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Evaluation of postoperative pain on Transversus Abdominis Plane block and Erector Spinae Plane block in patients undergoing gynecological surgery: a prospective, comparative study

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Abstract

INTRODUCTION: Moderate to severe pain after gynecological surgery has an impact on postoperative recovery and mobilization. Transversus Abdominis Plane (TAP) block and Erector Spinae Plane (ESP) block have been used as multimodal analgesia for abdominal surgery. **OBJECTIVES:** This study aims to compare postoperative pain in patients undergoing either ESP blocks or TAP blocks, and the need for postoperative morphine in patients undergoing gynecological surgery. **MATERIALS AND METHODS:** This was a single-center, prospective, double-arm, comparative study. Forty subjects were enrolled in this study, and classified into two groups. One group of 20 subjects underwent ESP block, and the remaining 20 subjects underwent TAP block following a gynecologic surgical procedure. Patients were then assessed using with the Numeric Rating Scale (NRS) pain score which will be observed at intervals of 0–1 hour, 1–6 hours, 6–12 hours, and 12–24 hours. Numerical data analysis was done using an unpaired T-test on normally distributed data and the Mann-Whitney test on non-normally distributed data. Categorical data analysis was done using Fisher's Exact Test. **RESULTS:** NRS score at rest was higher in the TAP block group at 1–6 hours and 6–12 hours (pain scale 3) than in the ESP block group (pain scale 1). Movement-evoked pain NRS score was higher in the TAP block groups significantly. **CONCLUSION:** ESP block results in a lower postoperative pain score NRS value and reduces the need for morphine in post-gynecological surgery patients with a median incision compared to the TAP block.

Оценка послеоперационной боли в условиях ТАР-блока и ESP-блока у пациенток гинекологического профиля: проспективное сравнительное исследование

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Реферат

ВВЕДЕНИЕ: Умеренная или сильная боль после гинекологических операций влияет на послеоперационное восстановление и мобилизацию. Блокада поперечной плоскости живота (ТАР-блок) и межфасциальная блокада мышцы, выпрямляющей спину (ESP-блок), использовались в качестве мультимодальной анальгезии при абдоминальной хирургии. **ЦЕЛЬ:** Целью данного исследования является сравнение послеоперационной боли у пациенток, перенесших либо ESP-блок, либо ТАР-блок, и потребность в послеоперационном морфине у пациенток, перенесших гинекологическую операцию. **МАТЕРИАЛЫ И МЕТОДЫ:** Одноцентровое проспективное двухгрупповое сравнительное исследование. В исследование вошли 40 субъектов, разделенных на две группы. В одной группе применяли ESP-блок (n = 20), у остальных 20 пациенток применяли ТАР-блок после гинекологической операции. Интенсивность боли оценивали по числовой рейтинговой шкале (ЧРШ) оценки боли в интервалах 0–1 ч, 1–6 ч, 6–12 ч и 12–24 ч. Статистический анализ проводился с использованием непарного Т-критерия для нормально распределенных данных и теста Манна–Уитни для ненормально распределенных данных. Категориальный анализ данных проводился с использованием точного критерия Фишера. **РЕЗУЛЬТАТЫ:** Оценка ЧРШ в состоянии покоя была выше в группе ТАР-блока через 1–6 ч и 6–12 ч (оценка боли — 3 балла), чем в группе блокады ESP-блока (оценка боли — 1 балл). Оценка по ЧРШ боли, вызванной движением, была значительно выше в группах ТАР-блока. **ВЫВОД:** ESP-блокада приводит к более низкому значению оценки послеоперационной боли по ЧРШ и снижает потребность в морфине у пациентов после гинекологических операций со срединным разрезом по сравнению с ТАР-блоком.

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KEYWORDS: nerve block, pain, postoperative, ESP block, TAP block, bupivacaine, analgesia, morphine

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Introduction

Pain is one of the most common complaints experienced by postoperative patients which can be very disturbing. Women generally complain of postoperative pain more than men [1]. Gynecology surgery is one of the most frequently performed types of surgery, in which 4.7–26.2 % of women will experience chronic postoperative pain after undergoing those surgeries [2]. Gynecological surgery such as hysterectomy, laparotomy, and salpingoophorectomy were done with a median incision and usually result in moderate to severe grade of postoperative pain [3, 4].

