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PAIN CONTROL AFTER CESAREAN SECTION: TRANSVERSE ABDOMINIS PLANE BLOCK VERSUS INTRAVENOUS PATIENT CONTROLLED ANALGESIA WITH FENTANYL

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ABSTRACT

Background: Around the world, cesarean sections (CS) are among the most common surgical procedures. Pain after a cesarean section is expected. A primary source of pain following a cesarean section is the incision formed in the abdominal wall. Parenteral self-administering drugs (PCA) and regional afferent nerve block (TAP block) are two effective modes that have recently gained popularity to control this pain. **Aim of the study**: to assess the impact of two different methods for postoperative analgesia (TAP) block and patient control analgesia (PCA) with IV fentanyl after an elective cesarean section under spinal anesthesia on a patient's pain efficacy and safety. **Methods:** This randomized controlled research was comprised of sixty women having a cesarean section under spinal anesthesia. They were split into two equal groups: the IV fentanyl PCA group and the TAP block group. After the surgery, while the patient was in the recovery room, the TAP block group received a total of 20 ml diluted 0.25% bupivacaine for each side (we mixed 10 ml of 0.5% isobaric bupivacaine with 10 ml of normal saline). The IV fentanyl PCA group receives an initial dose of 1 mcg/kg and then boluses of 20 mcg at a lock-time of 8 minutes. Postoperatively, mean arterial pressure, heart rate, oxygen saturation, nausea and vomiting, sedation, and visual analogue score were noted over 24 hours (at 0h, 1h, 2h, 4h, 6h, 12h, and 24h). ANOVA and the Chi-square test were used for statistical analysis. **Result:** Patients who received TAP block had prolonged analgesia; the mean time for rescue analgesia was 12±5 hours, and 6.5±2 hours for both the TAP block group and IV fentanyl PCA group respectively. The pain score was also lower in the TAP block group compared to the IV fentanyl PCA group. Nausea & vomiting scores and sedation scores were lower in the TAP group compared to the IV fentanyl PCA group. **Conclusion**: An ultrasound-guided TAP block is a more important and safe approach to provide postoperative analgesia to cesarean section under spinal anesthesia than IV PCA with fentanyl.

KEYWORDS: cesarean section, spinal anesthesia, transverse abdominal plane block, patient control analgesia.

INTRODUCTION

Cesarean delivery is one of the most common major surgical procedures. The postoperative pain from a cesarean delivery was the 10th most painful of 179 surgical procedures that were included in the study.[1]

Most patients describe their post-C-section pain as moderate to severe, and insufficient management can affect healthcare, baby care, and mother-child bonding.[2]

In addition, pain management should be safe for a neonate who is breastfeeding. The two main components of cesarean-section pain are visceral (from the uterus) and somatic (from the incision made in the abdominal wall). The incision in the abdominal wall is an important cause of pain for those patients.[3]

Post-CS pain control may not be effective with NSAIDs alone. For these patients, a multimodal analgesic approach that combines parenteral analgesics with an abdominal nerve block has recently gained popularity. A new specific technique called transverse abdominis plane (TAP) block can reduce pain from abdominal incisions by blocking afferent peripheral nerves in the abdominal wall between T6 and L1.[4]

Another treatment modality for postoperative pain is systemic opioids because they act effectively against

both of these elements (visceral and somatic). However, they have been associated with several adverse effects, including respiratory depression, pruritus, nausea, vomiting, and constipation.[5]

Following surgery, patients can use devices designed specifically for PCA to control their analgesic self-administration. PCA includes self-administering small IV amounts of opioids (such as fentanyl) using a programmable pump (by pressing a button).[6]

Significantly, effective postoperative pain management is essential to better postoperative recovery; it reduces postoperative death, improves healing, and shortens hospital stays and costs.[7]

PATIENTS AND METHODS

This prospective randomized clinical trial took place at Al-Zahraa Teaching Hospital from the 1st of May 2023 to the 30th of November 2024. Each technique was completed in full compliance with the committee's ethical guidelines by the Iraqi Board of Medical Specialization/anesthesia and intensive care unit.

