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ORIGINAL RESEARCH

Comparison of Spinal Morphine and Transversus Abdominis Plane Block on Opioid Requirements After Caesarean Section: An Observational Study

Suwarman[1], Osmond Muftilov Pison[1], Mohammad Fikry Maulana[1], Prapanca Nugraha[2]

[1]Department of Anesthesiology and Intensive Therapy, Faculty of Medicine, Universitas Padjadjaran, Bandung, West Java, Indonesia; [2]Department of Surgery, Faculty of Medicine, Universitas Padjadjaran, Bandung, West Java, Indonesia

Correspondence: Suwarman; Mohammad Fikry Maulana, Email suwarman@unpad.ac.id; mohammad19029@mail.unpad.ac.id

Objective: Acute postoperative pain is one of the major clinical problems that occurs in patients undergoing cesarean section with a prevalence of 89.8%. Postoperative pain causes discomfort and various complications for the mother. In addition, postoperative pain that is not handled properly can increase the risk of becoming chronic pain by 2.5 times. One of the methods recommended in the Enhanced Recovery After Caesarean Section (ERACS) protocol to prevent acute postoperative pain is the use of intrathecal long-acting opioids, with intrathecal morphine as the gold standard and Transversus Abdominis Plane (TAP) block. This study aims to assess the comparison of opioid needs as analgesic rescue between the administration of 0.1mg spinal morphine and TAP block with bupivacaine 0.2% 10mg in patients undergoing cesarean section.

Methods: This study is an observational study in a single Tertiary Hospital in West Java – Indonesia. Patients were given patient-controlled anesthesia (PCA) with fentanyl as analgesic rescue. Statistical analysis of the numerical data used the unpaired *t*-test and Chi-Square test for categorical data.

Results: In the group that was given spinal morphine, the duration of additional opioids was longer ($p < 0.05$), and the total dose of additional opioids was less than the TAP block group ($p < 0.05$).

Conclusion: The spinal morphine requires fewer additional opioids than the TAP block.

Plain Language Summary: Sectio caesarea (SC) is one of the most commonly performed surgeries in health care. One of the most common risks of SC is the occurrence of postoperative pain that can interfere with mothers' physical and mental health. Therefore, the anesthesia technique used must have an optimal effect both in relieving pain during surgery and postoperatively. In addition, the side effects of the anesthesia technique used must also be minimized. This is an observational study comparing the pain relief and side effects between two anesthesia techniques that are often mentioned in the literature, namely the use of morphine in spinal anesthesia and bupivacaine in the Transversus Abdominis Plane (TAP) Block. A total of 44 pregnant women who were indicated to undergo SC were divided into two groups. Pain and side effects subjectively reported by the women were monitored and documented for up to 24 hours postoperatively. Moderate-to-severe pain was an indication of additional pain relief. The results showed that the spinal anesthesia technique with morphine had a better postoperative pain relief effect, characterized by the need for less additional pain relief and a longer time interval to the first additional pain relief. Morphine-treated women experienced more mild side effects such as skin itching, nausea, and vomiting. However, this was not significant. Further research with a larger sample and consideration of other factors that may affect the mother's subjective pain perception such as histories of previous surgery, medication use, and previous pregnancy will provide more accurate comparative results.

Keywords: cesarean section, duration of analgesia, pain scale, spinal analgesia, transversus abdominis plane block

Introduction

The World Health Organization (WHO) stated that 21% of births worldwide occur through cesarean section procedures and were predicted to increase by 29% in 2030.[1] Cesarean section carries a risk of acute postoperative pain, with