Management of moderate to severe pain generally uses opioids as analgesics despite the considerable amount of side effects of the opioids that affect comfort and recovery such as nausea, vomiting, allergies, pruritus, and constipation [5, 6]. Regional analgesia is an alternative that can be done to reduce the side effects of opioid drugs [7].

Regional analgesia that can be used to manage postoperative pain in the abdominal area includes the transversus abdominis plane (TAP) block and erector spinae plane (ESP) block. TAP block was first introduced in 2001 and has been used in various surgical interventions. TAP block is a regional block with local anesthetic injection between the transversus abdominis and internal oblique muscles. TAP block acts on the sensory nerves from the anterolateral abdominal wall (T6-L1) that innervate the abdomen. TAP block is a relatively simple technique and can reduce postoperative pain and consumption of opioids, and has been extensively developed and studied in the context of open and laparoscopic hysterectomy [8, 9, 10]. Surgeries that often use this type of analgesia include cesarean section, laparoscopic cholecystectomy, hysterectomy, colorectal resection, appendectomy, inguinal hernia, prostatectomy, and bariatric surgery. Cesarean section is the ideal type of surgery to research TAP block because the conventional Pfannenstiel incision is located in the area of anesthesia with the lateral approach, the most commonly used site of incision [11, 12].

ESP block is a new method in the interfascial place that is used for postoperative pain and chronic neuropathic pain in the thoracoabdominal region [13]. ESP blocks were originally used for the management of acute and chronic chest pain, however, there has been an expansion in their scope of use after it was recognized that the muscles and the erector spinae plane extend from the cervico-thoracic to the lumbar vertebrae, making it possible for the anesthesiologist to block the spinal nerves innervating areas starting from shoulder girdle to the hip and proximal lower extremity targeting the appropriate vertebral level. ESP blocks have been used in breast, thoracic and cardiac, upper extremity, lower extremity, spine, and abdominal surgeries [14].

The ESP block has a widespread effect reaching three vertebral levels cranially and four vertebral levels caudally. ESP blocks provide extensive somatic and visceral analgesia and thus have an effect comparable to retrolaminar and paravertebral blocks [15]. Another advantage of ESP blocks is that the erector spinae muscles consist of muscles and tendons that stretch through the cervical, thoracic, and lumbar regions, and a single injection as much as 20–30 ml in adults can block several dermatomes so that the anesthetic effect can reach a point that is quite distant from the operating area [16].

This study aims to compare postoperative pain in patients undergoing either ESP blocks or TAP blocks, and the need for postoperative morphine in patients undergoing gynecological surgery.

Materials and methods

We conducted a single-center, prospective, double-arm, comparative study at Dr. Hasan Sadikin Bandung Hospital (RSHS) from December 27, 2022 until March 26, 2023. The research was conducted after obtaining a research clearance from the Ethics and Research Committee of RSUP Dr. Hasan Sadikin / Padjadjaran University No. LB.02.02/X.2.2.1/27051/2022. This study is registered in the National Library of Medicine Clinical Trials database with ID number NCT06044779.

The research sampling technique was carried out by consecutive sampling, namely by taking each research subject who met the inclusion and exclusion criteria based on the order of patient arrival. The subjects of the study were patients who underwent gynecological surgery with a median incision including hysterectomy, myomectomy, salpingectomy, ovarectomy, and ovarian cystectomy with physical status of ASA I-II (American Society of Anesthesiologists). Research subjects were excluded from the study if they had a history of allergies to local anesthetic drugs used for TAP blockade or ESP blockade and were allergic to morphine, had skin infections at the injection site, history of chronic pain, i.e. history of pain for more than 1 month and history of chronic pain medication consumption, impaired renal (urea > 39 mg/dL, creatinine > 1.3 mg/dL) and liver function (SGOT > 37 U/L; SGPT > 59 U/L), myopathy, coagulopathy, cardiac rhythm disturbances obtained from the results of the EKG examination, and neurological disorders in the form of hypesthesia or paraesthesia obtained from the results of the physical examination in the form of sensory examinations, pregnant, illiterate, uncooperative patients, and if the surgical procedure lasted more than 4 hours .