Sixty pregnant women were included in this study and divided into two groups, 30 in each. Both groups received spinal anesthesia with 2.5 ml (12.5mg) of heavy 0.5% bupivacaine. Group I was followed by TAP block, and Group II was followed by IV fentanyl PCA at the end of surgery.

Inclusion criteria

- Age between 18-40 years old.
- Gestational ages up to 38 weeks or more (according to ultrasound).
- Elective cesarean section under spinal anesthesia

Exclusion criteria

- Contra-indication to spinal anesthesia.
- Body mass index ≥ 30kg/m2.
- Hypersensitivity to study drugs.
- Patient physical status ASA > II.
- Psychological disorder.
- Patient refusal.

In addition to evaluating patients' medical histories, patients from both groups had relevant clinical examinations and laboratory investigations. An ultrasound was checked, as well as other eligibility requirements and an assessment of their ASA physical status.

Once the patients were in the operating room, a 4 mL/kg (0.9% normal saline) infusion was initiated through a 20-gauge cannula; in addition, ECG, pulse oximetry, and a non- invasive blood pressure monitor were used to monitor all patients.

At the end of the operation, the patients were randomly assigned to one of two groups: the TAP block group or the PCA group. In the TAP block group, while the patient was supine, a high-frequency ultrasound probe was placed between the iliac crest & the lower costal border on the lateral abdominal wall, showing the lateral abdominal muscles. Which are, from the exterior to the interior, the external oblique EO muscle, internal oblique IO muscle, and transverses abdominis TA muscle. With a completely aseptic technique, an echogenic needle is advanced, reaching the fascial plane between the IO & TA muscles. Then 2 ml of saline was injected to verify the proper needle tip position, and then 20 ml of 0.25% isobaric bupivacaine was injected slowly into each side (right and left).

The PCA group: All patients in this group were given an initial dose of 1mcg/kg fentanyl intravenously. For the PCA, 1mg of fentanyl was diluted in 100 ml of normal saline. The PCA blouses were 20mcg at an 8-minute lock time interval using an automated patient control analgesia infusion device Figure 2.2. The women were received further education about the possibility of a clinical bolus that might be provided by a physician in case of inadequate pain reduction.

At the post-anesthesia care unit (PACU), the patients were under standard monitoring, following the traditional obstetric department practice. The patients got conventional analgesia, which included IM diclofenac 75 mg every 12 hour the initial dosage was administered immediately post-surgery.

The evaluation of pain's degree and severity using the visual analogue score (VAS score), where 0 = no pain and 10 = most intense imaginal pain, the time for the first rescue analgesia in minutes, sedation score using the modified Ramsay sedation score where 1=awake, and 8= unresponsive to painful stimulation, hemodynamic parameters (heart rate, mean arterial pressure and blood oxygen saturation were also noted, an associated complication such as nausea and vomiting, hypotension, and bradycardia was done immediately after PACU admission which considered as (zero time) then, 1, 2, 4, 6, 12, 24 hours after that.

In the case of VAS score ≥5, paracetamol (1g) plus Nefopam 20mg was given, hypotension was treated with IV boluses ephedrine (2.5-10mg) and fluid as required, bradycardia was treated with IV atropine (0.6-1mg), nausea and vomiting was treated with IV ondansetron (4-8mg), hypoxia was treated with simple oxygen mask of (5-6L/min).

Statistics were gathered, processed, and analyzed with an IBM-compatible computer and SPSS version 26. Fisher's exact test was used to evaluate demographic factors, followed by repeated measures ANOVA if the data had a normal distribution and the Chi-square test for nominal or ordinal variables. The accepted margin of error was set at 5%, and the confidence interval was set at 95%. As a result, the subsequent P value was deemed significant:

P-value for probability P values were considered significant if they were less than 0.05. P-values less than 0.001 were regarded as very significant. P values greater than 0.05 were considered insignificant.