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a prevalence of 89.8%.[2] Suboptimal analgesia following cesarean section is associated with delayed functional recovery and mobilization, along with higher risk of maternal thromboembolism, poor maternal-newborn bonding, and breastfeeding difficulties. In addition, it may increase the risk of chronic pain and postpartum depression.[3] These problems associated with cesarean section give complex challenges to anesthesiologists. The patients need a quick postoperative recovery time in order to have immediate physical contact and care for their babies.[4] Enhanced Recovery After Caesarean Section (ERACS) protocol was released in 2018 by the Enhanced Recovery After Surgery (ERAS) society.[5–7] It provides various benefits such as significant reduction in the use of opioid analgesics, minimal pain scale, increased early mobilization, reduced length of hospital stay, and reduced total cost of care in the hospital.[8,9] Based on ERACS, spinal anesthesia is recommended for cesarean section.[6] One of the methods recommended in ERACS to prevent acute postoperative pain is the use of intrathecal long acting opioids.[7] Morphine, as a long-acting opioid, has a long duration of postoperative analgesia effect. It can modulate nociceptive processes without affecting motor, sympathetic, and proprioceptive functions. However, its use is associated with the incidence of various side effects such as nausea, vomiting, and pruritus. On the other hand, TAP block is a plane block performed by blocking the spinal cord area from T6 to L1.[10] The TAP block procedure can reduce the use of opioids, thus reducing the risk of side effects. In addition, the TAP block procedure will not cause motor blockade.[10,11] McMorrow showed that spinal morphine provides a better analgesic effect compared to TAP block anesthesia with ropivacaine in post-cesarean section patients.[10] However, Kahsay and Kwikiriza showed that TAP block provides a good analgesic effect in post-cesarean section patients, proved by a significant difference in VAS values.[12] The aim of this study was to analyze the comparison of postoperative analgesic effects between spinal anesthesia with morphine and TAP block with bupivacaine against opioid requirements after cesarean section surgery at Dr Hasan Sadikin General Hospital, Bandung.

Materials and Methods

Study Design and Setting

This is an observational study conducted in a tertiary general hospital in West Java, Indonesia, and follows The Strengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines.[13] This study was conducted at Dr Hasan Sadikin General Hospital in Bandung, West Java, Indonesia, from February to July 2023. Forty-four ASA II parturients aged between 18 and 45 years scheduled for cesarean section surgery under spinal anesthesia were divided into two groups. Patients will be excluded if they have a history of allergy to the drugs used in the study; patients whose cesarean section approach is other than with midline incision; patients who experienced spinal anesthesia failure; spinal anesthesia converted to general anesthesia; or experience allergic reactions to drugs used during the procedure. The determination of the minimal sample was based on the sample size of comparison of two proportions; the power was 80%, and the significance level was 5%; therefore, a minimal sample size of 44 people was obtained.[14] The patients were divided into two groups: the spinal group and the TAP group. The study was conducted after obtaining approval from the Hospital's Ethics and Research Committee.

Data Collection

After establishing an intravenous catheter with an 18G venous cannula before entering the operating room, hemodynamic monitoring including non-invasive blood pressure, an electrocardiogram, and oxygen saturation was performed, and then oxygen was given via nasal cannula at 3 liters per minute. After preloading with colloid fluid of 7 mL/kgBW within 20 minutes. Spinal anesthesia was performed in the sitting position between L3 and L4 intervertebral level using a 25G Quincke spinal needle. In the spinal morphine group, spinal anesthesia was performed by administering hyperbaric bupivacaine 10 mg, fentanyl 25 µg, and morphine 100 µg. In the TAP block group, spinal anesthesia was performed by administering hyperbaric bupivacaine 10 mg and fentanyl 25 µg. The patient was then positioned in a supine position. The height of the sensory block was assessed using a pinprick test. Once the spinal block reaches thoracic 6, surgery begins. If within 15 minutes the height of the blockade was not reached, the patient was excluded from the study. After the baby was born, the patient was given intravenous midazolam sedation at 0.1 mg/kgBW. In the second group (TAP block), after the surgery was completed, TAP block was performed using 20 mL of 0.2% bupivacaine on both sides with

ultrasound guidance. The patient was then taken to the recovery room for observation of degree of consciousness and hemodynamic monitoring. While in the postoperative recovery room, a research assistant assessed the patient's post-operative opioid needs in the postspinal room without knowing the patient's treatment group (blind). The patient will use a perfusor-PCA (patient-controlled analgesia) device that has been fitted with a 50-cc syringe containing fentanyl at a dose of 500µg dissolved in 40mL of 0.9% NaCl liquid. If the patient feels moderate-to-severe pain, the patient can press the PCA to receive additional opioid analgesics. Each time the device is pressed, the additional analgesic dose given is 25µg of fentanyl. The PCA tool will be installed for 24 hours with a log-out interval of 10 minutes.

Statistical Analysis

Data analysis included descriptive analysis and hypothesis testing to assess the proportion of each variable. A normality test with the Shapiro–Wilk test was conducted to evaluate the data distribution; the statistical test would be carried out using the unpaired *t*-test. The statistical analysis for categorical data was analyzed with the Chi-Square test. The Statistical Package for the Social Sciences (SPSS) 26 was used to compute the statistical analysis. A p value < 0.05 was considered as statistically significant.