The primary outcome of this study was total morphine consumption in the first 24 hours, and the secondary outcomes were NRS pain scores at several postoperative time points.

Procedures

Patients who will be operated on and are already in the operating room, are re-examined and monitored, and data regarding blood pressure, pulse rate, and respiratory rate were recorded. All patients were induced intravenously using fentanyl 2 μg/kgBW, propofol 2 mg/kgBW, and atracurium 0.5 mg/kgBW. After the patient fell asleep, intubation was performed using a 7.0-millimeter endotracheal tube and given maintenance anesthesia in the form of sevoflurane gas 1–2 volume percent (vol%) and the fraction of inspired oxygen was 0.5 (oxygen 1 liter per minute: air 2 liters per minute). Blood pressure and heart rate were measured every 3 minutes until the operation was completed.

A median incision was performed for all patients because the surgeon required sufficient exposure to the operative field to remove large masses. After the operation was completed, each group received TAP block anesthesia with 20 mL of 0.25 % bupivacaine, and the other group received ESP block anesthesia with 20 mL of 0.25 % bupivacaine. After extubation, patients were observed at the Post Anesthetic Care (PACU), and blood pressure, pulse rate, and oxygen saturation were monitored. Assessment to find out whether TAP or ESP blocks work postoperatively was done with a pinprick test. The pinprick test is one of the stimulus modalities to assess the presence or absence of sensory block in the anesthetized area. The patient will be given a pain stimulus with a needle on the innervation area that was blocked by a TAP block or ESP block, then compared with the area outside the blocked innervation. Pain stimulus is given from distal to proximal. The patient will be asked whether they feel a sharp or dull sensation. TAP or ESP block is considered to be working if the patient does not feel a sharp sensation in the innervation area that is blocked by TAP block or ESP block.

Patients will be asked to rate their pain with a Numeric Rating Scale (NRS). The pain scale will be evaluated at intervals of 0–1 hour, 1–6 hours, 6–12 hours, and 12–24 hours at rest, that is, when the patient is not doing any activity; and when mobile, that is, when the patient is mobilizing, such as turning left or right. The duration of analgesia will be calculated until the patient requires morphine, that is, if the NRS is > 3 using the Patient Controlled Analgesia (PCA) and the total postoperative need of analgesic is calculated. The total amount of morphine needed for 24 hours postoperatively is calculated in units of mg dose. The scores expressed by the patient and the time will be recorded and analyzed. If the patient feels worsening pain outside of the data collection time, the patient is asked to report it to the nurse on duty so that they can contact the researcher. The patient will be monitored while in the PACU room for 2 hours and then transferred to a general ward. Previously the patient and family will be given informed consent regarding the use of the PCA tool.

Table 1. Patient Characteristics of TAP Block and ESP Block

Variables	Groups		*p*-value
	TAP Block *n* = 20	ESP Block *n* = 20	
Age			**0.105**
Mean ± Std	56.20 ± 5.136	53.20 ± 6.246	
Median	57.50	53.50	
Range (min-max)	47.00–64.00	36.00–63.00	
Weight			**0.117**
Mean ± Std	54.51 ± 7.266	50.75 ± 7.555	
Median	56.95	50.85	
Range (min-max)	37.20–65.50	36.40–62.00	
Height			**0.434**
Mean ± Std	153.45 ± 5.165	152.15 ± 5.224	
Median	153.00	152.00	
Range (min-max)	145.00–162.00	145.0–162.00	
BMI			**0.344**
Mean ± Std	23.37 ± 4.315	22.09 ± 4.085	
Median	24.18	22.20	
Range (min-max)	14.17–30.72	14.20–28.69	
Level of education			**0.465**
≤ High school	14	16	
Postgraduate	6	4	
Type of operation			**1.000**
Total histerectomy	12	12	
Salpingoophorectomy	8	8	
ASA Status			**1.000**
1	14	14	
2	6	6	
Duration of operation			**0.105**
Mean ± Std	96.90 ± 39.079	118.35 ± 42.653	
Median	96.50	121.00	
Range (min-max)	30.00–168.00	51.00–214.00	

Note: for numerical data, the *p*-value is tested with an unpaired T-test if the data is normally distributed, and with the alternative Mann-Whitney test if the data is not normally distributed. Categorical data *p*-value is calculated based on the Chi-Square test with alternative Kolmogorov Smirnov and Exact Fisher tests if the Chi-Square conditions are not met.