RESULT

This study examined the efficacy and safety of TAP block and IV fentanyl with PCA as postoperative analgesics following a cesarean section. 60 pregnant women were involved and assessed for eligibility on predefined inclusion-exclusion criteria. Table 1 presents the patient's demographic data and other data. The findings showed no statistically significant differences between the study group concerning age, weight, height, previous cesarean section, and duration of surgery, with a p-value > 0.05.

Table 1: Patient demographic profile and other data.

Demographic variables		PCA group (n = 30)	IV Fentanyl group (n = 30)	p-value
Age (years)		28.53±3.38	27.51±2.85	0.325 ns
Weight (kg)		67±4	68±5	0.396 ns
Height		158±4	156±5	0.093 ns
Previous CS n (%)	0	6 (20)	8 (27)	0.775 ns
	1	21 (70)	20 (67)	
	2	3 (10)	2 (11)	
Duration of surgery (min)		34±10	37±8	0.205 ns

PCA: patient-controlled analgesia, **IV:** intravenous, **CS:** cesarean section, **ns**: non-significant.

Initial VAS Scores (0 Hour): Both groups had a VAS score of 0, with no significant difference (p = NS). Early Postoperative Period (1-6 Hours): At 1 hour, the TAB group showed a significantly lower VAS score (0.7 ± 0.3) compared to the PCA group (1.8 ± 0.5) (p = 0.02). The difference became more pronounced at 2, 4, and 6 hours, with the TAB group maintaining lower pain scores (p-values ranging from 0.01 to 0.0005). The highest pain scores were observed at 6 hours, with the PCA group reaching 6.2 ± 0.9 compared to 2.2 ± 0.7 in the TAB group. Late Postoperative Period (12-24 Hours): At 12 hours, the TAB group maintained significantly lower pain scores (2.4 ± 0.8) versus the PCA group (6.4 ± 1.0) (p = 0.0002). At 24 hours, the TAB group continued to demonstrate superior analgesic effect with a VAS score of 2.2 ± 0.7 compared to 6.0 ± 0.9 in the PCA group (p = 0.0003).

Table 2: Visual analogue scores in both study groups over 24 hours.

Time (hours)	TAB Group (Mean ± SD)	PCA Group (Mean ± SD)	p-value
0	0.0 ± 0.0	0.0 ± 0.0	NS
1	0.7 ± 0.3	1.8 ± 0.5	0.02
2	1.2 ± 0.4	3.2 ± 0.6	0.01
4	1.8 ± 0.6	4.8 ± 0.8	0.001
6	2.2 ± 0.7	6.2 ± 0.9	0.0005
12	2.4 ± 0.8	6.4 ± 1.0	0.0002
24	2.2 ± 0.7	6.0 ± 0.9	0.0003

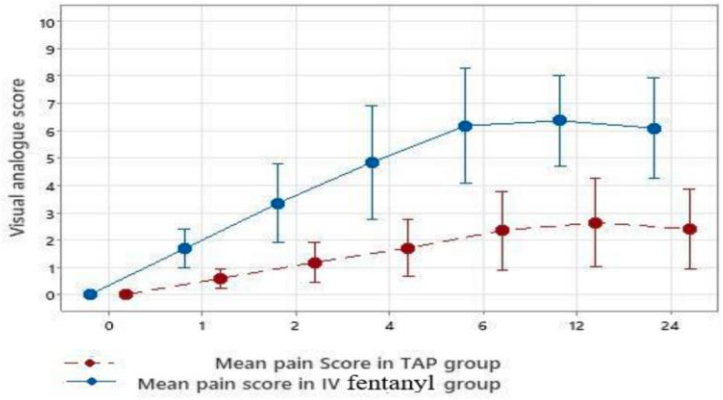

Figure 1: Visual analogue scores in both study groups over 24 hours (mean ± Sd).

