Comparison between ultrasound guided Transversus abdominis plane block and local anesthetic instillation in patients undergoing laparoscopic hysterectomy

Original Article

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ABSTRACT

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

Aim: The aim of this study is to assess degree of pain control, duration of action, duration of postoperative analgesia, the effect on postoperative analgesic requirements in patients undergoing laparscopic hysterectomy and compare between Transversus abdominis plane block and intraperitoneal local anesthetics instillation.

Materials and Methods: This study enrolled 50 cases for laparoscopic hysterectomy. They were divided randomly into two groups : TAP group (n=25) patients of this group received TAP block performed by ultrasound guidance and IPLA group (n=25) patients of this group received intraperitoneal local anesthetic (bupivacaine) instillation. After surgery, visual analogue score (VAS) was recorded at 1, 2,4,6,12,18 and 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 = 0.048, 0.049*, and *0.003* at 6, 12, 18 and 24 hours after surgery) and total analgesic consumption (morphine in mg) was lower (8.36 ± 1.98 mg) in TAP group (8.2 mg) compared to IPLA (12.24 ± 1.33 mg).

Conclusion: TAP block provide better postoperative pain control and reduce postoperative opioid requirement in comparison with intraperitoneal local anesthetic instillation in patients undergoing laparscopic hysterectomy.

Key Words: Intraperitoneal analgesia, laparoscopic hysterectomy, pain after laparoscopy, TAP block

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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[1].

In experienced hands and in dedicated centers, laparoscopic hysterectomy for uteri weighing ≥ 1 kg is feasible and safe. Minimally invasive surgery retains its well-known advantages over open surgery even in patients with extremely enlarged uteri[2].

Ultrasound guided transversus abdominis plane (TAP) block can be used as an analgesic supplement in procedures involving the abdominal wall, laparoscopic surgery, abdominal hysterectomy, renal transplantation, and prostatectomy[3].

Recent studies suggested that Intraperitoneal instillation of local anesthetic significantly reduces pain intensity scores in the early postoperative period after laparoscopic hysterectomy surgery and helps in improving the postoperative recovery profile and outcome[4].

The mechanism of action of intraperitoneal instillation of local anesthetic is not fully understood, although it is likely that there is a blockade of free afferent nerve endings in the peritoneum. Systemic absorption of local anesthetic from the peritoneal cavity may also play a part in reduced nociception[5].

PATIENTS AND METHODS

This prospective randomized clinical trial study was conducted in Ain-Shams University Hospital after obtaining the approval from the Medical Ethical Committee in Ain-Shams University (FMASU M S 2722019/). It included

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fifty adult patients undergoing laparoscopic hysterectomy. The patients were randomly assigned to two equal groups ; group TAP which was given ultrasound guided TAP block and group IPLA in which intraperitoneal local instillation of local anesthetic was done.

Pre-operative Settings : Routine preoperative investigations were done to all patients including laboratory investigations as (complete blood picture, bleeding time, prothrombin time and partial thromboplastin time), age and weight were recorded. The patient was 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 intraperitoneal instillation 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 the 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.

At the end of surgery : Group TAP ; bilateral TAP block was done with 20 ml of 0.25% bupivacaine on each side (total volume of 40 ml of 0.25% bupivacaine) 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, 2 ml 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.

However, group IPLA in the operating room, after the end of the surgery and removal of the uterus and haemostasis, residual blood, fluid ; the surgeon installed 40 ml of 0.25% bupivacaine -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 5 seconds 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 100 ml 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, blood pressure and heart rate 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.).Total dose of morphine consumed during first 24 hours postoperatively were recorded.

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 hours were noted in both groups postoperatively.

STATISTICAL ANALYSIS

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc, Chicago, Illinois, USA). Quantitative data were expressed as mean ± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

RESULTS

Among the 50 cases enrolled in the study, there were no significant differences between the two studied groups with respect of basic characteristics; namely, age and body mass index (BMI and ASA) (Table 1). This table showed 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 the two studied groups regarding heart rate (HR) at 12,18 and 24 hours monitored in beats per minute at fixed times interval post-operatively. This table showed no statistically significant difference between the two groups at time 1-6 hours post-operatively where *p value > 0.05.* Also, statistically highly significant difference between the two studied groups according to heart rate at 12,18, and 24 hours postoperatively where *p value < 0.001* was illustrated in this table.

Arterial Blood Pressure (ABP) : Arterial blood pressure (systolic and diastolic) was compared between the two studied groups shown in Tables 3 and 4. There were no statistically significant differences between the two studied groups regarding ABP.

Table 3 showed no statistically significant difference between the two studied groups according to systolic blood pressure (*P value > 0.05*).

Table 4 showed no statistically significant difference between the two studied 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 two studied groups regarding VAS at 6, 12, 18 and 24 hours postoperatively.

Table 5 showed no statistically significant difference between the two studied groups according to VAS at time 1-4 hours post-operatively and highly significant difference between the two studied groups according to VAS at 6,12,18 hours and 24 hours, postoperatively where *P value < 0.001*.