Statistical Analysis

The required sample size was obtained by the formula for determining the sample size for an unpaired numerical comparative analytic study of 2 groups. At least 16 people for each group were determined to achieve an 80 % power, with a type I error of 5 % level. The expected difference was 50 % between the two groups and the effect size was 0.5. We included more than 16 patients per group to compensate for excluded patients.

Data analysis includes descriptive analysis and hypothesis testing. Data with a numerical scale such as the patient's age, weight, height, body mass index (BMI), etc. are presented with the mean, standard deviation, median, and range. Then for the data on patient characteristics in the

Table 2. Comparison of Rest NRS in TAP Block and ESP Block Groups

Variables	Groups		*p*-value
	TAP Block *n* = 20	ESP Block *n* = 20	
Rest NRS 0–1 hour			**0.201**
Mean ± Std	0.65 ± 0.933	0.20 ± 0.410	
Median	0.00	0.00	
Range (min-max)	0.00–3.00	0.00–1.00	
Rest NRS 1–6 hours			**0.004***
Mean ± Std	1.40 ± 1.046	0.45 ± 0.510	
Median	1.00	0.00	
Range (min-max)	0.00–3.00	0.00–1.00	
Rest NRS 6–12 hours			**0.0001****
Mean ± Std	2.75 ± 0.639	1.20 ± 0.523	
Median	3.00	1.00	
Range (min-max)	2.00–4.00	0.00–2.00	
Rest NRS 12–24 hours			**0.068**
Mean ± Std	4.35 ± 0.745	3.85 ± 0.813	
Median	4.50	4.00	
Range (min-max)	3.00–5.00	3.00–5.00	

Note: for numerical data, the *p*-value is tested with an unpaired T-test: * if the data is normally distributed and with the alternative Mann–Whitney test, ** if the data is not normally distributed.

form of categorical data, codes were assigned and presented as frequency distributions and percentages.

Statistical analysis begins with the analysis of the characteristics of the two groups, to test whether the two groups are homogeneous so that they are feasible to be compared or not. If there are significant confounding variables, an analysis of covariance is performed through binary logistic regression analysis.

A statistical analysis to compare the mean of numerical variables between the 2 groups was done with the unpaired t-test if the data is normally distributed, and the Mann-Whitney test if the data is not normally distributed. For numerical data, before the statistical test is done, the numerical data is assessed by a normality test using the Shapiro-Wilk test if the data is less than 50, with an alternative of Kolmogorov Smirnov if the data is more than 50, where this test is used to test whether the data is normally distributed. Statistical analysis for categorical data was done with the Chi-square test if the Chi-Square conditions were met, if not met then Fisher's Exact test was used for tables 2 × 2 and Kolmogorov Smirnov for tables other than 2 × 2. The Chi Square requirement is that there is no expected value which is less than 5 as much as 20 %.

The significance criteria used is the p-value, in which $p \leq 0.05$ is statistically significant or significant, and $p > 0.05$ is not significant or statistically insignificant.

Results

This study included 40 patients who met the inclusion and exclusion criteria. The characteristics of the subjects of the study subjects based on age, level of education, type of surgery, physical status, body mass index (BMI), and duration of surgery did not show significant differences or were not statistically significant ($p > 0.05$; table 1).

The TAP block group had an average age of 56.2 ± 5.12 years old and consisted of 14 patients with the level of education of high school and 6 patients with university education level. The average BMI is 23.37 ± 4.31 kg/m^2. A total of 12 patients underwent hysterectomy and 8 patients underwent salphyngoophorectomy, 14 patients with ASA status 1, and 6 patients with ASA status 2. The average duration of surgery in this group was 96.9 ± 39.08 minutes.

