoscopic Cholecystectomy surgery. They were divided into 2 groups: TAP group: (n=30) patients of this group received TAP block performed by ultrasound guidance and LWI group (n=30) patients of this group received wound infiltration of local anesthetic (ropivacaine).

We found that there was statistically significant difference between two groups according to pain score (VAS) at 6hrs, 18hrs and 24 hrs postoperatively. There was a highly significant delay in the time of requirement of rescue analgesia among supplied by TAP group patients. Also, there was a statistical difference in postoperative morphine consumption between 2 groups. The mean morphine consumption was 8.2 mg in the TAP group while was 12.2 mg in the LWI group.

The results of our study agree with *(Noueeldin et al., 2018).* They concluded that TAP block is more effective in reduction of both pain scores in the early postoperative period and cumulative meperidine consumption than trocar site local anesthetic infiltration in surgical laparoscopy.

In contrary to our results, demonstrated that bilateral US-guided TAP block did not reduce morphine consumption or pain scores at rest or movement during the first 24 hours after laparoscopic hysterectomy compared with control group which received morphine patient-controlled analgesia.

Transversus abdominis plane (TAP) block, first documented by *Rafi in 2001,* is used for the Discussion 88 management of post operative abdominal pain *(Aveline et al., 2011)*. The advantages of TAP block include simple and effective analgesic technique, appropriate for surgical procedures where parietal peritoneum is a significant component of postoperative pain, very minimal complication rate and can be performed even if neuraxial techniques are contraindicated. In surgeries where TAP block alone may not be adequate, it may be used as part of a multimodal pain regimen *(Chin et al., 2017)*. TAP block is both effective and safe post operative analgesic modality in a variety of procedures including general surgeries and decreases opioid (e.g.pethedine) consumption after lower abdominal *(Petersen et al., 2013)*.

The anterior abdominal wall components are supplied by sensory neurons derived from the anterior rami of spinal nerves T6 to L1, which include intercostal nerves T6 to T11, subcostal nerve T12 and ilioinguinal and iliohypogastric nerves L1. These neurons traverse through the neurofascial plane between the internal oblique and the transversus abdominis muscles.

The efficacy of ultrasound-guided TAP block by subcostal approach for providing analgesia after robot-assisted laparoscopic abdominal cancer surgery *(Mahran et al., 2016)*. 30 patients scheduled for robot-assisted laparoscopic abdominal cancer surgery (Cholecystectomy, colorectal cancer resection, or cystectomy) received general anesthesia. They found that TAP block is an effective and safe method for providing analgesia that markedly reduces morphine consumption.

Regarding the approach of TAP block *(Yoshiyama et al., 2016)* found that the posterior TAP block could provide more effective analgesia than the lateral TAP block in patients undergoing laparoscopic gynecologic surgery. The injection site of the posterior TAP block in this study was the lumbar triangle of Petit, but several other approaches of the posterior TAP blocks including quadratus lumborum blockade have been reported in recent years. The difference among these posterior TAP blocks is still not known in detail, which needs further investigations.

We did not encounter any complication with TAP block in our study. Most of the other studies have also not reported any complication with TAP block. The advantage of TAP block is the safety profile of the block. However, the incidence of colon and liver injury has also been reported *(Young et al., 2012)*.

On the other hand, the use of wound infiltration by local anesthetics during laparoscopic surgery to decrease postoperative pain dates back to the early 1990s. The general surgery literature first reported use of wound infiltration by local anesthetics for minimally invasive cholecystectomies *(Marta Dec et al., 2016)*. A meta-analysis of 30 studies of laparoscopic cholecystectomies showed a decrease in the amount of narcotics used

postoperatively as well as decreased postoperative pain scores.

This randomized controlled study: aimed to assess degree of pain control, duration of postoperative analgesia, the effect on postoperative analgesic requirements and associated side effects in patients undergoing laparoscopic Cholecystectomy and compare between transversus abdominis plane block and wound infiltration by local anesthetics.