Table 3 demonstrated that the time of first rescue analgesia was shorter in the IV fentanyl group compared to the TAP group. The mean time to first rescue analgesia was 6.5 hrs in the IV fentanyl analgesia and 12 hours in the TAP group with a p-value < 0.001. The mean dose of paracetamol consumption was higher in the IV fentanyl group (2.17g) compared to the TAP group (1.26g), and the Nefopam consumption was higher in the IV fentanyl group (47.83mg) compared to the TAP group (31.30), with a p-value < 0.001. The mean sedation score was significantly different between the TAP group (1.57±0.47) and the PCA group (2.2±0.41), with a P-value <0.01.

The number of patients who experienced a PONV was significantly lower in the TAP group (5 patients) compared to the IV fentanyl group (13 patients), with a p-value < 0.5. The incidences of hypotension and bradycardia were comparable, with insignificant differences between both study groups, a p-value of > 0.05. No incidence of hypoxia was observed.

Table 3: Time for rescue analgesia, paracetamol-Nefopam consumption, and associated side effects over 24hs.

	TAP Group	IV Fentanyl Group	p-value
Time for first rescue analgesia (hs)	12±5	6.5±2	< 0.001**
Paracetamol consumption g/24hs	1.26±0.45	2.17±0.23	< 0.0001**
Nefopam consumption mg/24hs	31.30±10.14	47.83±9.98	< 0.0001**
Sedation score (mean±Sd)	1.57±0.47	2.2±0.41	< 0.01*
PONV n (%)	5(16.7)	13(43.3)	0.024*
Hypotension n (%)	6(20)	4(13)	0.488 ns
Bradycardia n (%)	3(10)	7(23)	0.166 ns
Hypoxia	0	0	-

PONV: postoperative nausea and vomiting, * = significant, ** = highly significant.

After 2hs, 4hs, 6hs, and 12hs, this table showed a significant difference (P < 0.05) in mean arterial blood pressure (mmHg) between the study groups. P value > 0.05 indicates that there was no significant difference between the groups under investigation at 0h, 1h, and 24 h Table 4.

Table 4: Comparison of mean arterial blood pressure (in mmHg) between two study groups.

Time interval	TAP Group MAP (Mean±Sd)	IV Fentanyl Group MAP (Mean±Sd)	p-value
0h	84.08±6.76	83.20±4.36	0.552 ns
1h	77.68±8.42	80.02±4.27	0.182 ns
2hs	79.23±2.88	81.64±4.02	0.010*
4hs	82.33±5.14	86.11±4.60	0.004*
6hs	75.20±5.14	82.26±5.31	<0.001**
12hs	77.61±5.14	74.27±6.34	0.029*
24hs	77.37±4.46	75.77±3.86	0.142 ns

MAP: mean arterial pressure.

According to the findings in Table 3.5, the groups had significant differences in terms of heart rate after 1h, 2hs, and 3hs. The groups had no significant differences in the h0, 6hs, 12hs, and 24hs with a p-value > 0.05.

Table 5: Comparison of heart rate (beat/min) between two study groups.

Time interval	TAP Group HR (Mean±Sd)	IV Fentanyl Group HR (Mean±Sd)	p-value
0h	78.71±10.23	76.70±10.55	0.456 ns
1h	67.77±8.50	73.71±9.88	0.018*
2hs	71.8±6.5	81.4±6.2	<0.001**
4hs	71.9±5.8	82.6±5.6	<0.001**
6hs	71.5±8.3	73.0±8.1	0.481 ns
12hs	71.6±7.7	73.0±8.1	0.495 ns
24hs	71.7±8.2	74.7±7.3	0.139 ns

HR: heart rate.

The SpO_2 readings within the group comparisons and between the study groups didn't demonstrate any significant variations with a p-value > 0.05 Table 6.