Total Morphine Consumption : Morphine consumption during the first 24 hours postoperatively was compared between the two studied groups regarding the total dose required and shown in Table 6.

Table 6 showed highly significant difference between the two studied 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 12.24 ± 1.33) was given to patients of IPLA group than total dose of morphine (with mean 8.36 ± 1.98) given to patients of TAP block group.

Table 1: Comparison between two groups according to demographic data

		TAP (N = 25)	IPLA (N = 25)	Test value	*P- value*
Age	Mean±SD	53.96 ± 4.25	54.40 ± 3.14	-0.417•	0.679
	Range	47 – 60	51 – 59		
BMI	Mean±SD	34.40 ± 3.07	36.92 ± 1.50	-3.690•	0.072
	Range	32– 38	34 – 39		
ASA	I	15 (60.0%)	14 (56.0%)	0.082*	0.774
	II	10 (40.0%)	11 (44.0%)		

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

Table 2: Comparison between two groups as regards heart rate

Heart rate (beat/min)		TAP (N = 25)	IPLA (N = 25)	Test value•	*P- value*
Heart rate 1hr	Mean±SD	71.40 ± 4.73	73.12 ± 5.04	-1.244	0.219
	Range	65 – 77	65 – 80		
Heart rate 2hrs	Mean±SD	71.72 ± 4.85	73.44 ± 4.98	-1.236	0.222
	Range	65 – 80	65 – 80		

Heart rate 4hrs	Mean±SD	71.80 ± 4.86	73.56 ± 4.88	-1.277	0.208
	Range	65 – 80	65 – 80		
Heart rate 6hrs	Mean±SD	72.04 ± 5.05	73.52 ± 4.78	-1.065	0.292
	Range	65 – 80	65 – 80		
Heart rate 12hrs	Mean±SD	75.40 ± 8.05	81.56 ± 6.73	-2.937	0.005
	Range	65 – 90	72 – 92		
Heart rate 18hrs	Mean±SD	77.52 ± 6.76	85.08 ± 7.29	-3.802	0.000
	Range	65 – 90	72 – 99		
Heart rate 24hrs	Mean±SD	78.12 ± 6.70	86.04 ± 7.65	-3.894	0.000
	Range	65 – 90	72 – 99		

●: Independent t-test

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

SBP (mmHg)		TAP (N = 25)	IPLA (N = 25)	Test value•	*P- value*
Systolic BP 1hr	Mean±SD	134.00 ± 10.41	131.40 ± 9.95	0.903	0.371
	Range	120 – 150	120 – 150		
Systolic BP 2hrs	Mean±SD	134.60 ± 10.20	133.00 ± 9.57	0.572	0.570
	Range	120 – 150	120 – 150		
Systolic BP 4hrs	Mean±SD	135.60 ± 10.24	134.20 ± 9.86	0.492	0.625
	Range	120 – 155	120 – 150		
Systolic BP 6hrs	Mean±SD	134.00 ± 11.18	131.60 ± 9.43	0.820	0.416
	Range	120 – 150	120 – 150		
Systolic BP 12hrs	Mean±SD	133.60 ± 9.95	132.60 ± 9.37	0.366	0.716
	Range	120 – 150	120 – 150		
Systolic BP 18hrs	Mean±SD	133.00 ± 10.80	133.20 ± 10.89	-0.065	0.948
	Range	120 – 150	120 – 155		
Systolic BP 24hrs	Mean±SD	135.20 ± 11.22	131.60 ± 9.43	1.228	0.226
	Range	120 – 150	120 – 150		

●: Independent t-test

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

DBP (mmHg)		TAP (N = 25)	IPLA (N = 25)	Test value•	*P- value*
Diastolic BP 1hr	Mean±SD	81.00 ± 6.12	81.60 ± 4.50	-0.395	0.695
	Range	70 – 90	75 – 90		
Diastolic BP 2hrs	Mean±SD	80.40 ± 5.76	82.00 ± 5.40	-1.013	0.316
	Range	70 – 90	70 – 90		
Diastolic BP 4hrs	Mean±SD	81.40 ± 6.70	82.40 ± 5.02	-0.597	0.553
	Range	70 – 95	75 – 90		
Diastolic BP 6hrs	Mean±SD	81.80 ± 6.60	82.20 ± 4.80	-0.245	0.807
	Range	70 – 90	75 – 90		
Diastolic BP 12hrs	Mean±SD	82.80 ± 4.58	81.60 ± 4.50	0.934	0.355
	Range	70 – 90	75 – 90		
Diastolic BP 18hrs	Mean±SD	83.20 ± 5.18	82.60 ± 4.59	0.433	0.667
	Range	70 – 95	75 – 90		
Diastolic BP 24hrs	Mean±SD	82.60 ± 4.81	82.80 ± 4.80	-0.147	0.884
	Range	70 – 90	75 – 90		