Results

General characteristics of the subjects, including age, weight, height, body mass index (BMI), and length of surgery were homogeneous and suitable for comparison as shown in Table 1. Time to first additional opioid analgesics in post-cesarean section patients given spinal morphine had a mean of 600.45 ± 68.901 with a median value of 600.00, while those with TAP block had a mean of 438.18 ± 46.867 with a median value of 430.00 as shown in Figure 1. The Results of the unpaired-*t*-test showed a p value of 0.001 (<0.05), which means that there was a significant difference in the time of pain suppression between the two groups as shown in Table 2.

Table 1 Demographic Characteristics and Duration of Surgery

Characteristics	Group		P-value*
	Morphine (n=22)	TAP-Block (n=22)	
Age (years)			0.709
Mean±Std	29.41±4.846	30.05±6.290	
Median	30.00	30.50	
Range (Min-Max)	19.00–38.00	18.00–39.00	
Body Weight (kg)			0.215
Mean±Std	70.18±2.839	71.36±3.360	
Median	70.00	71.00	
Range (Min-Max)	65.00–77.00	65.00–79.00	
Height (meter)			0.245
Mean±Std	1.58±0.023	1.59±0.024	
Median	1.58	1.60	
Range (Min-Max)	1.55–1.62	1.55–1.64	
Body Mass Index (BMI)			0.668
Mean±Std	27.07±1.157	28.24±1.436	
Median	27.79	28.67	
Range (Min-Max)	26.04–30.84	25.39–30.86	
Surgery Time (minutes)			0.921
Mean±Std	89.09±16.009	89.55±14.302	
Median	90.00	90.00	
Range (Min-Max)	60.00–120.00	60.00–120.00	

Notes: *Chi Square Test. The significance value is based on the p value <0.05.

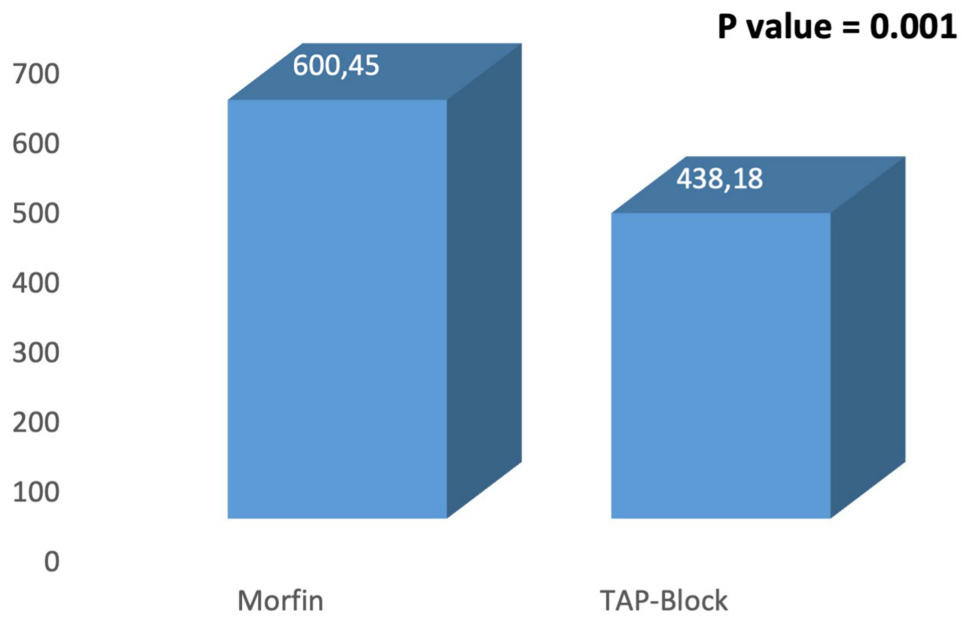

Figure 1 Time taken to first dose of fentanyl (minutes).

The total need for additional opioids in post-cesarean section patients with spinal morphine was lower than that with TAP block. In the spinal morphine group, the mean consumption of additional opioids was 38.64±16.775µg with a median value of 50.00, while in the TAP block group, it was 50.00±18.898µg with a median value of 50.00 as shown in Figure 2. The Mann–Whitney test results showed a p value of 0.043 (<0.05), which means that there was a significant difference in the total need for additional opioids between the two groups as shown in Table 3.