The ESP block group had an average age of 53.2 ± 6.25 years old and consisted of 16 patients with the level of education of high school and 4 patients with university education level. The average BMI is 22.09 ± 4.09 kg/m^2. The type of operation and physical status of this group are similar to the TAP block group. A total of 12 patients underwent hysterectomy and 8 patients underwent salphyngoophorectomy, 14 patients had ASA status 1 status and 6 patients had ASA status 2. The average duration of surgery in this group was 118.35 ± 42.65 minutes.

Table 3. Comparison of Mobile NRS in the TAP Block and ESP Block Groups

Variables	Groups		*p*-value
	TAP Block *n* = 20	ESP Block *n* = 20	
Mobile NRS 0–1 hour			**0.040***
Mean ± Std	0.90 ± 1.165	0.10±0.308	
Median	0.00	0.00	
Range (min-max)	0.00–3.00	0.00–1.00	
Mobile NRS 1–6 hours			**0.030***
Mean ± Std	2.70 ± 1.081	1.80 ± 1.281	
Median	3.00	1.50	
Range (min-max)	1.00–4.00	0.00–4.00	
Mobile NRS 6–12 hours			**0.758**
Mean ± Std	3.75 ± 0.550	3.70 ± 0.657	
Median	4.00	4.00	
Range (min-max)	3.00–5.00	3.00–5.00	
Mobile NRS 12–24 hours			**0.659**
Mean±Std	4.20 ± 0.894	3.90 ± 1.373	
Median	4.00	4.00	
Range (min-max)	2.00–5.00	1.00–6.00	

Note: for numerical data, the *p*-value is tested with an unpaired T-test: * if the data is normally distributed and with the alternative Mann–Whitney test, ** if the data is not normally distributed.

Table 4. Comparison of Morphine Needs in TAP Block and ESP Block Groups

Variables	Groups		*p*-value
	TAP Block *n* = 20	ESP Block *n* = 20	
Time needed until the first dose of morphine (hour)			**0.007***
Mean ± Std	9.50 ± 1.504	10.75 ± 1.164	
Median	9.00	11.00	
Range (min-max)	8.00–12.00	8.00–12.00	
Total morphine consumption in 24 hours (mg)			**0.002***
Mean ± Std	4.85 ± 0.813	3.85 ± 0.933	
Median	5.00	4.00	
Range (min-max)	4.00–6.00	2.00–6.00	

Note: for numerical data, the p-value is tested with an unpaired T-test: * if the data is normally distributed and with the alternative Mann-Whitney test, ** if the data is not normally distributed.

Comparison of rest and mobile NRS in the two groups is shown in table 2 and table 3. The average time needed for the first dose of morphine in the TAP block group was 9.5 ± 1.5 hours, while in the ESP block group, the average time needed was 10.75 ± 1.16 hours. The total consumption of morphine within 24 hours was 4.85 ± 0.81 mg in the TAP block group and 3.85 ± 0.93 in the ESP block group. Based on the results of the analysis, it was found that the average time to the first dose of morphine and the total amount of morphine consumed in 24 hours was significant in both groups ($p < 0.05$; table 4). From the data gathered on this study, there was no additional intraoperative administration of analgesics which affected the prolongation of the duration of postoperative analgesia.

Discussion

Data on the characteristics of the subjects based on the age, education level, type of surgery, ASA status, BMI, and duration of surgery between the TAP block and ESP block groups did not show significant differences ($p > 0.05$) so the two groups were considered homogeneous and fit for comparison.

Several studies have shown different results regarding the effect of a patient's age on pain. One study found that older adults were more sensitive to experimental pain than younger adults, [17] whereas another study showed decreased sensitivity with age [18]. Pain is usually less noticed in older adults than in younger adults [19]. A meta-analysis showed that pain tolerance thresholds do not change substantially with age. Aging reduces pain sensitivity to lower pain intensity [20].

