Al-Azhar International Medical Journal

Volume 4 | Issue 11 Article 4

2023
Section: Obstetrics and Gynecology

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How to Cite This Article

ELBasry, Mohamed Gamal Kamel; MOHAMMED, MOHAMMED ALI; AHMED, ALAA ELDEEN MAHMOUD SAYED; and ELMAZZALY, SAGED MOHAMMED (2023) "Comparative study between Transversus Abdominus plane (TAP) block & Patient-controlled analgesia (PCA) and local infiltration at site of incision as postoperative analgesia for pain in Cesarean section," *Al-Azhar International Medical Journal*: Vol. 4: Iss. 11, Article 4.
DOI: https://doi.org/10.58675/2682-339X.2050

ORIGINAL ARTICLE

Comparative Study Between Transversus Abdominis Plane Block and Patient-Controlled Analgesia And Local Infiltration at Site of Incision as Postoperative Analgesia For Pain in Cesarean Section

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Abstract

Background: **One of the most typical surgeries performed worldwide is a cesarean section (CS). Both the mother and the infant experience postoperative discomfort, particularly in the first 48 h after delivery, which can be controlled by multimodal analgesia such as transversus abdominis plane (TAP) block, patient-controlled analgesia (PCA), and local infiltration at the site of the incision, among other techniques.**

Aim: **To assess the impacts of three different methods of postoperative analgesia (TAP) block, PCA, and local infiltration at the site of the incision after an elective CS − on patient perceptions of pain and pain scores, efficacy, and safety.**

Patients and methods: **This was a comparative research that was performed at Al-Azhar University Hospitals and Nasser Institute for Research and Treatment Hospital on 300 women undergo elective CS from June 2022 till November 2022. The study group divided into three equal groups (100 women/group): group I: we used a bilateral TAP block with 0.25 % bupivacaine in 20 ml saline at the conclusion of operation after skin closure. Group II: we used IV pethidine for PCA. Group III: we used wound infiltration with 0.25 % bupivacaine in 20 ml.**

Results: **There was no significant variation in demographic data and vital signs between groups at 2, 6, and 12 h postoperatively, and according to the time of first analgesia, time for ambulation, the visual analog scale, and the percentage of patients with postoperative nausea, vomiting, and allergy. Statistically significant variances exist.**

Conclusion: **Regarding patient anticipation of pain and pain score, time of first analgesia, and time for ambulation, PCA was superior to TAP block and local wound infiltration.**

Keywords: Cesarean section, Local infiltration, Pain, Patient-controlled analgesia, Transversus abdominis plane block

1. Introduction

One of the most typical surgeries performed worldwide is a cesarean section (CS). Both the mother and the infant experience postoperative discomfort, particularly in the first 48 h after delivery. The relationship between mother and child might be broken by the agonizing suffering.[1]

In the recent decades, there has been a sharp rise in the number of CS worldwide, which now surpasses 21 % of women gave birth by cesarean worldwide, according latest available data (2010−2018) from 154 countries covering 94.5 % of world live births.[2]

Adequate postsurgical analgesia after CS is crucial because it promotes early recovery, ambulation, and breastfeeding and reduces the risk of many negative side effects, including respiratory issues, venous thromboembolism, and longer hospital stays.[3]

A variety of alternate methods, such as wound infiltration by the obstetrician after the conclusion

Accepted 24 June 2023.
Available online 30 December 2023

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https://doi.org/10.58675/2682-339X.2050

of surgery, transversus abdominis plane (TAP), and patient-controlled analgesia (PCA), have been documented to limit the use of opioids postoperatively.[4]

One of these, the TAP block, has been used as part of the multimodal analgesic strategy to treat postoperative pain after different abdominal procedures. The somatic analgesia produces is adequate, and the visceral blockage is minimal or nonexistent.[5,6]

The TAP block was created by Rafi in 2001 as a landmark-guided technique that results in a field block using the Petit triangle. A local anesthesia solution is injected into the space between the transversus abdominis and internal oblique muscles as part of the procedure. Since the thoracolumbar nerves from the T6 to L1 spinal roots run into this plane and provide sensory nerves to it, local anesthesia applied in this plane may block the neural afferents and provide analgesia to the anterolateral abdominal wall.[7]

PCA is frequently taken to mean on-demand, intermittent, IV opioid administration with patient control (whether or not there is a constant background infusion). This method is based on using an advanced microprocessor-controlled infusion pump that administers an opioid dosage according to a predetermined schedule when the patient presses a demand button.[8]

Since 1971, PCA has been used to maximize pain relief; the first PCA pump to be sold commercially debuted in 1976. PCA enables patients to give a predefined bolus amount of medicine on-demand at the touch of a button, thereby relieving their pain at their desired dose and schedule.[9]

The study carried out in the early 1900s by Ewald Fulde and Walter Capelle is responsible for the intuition to irrigate the surgical site with local anesthetic solutions.[10]

Techniques for local infiltration (Local Infiltration Anesthesia) with anesthetics have lately been brought back as crucial components of multimodal analgesia plans for controlling postoperative pain.[10]

The goal of this research is to compare effectiveness, safety, pain intensity of three different method in pain management after elective CS.