Most patients did not experience any side effects. There were no allergic side effects in the two groups. Pruritus was experienced only by two patients (9.1%) in the spinal morphine group, while nausea and vomiting were found in seven patients (31.8%) in the spinal morphine group and two patients (9.1%) in the TAP block group. The Chi-Square test showed a p value of 0.215 (>0.05), which means that there was no significant difference between the incidence of adverse events in the two groups as shown in Table 4.

Discussion

The research subjects in this study had an average age of 29.4 years in the spinal morphine group and 30.04 years in the TAP block group. This was in line with a study in Lebanon that stated that increasing age in pregnancy increased the incidence of cesarean sections.[15] A similar study at Dr Hasan Sadikin General Hospital showed a predominance of 20–35 years of age.[16] The subjects were overweight on average. The patient's body structure affects the success of regional anesthesia. In TAP block, this success is influenced by changes in the patient's fat distribution, muscle, and connective

Table 2 Time of Fentanyl Requirement in Both Groups

Fentanyl Requirement: Time Taken Until First Dose of Fentanyl (Minutes)	Group		P-value*
	Morphine (n=22)	TAP-Block (n=22)	
Mean±Std	600.45±68.901	438.18±46.867	0.001
Median	600.00	430.00	
Range (min-max)	480.00–720.00	380.00–530.00	
IQR (Q1-Q3)	107.50 (547.50–655.00)	75.00 (397.50–472.50)	

Notes: *Unpaired *t*-test. The value of significance is based on the p value <0.05.

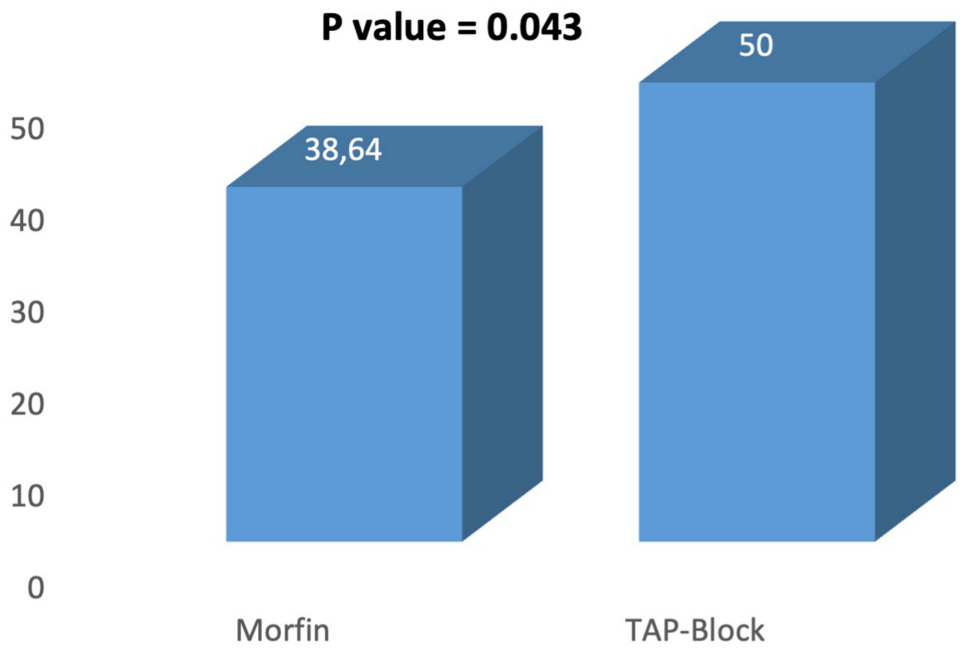

Figure 2 Total fentanyl consumption (µg) in 24 hours.

tissue structure, related to the depth of the TAP block distance.[17] In addition, obesity may also increase the risk of intrathecal morphine complications.[18] The risk of postoperative complications is particularly high in the obese maternal group, such as decreased respiratory function that could occur even under regional anesthesia. In obese mothers, postpartum complications are more common in mothers who undergo caesarean section. Obese mothers are usually hospitalized for a much longer time.[19] The average length of cesarean section in the spinal morphine group and the TAP

Table 3 Fentanyl Requirements in Both Groups

Fentanyl Requirement: Total Fentanyl Consumption (µg) in 24 Hours	Group		P-value*
	Morphine (n=22)	TAP-Block (n=22)	
Mean±Std	38.64±16.775	50.00±18.898	0.043
Median	50.00	50.00	
Range (Min-Max)	25.00–75.00	25.00–75.00	
IQR (Q1-Q3)	25.00 (25.00–50.00)	50.00 (25.00–75.00)	

Notes: *Unpaired *t*-test. The value of significance is based on the p value <0.05.