Obese individuals are more sensitive than non-obese individuals to pressure pain but not to thermal pain. Body fat distribution can influence sensory detection and pain sensitivity. Pain response varies according to subcutaneous body fat in different parts of the body. Body location can vary in response to different types and intensity of stimuli. There are inconsistent findings from several studies [21]. Heavier individuals have a higher pain tolerance [22]. While based on the study done by Emerson, et al., it was found that there was no difference between the obese and non-obese groups in pain sensitivity to painful stimuli of noxious hot and cold temperatures. There was no relationship between central adiposity or body fat (percentage or distribution) and pain response to noxious hot or cold stimuli. Obesity has minimal influence on pain sensitivity. Therefore, it is unlikely that obesity alone increases susceptibility to the development of chronic pain through amplification of nociceptive processes [23].

Level of education is an important factor related to pain [24]. Research in the United States of America shows that populations with higher levels of education will complain of less pain than populations with lower levels of education [25].

ASA physical status determines the morbidity of the patient and its effect on functional limitations hence helping the anesthesiologist to predict preoperative risk. High ASA physical status indicates the presence of morbidities including diabetes mellitus, morbid obesity, alcohol dependence, kidney failure, and others that can affect the effect of anesthetic drugs on the patient's recovery time [26].

Prolonged surgical duration is associated with higher surgical stress to the body and a higher number of tissue trauma. This is significantly associated with postoperative pain, which is in agreement with previous studies [27]. A study of gynecological surgery patients in Ethiopia showed that the longer the duration of surgery in hours, the greater the number of times patients reported experiencing severe pain [28]. A study involving 23 types of gynecological surgeries showed a significant correlation between longer operations and higher pain intensity [29].

In this study, the p-value for the variables of NRS at rest for 1–6 hours and NRS at rest for 6–12 hours is less than 0.05 (p-value < 0.05) which means that it is statistically significant between the variables NRS at rest for 1-6 hours and NRS at rest for 6–12 hours in the TAP Block and ESP Block groups. The pain scale in post-gynecological surgery patients who underwent ESP block was lower than TAP block, with a statistically significant difference ($p < 0.05$) in rest NRS at 1–6 hours and 6–12 hours postoperatively and mobile NRS at 0–1 and 1–6 hours postoperatively. Pain after gynecological surgery has a visceral and a somatic component, and the findings of this study could be due to the differences in mechanism and site of action between the two types of blocks. ESP block provides a broad and potent analgesic effect unilaterally. This effect is achieved by injecting a local anesthetic into the plane between the erector spinae muscles and the transverse processus muscle then diffusing into the paravertebral space via the space between the adjacent vertebrae and blocking the dorsal and ventral rami of the spinal nerves [30, 31]. In contrast, a TAP block is achieved by injecting a local anesthetic into the plane between the internal oblique muscle and the transversus abdominis muscle. The spinal roots supplying the thoracolumbar nerve pass through this plane and innervate the anterolateral abdominal wall [32]; Therefore, TAP blocks can only cover somatic pain [31, 33].

TAP blocks do not cover visceral pain and the spread of local anesthetic is limited [34]. Meanwhile, ESP block covers somatic and visceral pain by affecting the ventral rami and communicating rami containing sympathetic nerve fibers as the local anesthetic spreads through the paravertebral space [16, 31].

A previous study that performed ultrasound-guided ESP blocks with single-shot bilateral performed at the end of a total hysterectomy managed to significantly reduce VAS scores postoperatively with a highly statistically significant result at 30 minutes, 2, 12, 16, 20, and 24 hours when compared to TAP block, with decreased NRS scores with statistically significantly result in the ESP block group at 15, 30, and 60 minutes and 12 and 24 hours postoperatively compared to postoperative TAP block [35, 36] TAP blocks are more effective at relieving parietal pain (pain from the skin and muscle from a surgical incision) and not visceral pain (pain from intra-abdominal structures) compared to ESP [37].

The results of this study showed similar results compared to the previous studies, in which there is a prolonged analgesic effect in patients undergoing lower abdominal caesarean section after bilateral ESP block using a single injection with NRS values of 1–3 in the first 24 hours with a mild to moderate pain scale 6 hours postoperative [38, 39].