Table 6: Comparison of SpO_2 (in percentage) between two study groups.

Time interval	TAP Group SPO_2 (Mean±Sd)	IV Fentanyl Group SPO_2 (Mean±Sd)	p-value
0h	98.1±1.1	98.2±1.2	0.734 ns
1h	99.5±1.2	99.4±1.8	0.802 ns
2hs	98.8±1.5	98.6±2.1	0.673 ns
4hs	97.2±2.1	97.2±1.9	1.0 ns
6hs	97±2.3	97.2±2.1	0.727 ns
12hs	97.4±2.2	97.2±1.8	0.701 ns
24hs	97.8±1.6	97.5±0.9	0.375 ns

DISCUSSION

The TAP block is a safe and efficient regional anesthetic method that produces great outcomes in a variety of surgeries.[8]

Transverse abdominal plane (TAP) block using an ultrasound guide is used as an alternative analgesic to minimize opioid consumption during surgery and postoperative pain management.[9] By expanding regional anesthetic techniques in postoperative pain management, it is possible to diminish the negative effects of drugs with systemic action and provide pain relief more effectively.

According to Cahrlton et al.[10], few studies have compared TAP block to any other pain treatment technique. Additionally, we failed to find research comparing the analgesic effects of IV fentanyl PCA and TAP block.

Sharma et al.[11], who observed that VAS values were lower in patients with TAP block than in those without, have studied the analgesic consequences of tramadol PCA versus TAP block.

McDonald et al[12] found that TAP block effectively reduces somatic (incisional) pain after cesarean section. It significantly reduces opioid consumption, thereby decreasing side effects, nausea, vomiting, and sedation. However, in the systematic review reported by Kehlet et al[13], they presented that IV fentanyl PCA provided systemic pain relief by addressing both somatic and visceral pain, the study highlighted that fentanyl offers more thorough alleviation for uterine contractions, which are the primary cause of visceral pain following cesarean sections, Additionally, IV fentanyl provides patient-controlled analgesia, enabling personalized dosage that can enhance patient satisfaction and pain management results. However, particularly when taken in larger

dosages, it does have certain risks, including respiratory depression and opioid-related side effects like sleepiness and constipation.

In line with our research study, Singh et al[14] informed that IV fentanyl PCA patients needed more opioids during the first 24 hours after cesarean delivery compared to TAP block. This may raise the possibility of opioid-related side effects including respiratory depression, nausea, and constipation.

Albrecht et al[15] found that TAP block leads to the minimized need for opioids during 24-48 hours after surgery.

The current research, reports that the patients who experienced IV fentanyl PCA compared to those who underwent the TAP block in the first 24 hours showed a significant difference in VAS values, time for rescue analgesia, and further analgesia request, in contrary to our study, Abudakika et al[16] which they reported that no significant effect between IV opioid and TAP group, this could be explained by a different anesthesia technique and used of IV tramadol. The TAP block appears to be more efficient when the volume is 30 mL, rather than 20 mL or less, due to its volume-dependent nature. In our study, we injected 20 ml of diluted isobaric bupivacaine 0.5% in both abdominal sides, which showed to be effective compared to the IV fentanyl PCA group.

Our study found that the TAP block group's heart rates and mean arterial blood pressure were significantly lower than those of the IV fentanyl group were. This could be because the TAP block group's sympathetic nervous system was less activated and there were fewer patient complaints of distress, however, it is not clinically meaningful.

In our research, the TAP-blocking patients had decreased the frequency of adverse effects such as sedation, nausea, or vomiting. Nausea or vomiting combined with sedation may be because of fentanyl intake; this result is consistent with Hwang et al.'s findings.[17]

CONCLUSION

We conclude that the transverse abdominal plane (TAP) block demonstrates superior outcomes in terms of pain relief and fewer side effects. This underscores its potential as a safer and more effective modality for postoperative pain management in cesarean section under spinal anesthesia.

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