Table 4 Side Effects of Research Subjects

Side Effects	Group		P-value*
	Morphine (n=22)	TAP-Block (n=22)	
No side effects	13 (59.1%)	20 (90.9%)	0.215
Allergies	0 (0.0%)	0 (0.0%)	
Pruritus	2 (9.1%)	0 (0.0%)	
Nausea/vomiting	7 (31.8%)	2 (9.1%)	

Notes: *Chi Square Test. The significance value is based on the p value <0.05.

block group was 89.08 minutes and 89.54 minutes, respectively. Surgery can stimulate the inflammatory process which leads to local edema, increased tissue pressure, and stimulation of nociceptors. Faster surgery will reduce the risk of severe postoperative pain.

Differing from the intrathecal administration of local anesthetic agents, spinal morphine administration does not cause muscle weakness, loss of proprioceptive sensation, or sympathetic denervation. Morphine is often considered a quintessential opioid analgesic.[20] Cesarean section is an ideal type of surgery to study TAP block because the conventional Pfannenstiel incision is in the area of anesthesia with a commonly used lateral approach. Several studies have concluded that TAP block with a posterior or lateral approach accompanied by analgesic administration in the form of acetaminophen, NSAIDs, and parenteral opioids provides a significant analgesic effect.[21,22] This study found that the length of time that patients required first additional opioid analgesics in post-cesarean section patients given spinal morphine was longer compared to TAP block, in line with an Ethiopian study.[23] The findings in this study shed light on the effectiveness of spinal morphine in treating somatic pain and visceral pain arising from the wound and uterus.[24] In addition, this study also examined the total need for additional opioids in post-cesarean section patients, which was also lower in spinal morphine patients.[23,25]

Based on Huang et al's meta-analysis, morphine administration is known to cause higher side effects than TAP block, namely nausea, vomiting, and pruritus.[26] Morphine can stimulate the vestibular organ directly, increase vestibular sensitivity, and activate mu receptors on the vestibular epithelium. Morphine also causes dilatation of blood vessels in the skin and causes pruritus.[27]

This study concluded that the use of 100µg spinal morphine as multimodal anesthesia in cesarean section procedures requires fewer rescue analgesics but with more side effects than the group given TAP block. Side effects obtained based on the results of this study include pruritus, nausea, and vomiting. The study was conducted in West Java, so the results might be limited to the regional characteristics of the Sudanese patients, as the majority race of West Java. This study did not assess the subjectivity of the subject's pain level using pain assessment instruments because the researchers used PCA, where pain scores were assessed in surgery with mild pain risk. This study did not assess the subject's prior psychiatric conditions, as some conditions have been well documented associated with the additional requirements of postoperative analgesics. There was a difference in the start time of the intervention between spinal morphine and TAP block, so that the need for opioids was also different at the beginning of the study.

The results of this study can be developed for future research by adding other variables that have not been examined in this study, such as previous history of surgical procedure, history of drug use, or history of previous pregnancy. In addition, similar studies can also be conducted in several other study centers, so that the population becomes larger. This study can serve as a basis for clinicians or anesthesiologists consideration in the selection of postoperative analgesics between TAP block and spinal morphine, especially in cases of post cesarean section. The anesthesiologist could alternatively choose TAP block for caesarean in patient with major contraindication for spinal morphine such as elevated intracranial pressure infection at the site of the procedure, hypotension, and coagulopathy.[28]

Conclusions

This study concluded that the use of 100µg spinal morphine as multimodal anesthesia in cesarean section procedures requires fewer rescue analgesics and longer length of time that patients required first additional opioid analgesics but with more adverse events than the group given TAP block. Side effects obtained based on the results of this study include pruritus and nausea vomiting.

Data Sharing Statement

All data and tables used to support the findings of this study are included within the article and available upon request to the corresponding author.

Ethical Declaration

This research was carried out in accordance with the Declaration of Helsinki. The study was given ethical approval by the Dr Hasan Sadikin Hospital ethics committee, with registration number LB.02.01/X.6.5/47/2023. Prior to approval, the lead researcher informed the ethical committee board about the study's objectives, potential risks, and benefits of the procedure the research participant underwent. All research participants received comprehensive information about the aims, advantages, and risks of the study. The same skilled anaesthesiologist performed the procedure on each research participant with assistance from an anaesthesiology resident. An informed consent form was signed by each research subject prior to their involvement in the study.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare no conflict of interest.

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