●: Independent t-test

Table 5: Comparison between two groups according to VAS

Visual analogue score (VAS)		TAP (N = 25)	IPLA (N = 25)	Test value•	*P- value*
VAS 1hr	Mean±SD	1.40 ± 0.50	1.36 ± 0.49	0.286	0.776
	Range	1 – 2	1 – 2		
VAS 2hrs	Mean±SD	1.48 ± 0.65	1.44 ± 0.51	0.242	0.810
	Range	1 – 3	1 – 2		
VAS 4hrs	Mean±SD	1.56 ± 0.65	1.80 ± 0.82	-1.149	0.256
	Range	1 – 3	1 – 3		
VAS 6hrs	Mean±SD	2.08 ± 0.86	4.12 ± 1.01	-7.667	0.000
	Range	1 – 3	2 – 6		

VAS 12hrs	Mean±SD	4.08 ± 1.00	6.04 ± 0.93	-7.173	0.000
	Range	2 – 6	4 – 7		
VAS 18hrs	Mean±SD	4.28 ± 1.65	6.48 ± 1.08	-5.580	0.000
	Range	2 – 8	5 – 9		
VAS 24hrs	Mean±SD	4.08 ± 1.00	6.64 ± 1.38	-7.516	0.000
	Range	2 – 6	4 – 9		

●: Independent t-test

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

		TAP (N = 25)	IPLA (N = 25)	Test value•	*P- value*
Morphine consumption	Mean±SD	8.36 ± 1.98	12.24 ± 1.33	-8.140	0.000
	Range	4.00 – 12.00	9.00 – 14.00		

●: Independent t-test

DISCUSSION

Laparoscopic hysterectomy 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 hysterectomy is often difficult to control, which leads to increased opioid use and delayed discharge from hospital, despite being a minimally invasive laparoscopic surgery[7].

A significant proportion of pain experienced by patients undergoing abdominal surgeries is related to somatic pain signals derived from the abdominal wall[8].

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[9].

In this study, 50 female patients scheduled for laparoscopic hysterectomy surgery. They were divided into 2 groups ; TAP group (n=25) patients of this group received TAP block performed by ultrasound guidance and IPLA group (n=25) patients of this group received intraperitoneal local anesthetic (bupivacaine).

This study revealed a statistically significant difference between the two studied groups according to pain score (VAS) at 6 hrs, 18 hrs 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 8.36 mg in the TAP group, while it was 12.24 mg in the IPLA group.

The results of this study agrees with the study of Noureldin *et al*.[10]. 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 gynecologic laparoscopy.

In contrary to these results, Ghisi *et al.*[11] 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 described by Kuppuvelumani *et al.* in 1993 and formally documented by Rafi in 2001 is used for the Discussion 88 management of post-operative abdominal pain[12].

The advantages of TAP block included 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[13]. TAP block is both effective and safe post-operative analgesic modality in a variety of procedures including general surgeries and decreases opioid (e.g. pethidine) consumption after lower abdominal[14].

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 neuron fascial plane between the internal oblique and the transversus abdominis muscles[15].

The efficacy of ultrasound-guided TAP block by subcostal approach for providing analgesia after robot-assisted laparoscopic abdominal cancer surgery was studied by Mahran and Hassan[16]. Thirty patients scheduled for robot-assisted laparoscopic abdominal cancer surgery (hysterectomy, 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[17] 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.

This study 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[18].

On the other hand, the use of intraperitoneal local anesthetics during laparoscopic surgery to decrease postoperative pain dates back to the early 1990s. The general surgery literature first reported use of intraperitoneal local anesthetics for minimally invasive cholecystectomies[19]. 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[20].

Retrospective cohort study showed that the administration of intraperitoneal bupivacaine was associated with decreased postoperative narcotic use and a trend toward decreased patient-reported pain scores in patients undergoing minimally invasive surgery, including major procedures such as hysterectomy and cancer staging procedures[21].

The reported effect of intraperitoneal local anesthetics has been mixed in the gynecologic literature. A meta-analysis of seven randomized controlled trials performed in gynecologic surgery patients showed an association between the use of intraperitoneal local anesthetics and decreased pain scores initially[22].

Badawy in 2015[23] studied instillation of intraperitoneal local analgesia prior removal of trocars in cases of laparoscopic hysterectomy as compared to control group (in which instillation of intraperitoneal normal saline was used). Intraperitoneal local anesthetic was associated with significant reduction of overall pain scores during the first 24 hours following surgery. This was reflected on the reduction of postoperative analgesia and opioid requirements. There was also reduction in the incidence of postoperative nausea and vomiting.

CONCLUSION

This study demonstrated that transversus abdominis plane block provide better postoperative pain control and reduce postoperative opioid requirement in comparison with intraperitoneal local anesthetic instillation in patients undergoing laparoscopic hysterectomy.

CONFLICT OF INTEREST

There are no conflicts of interests.

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