This study showed a slightly different result with a shorter duration of analgesia compared to the previous study because, in the previous study, the adjuvant norepinephrine

or epinephrine was added which could prolong the duration of analgesia, whereas in this study no adjuvant was added and only bupivacaine was used [38].

In this study, the results of the p statistical test were greater than 0.05 ($p > 0.05$) for mobile NRS 6–12 hours and 12–24 hours which means that it is not statistically significant, thus it can be explained that there was no statistically significant difference in the two groups of rest NRS 0–1 hour and 12–24 hours.

The mechanisms underlying pain on mobilization may be different from pain at rest. In addition, pain induced by movement may have a different response to analgesia than pain at rest [40]. Pain on movement is generally caused by a response to tissue damage through a peripheral mechanism of inflammation that causes sensitization through maladaptive changes in the response properties of peripheral and/or central neurons. Inflammation can change the response rate and activity of nociceptors. The key mechanism of mobile pain is activation of previously dormant nociceptors, which causes an exaggerated response to movements that should not cause pain. This mechanism has been clinically tested by injecting a chemical irritant directly into a muscle to produce inflammation, which causes increased pain in motion. Increases in intramuscular nerve growth factor after muscle tissue damage may promote persistent upregulation of nociceptive receptors and neuropeptides that increase the responsiveness of neurons. Inflammation resulting from ischemia-reperfusion-induced muscle injury can cause hyperalgesia by sensitizing muscle afferents through the upregulation of ion channels in sensory neurons. Pain on mobilization can also occur in the absence of tissue damage and inflammation, one of the causes being mediated by the release of neurotrophic factors by muscle fibers and satellite cells that interact to trigger nociceptor activation [41].

Apart from the mechanisms of the peripheral nervous system, the central nervous system also has a role in relation to pain on mobilization through the modulation of motor and nociceptive responses. Previous studies reported that activation of N-methyl-D-aspartate (NMDA) receptors in the medulla raphe nucleus can mediate exercise-induced hyperalgesia. Recent meta-analyses have also shown that perceptions of fear and threat can affect central pain through cognitive and affective responses [41].

In a previous study of ESP-treated patients compared to non-blocked patients, patients who received ESP block not only significantly reduced their pain scores from the postoperative period until 24 hours but also prolonged the mean time to first analgesia until after 6.93 hours [42]. In the TAP block study, a meta-analysis assessed the TAP block for postoperative analgesia after laparoscopic surgery. From this meta-analysis, TAP blocks were found to reduce pain with significantly different pain scores after 2 hours, borderline differences between active TAP blocks and controls at 6 hours, with TAP blocks having no effect on pain at hour 24 [43]. Other studies of meta-analysis show the benefits of TAP block for open and laparoscopic hysterectomies. The study concluded that, compared with placebo or no block, the use of posterior/lateral TAP block resulted in reduced 24-hour morphine consumption, decreased pain scores at rest and on movement, lower incidence of nausea and vomiting, and prolonged analgesic duration after an open hysterectomy [44]. A previous study reviewing the incidence of movement-evoked pain (MEP) and pain at rest (PAR) with subjects undergoing thoracotomy, knee arthroplasty, and hysterectomy showed that the intensity of pain on movement increased by up to 95 % compared to pain at rest in the first 3 days after surgery [45]. The things mentioned above can explain the findings of this study where both rest NRS and mobile NRS at 1-6 hours can both be covered but after 6 hours only rest NRS is covered [15, 16, 19, 30, 35, 36, 46–55].

In this study, the total time needed for morphine consumption within 24 hours in the TAP block and ESP block groups was less than 0.05 (p-value < 0.05), which means it is significant (table 3) with the time needed for the first dose of morphine was faster in the TAP block group than in the ESP block group. The results from this study are similar to several previous studies.

Conclusion

ESP block results in a lower postoperative pain score NRS value and reduces the need for morphine in post-gynecological surgery patients with a median incision compared to the TAP block.

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Author contribution. All authors according to the ICMJE criteria participated in the development of the concept of the article, obtaining and analyzing factual data, writing and editing the text of the article, checking and approving the text of the article.

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