CONCLUSION

This study demonstrated that transversus abdominis plane block provides better postoperative pain control & reduce postoperative opioid requirement in comparison with wound infiltration by local anesthetic in patients undergoing laparscopiccholecystectomy.

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دراسة مقارنة بين تسكين المسارات العصبية علي العضلة المستعرضة الباطنية وحقن المسكن الموضعي في تسكين الألم بعدعملية استئصال المرارة بالمنظار الجراحي

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خلفيـــة البحـــث: عمليـــات استئصـــال المـــرارة بالمنظـــار الجراحـــي أصـــبحت مـــن العمليـــات الاوسع انتشارا و التي تؤدي الى الم بجدار البطن بعد اجراء العملية.

الهـــدف مـــن البحـــث: دراســـة مقارنـــة بـــين تســـكين المســـارات العصـــبية علـــي العضـــلة المستعرضـــة الباطنيـــة وحقـــن المســـكن الموضـــعي فـــي تســـكين الألـــم بعـــد عمليـــة استئصال المرارة بالمنظار الجراحي.

المرضـــى و طـــرق االبحـــث: شـــملت الدراســـة 60 مريضـــا خضـــعوا لعمليـــة استئصـــال المـــرارة الجراحيـــة بالمنظـــار فـــي مستشـــفيات جامعـــة الازهـــر فـــي الفتـــرة مـــن اكتـــوبر 2020 الـــى ابريـــل 2021، و قـــد تراحـــت اعمـــارهم بـــين 18 الـــى 60، و معامـــل كتلـــة الجســـم مـــن 30 الـــى 38 كجـــم /م2، ولـــيس لـــديهم تـــاريخ مرضـــى لســـيولة الـــدم او حساســـية لـــدى المخـــدر الموضـــعي او اي عـــدوى بأمـــاكن حقـــن المخـــدر الموضـــعي، وقـــد تـــم تقســـيم المرضـــى الـــى مجمـــوعتين متســـاويتين (مجموعـــة أ و مجموعـــة ب)، مجموعـــة أ و هـــم مـــن تلقـــوا تســـكين المســـارات العصـــبية علـــى العضـــلة المستعرضـــة الباطنيـــة و مجموعـــة ب و هـــم مـــن تلقـــوا المخـــدر الموضـــعي. و قـــد تـــم تســـجيل معـــدل ضـــربات القلـــب و ضـــغط الـــدم الانقباضـــي و الانبســـاطي ومتوســـط ضـــغط الـــدم، و تـــم ايضـــا تســـجيل مســـتوى تشـــبع الاكســـجين و تقيـــيم معـــدل الام و توقيـــت الحاجـــه لاول جرعـــة مســـكن بعـــد العمليـــة لمـــدة 24 ســـاعة كـــالاتي: عنـــد الســـاعة 1،2،4،6 خـــلاول اول 6 ساعات ثم كل 6 ساعات خلال باقي ال24 ساعة.

نتـــائج البحـــث: أظهـــرت الدراســـة أن المرضـــى الـــذين تلقـــوا مخـــدر موضـــعي فـــى امـــاكن الجـــرح يحتـــاجون الـــى جرعـــة مـــورفين اعلـــى مـــن هـــؤلاء الـــذين تلقـــوا تســـكين للمســـارات العصبية على العضلة المستعرضة الباطنية.

الاســـتنتاج: تســـكين المســـارات العصـــبية علـــى العضـــلة المستعرضـــة الباطنيـــة تـــوفر تحكمًـــا أفضـــل فـــي الألـــم بعـــد الجراحـــة وتقلـــل مـــن متطلبـــات المـــواد المســـكنة بعـــد الجراحـــة مقارنـــةً بحقـــن الجـــرح بالمخـــدر الموضـــعي فـــي المرضـــى الـــذين يخضـــعون لاستئصال المرارة بالمنظار.

الكلمـــات الدالـــة: استئصـــال المـــرارة، المنظـــارالجراحي، تســـكين المســـارات العصـــبية على العضلة المستعرضة الباطنية، المخدر الموضعي.