2. Patients and methods

This research is a comparative study that was done on 300 women who had elective CSs at Al Azhar University Hospitals, and Nasser Institute for Research and Treatment Hospital.

The ethical guidelines of the Obstetrics and Gynecology Department of Al Azhar University were followed in this investigation (ethics committee approval was obtained in July 2021). All of the pregnant participants in this research had their informed permission acquired after being told of the study's protocols.

2.1. Methods

Three hundred pregnant women were included in the study and underwent evaluation, which included a thorough history taking, physical evaluation, and an ultrasound. In accordance to inclusion and exclusion criteria, the study group was chosen.

2.1.1. Inclusion criteria

Age between 18 and 40 is acceptable. All pregnant women with gestational age 38 weeks or more according to last menstrual period or ultrasound. Scheduled to undergo CS with Pfannenstiel incision under spinal anesthesia. Normal coagulation profile. No history of relevant drug allergy or they were receiving medical therapies considered to result in tolerance to opioids.

2.1.2. Exclusion criteria

Refusal of regional block or patients requiring emergency procedures. Bleeding disorders. Skin lesions or wounds at site of proposed needle insertion. Evidence of peritonitis or septicemia. Patients undergoing upper segment CS. Patients requiring general anesthesia for obstetric or anesthetic reasons. Obesity (BMI$\geq$30 kg/m^2). History of allergy to the drugs used in this study.

2.1.3. Method of randomization

The participants were randomized into the three study groups according to a certain random allocation sequence which was developed via computerized software program in 1 : 1: 1 ratio. After the random allocation sequence was developed it was distributed into sequenced opaque closed envelopes. Each envelope contained only one assignment card for one of the three study groups.

Near the end of CS procedure a nurse was asked to open an envelope according to their ordered sequence to know at what study group will the participant be assigned, that is group I, II, or III.

Three groups of patients were randomly assigned (100 women/group):

Group I: we used bilateral TAP block with 0.25 % bupivacaine in 20 ml saline at the conclusion of operation after skin closure.

Group II: we used IV pethidine PCA.

Group III: we used wound infiltration with 0.25 % bupivacaine in 20 ml saline at the end of surgery.

All cases vital signs were compared between groups at 2, 6, and 12 h after surgery, as well as based on the first analgesic dose, time for ambulation, the visual analog scale (VAS), and the percentage of patients who experienced postoperative nausea, vomiting, and allergy.

2.2. Statistical methods

Data was investigated using the statistical program for social sciences, version 23.0. (SPSS Inc., Chicago, Illinois, USA). Mean, SD, and ranges were reported for the quantitative data. Numbers and percentages were also utilized to display qualitative variables. Utilizing the Kolmogorov–Smirnov and Shapiro–Wilk tests, the normality of the data was determined.

3. Results

Table 1 shows that there was no statistically significant difference between PCA, TAP, and local inf. group regarding preoperative parameters of the studied patients.

Table 2 shows that there was no statistically significant difference between PCA, TAP, and local inf. groups regarding blood pressure and pulse at 2 h postoperative.

Table 3 shows that there was no statistically significant difference between PCA, TAP, and local inf. groups regarding blood pressure and pulse at 6 h postoperative.

Table 4 shows that there was statistically significant variation between PCA and other study groups and significant variation between TAP block and local inf. regarding of first analgesia demand found longer pain tolerable in PCA group than TAP group and local inf. group (Table 5).

The previous table shows that there was statistically significant variation between PCA and other studied groups and significant variation between TAP block and local inf. regarding time for ambulation found shorter in PCA group than TAP group than in local inf. group (Table 6).

The previous table shows that there was statistically significant variation between PCA and other study groups and significant variation between TAP block and local inf. Regarding VAS found reduce in PCA group than TAP group than in local inf. group (Table 7).

Table 4 shows that there was statistically significant variation between PCA and other study groups as regard percentage of patients with postoperative nausea, vomiting, and allergy.

4. Discussion

The primary goal of the present research is to examine the effectiveness, safety, level of pain, and

Table 1. Comparison between the three studied groups regarding preoperative parameters.

Preoperative	PCA group	TAP group	Local inf group	Test value	*P* value	Significance
	N = 100	*N* = 100	*N* = 100			
Systolic BP						
Mean ± SD	103.60 ± 10.78	104.70 ± 10.96	106.00 ± 10.44	1.254•	0.287	NS
Range	90–120	90–120	90–120			
Diastolic BP						
Mean ± SD	67.10 ± 7.56	67.70 ± 7.37	68.10 ± 7.34	0.460•	0.632	NS
Range	60–80	60–80	60–80			
Temperature						
Mean ± SD	37.00 ± 0.13	36.99 ± 0.13	36.97 ± 0.15	1.638•	0.196	NS
Range	36.5–37.2	36.5–37.2	36.5–37.2			
RR						
Mean ± SD	13.90 ± 1.31	13.88 ± 1.17	13.88 ± 1.17	0.009•	0.991	NS
Range	12–16	12–16	12–16			
Pulse						
Mean ± SD	80.52 ± 5.32	79.92 ± 5.24	79.70 ± 5.23	0.651•	0.522	NS
Range	70–90	70–90	70–90			
Height						
Mean ± SD	163.09 ± 6.72	162.61 ± 4.80	162.97 ± 5.13	0.198•	0.820	NS
Range	152–177	153–177	153–177			
Weight						
Mean ± SD	75.47 ± 8.29	75.35 ± 8.54	76.58 ± 7.89	0.677•	0.509	NS
Range	60–90	60–90	61–90			

PCA, patient-controlled analgesia; TAP, transversus abdominis plane.

Table 2. Comparison between the three studied groups regarding blood pressure and pulse at 2 h postoperative.

2 h postoperative	PCA group	TAP group	Local inf group	Test value	*P* value	Significance
	N = 100	*N* = 100	*N* = 100			
Systolic BP						
Mean ± SD	103.95 ± 8.05	102.50 ± 9.36	104.05 ± 7.71	1.066•	0.346	NS
Range	85–120	85–120	85–120			
Diastolic BP						
Mean ± SD	65.65 ± 5.53	63.70 ± 6.30	64.75 ± 5.66	2.792•	0.063	NS
Range	55–75	55–75	55–75			
Pulse						
Mean ± SD	73.95 ± 6.84	73.49 ± 7.41	71.96 ± 7.62	2.039•	0.132	NS
Range	58–88	58–88	58–88			

PCA, patient-controlled analgesia; TAP, transversus abdominis plane.

Table 3. Comparison between the three studied groups regarding blood pressure and pulse at 6 h postoperative.

6 h postoperative	PCA group	TAP group	Local inf group	Test value	*P* value	Significance
	N = 100	*N* = 100	*N* = 100			
Systolic BP						
Mean ± SD	102.95 ± 9.98	101.45 ± 9.65	103.95 ± 7.73	1.882•	0.154	NS
Range	85–120	85–120	90–120			
Diastolic BP						
Mean ± SD	66.90 ± 7.10	65.85 ± 6.40	66.35 ± 5.98	0.651•	0.522	NS
Range	60–80	55–80	60–80			
Pulse						
Mean ± SD	80.58 ± 5.60	79.79 ± 6.79	79.92 ± 6.83	0.434•	0.648	NS
Range	70–94	62–94	62–94			

PCA, patient-controlled analgesia; TAP, transversus abdominis plane.

Table 4. Comparison between the three study groups as regard time of first analgesia.

Time to 1st analgesia (min)	PCA group	TAP group	Local inf group	Test value	*P* value	Significance
	N = 100	*N* = 100	*N* = 100			
Mean ± SD	517.70 ± 44.92	384.70 ± 65.19	282.50 ± 29.93	582.527•	0.000	HS
Range	450–600	280–480	220–320			
Post-hoc analysis						
	PCA vs. TAP		PCA vs. local inf.	TAP vs. local inf.		
Time to 1st analgesia	<0.001		<0.001	0.002		

PCA, patient-controlled analgesia; TAP, transversus abdominis plane.

Table 5. Comparison between the three study groups as regard time for ambulation.

Time for ambulation (h)	PCA group	TAP group	Local inf group	Test value	*P* value	Significance
	N = 100	*N* = 100	*N* = 100			
Mean ± SD	5.56 ± 1.38	6.52 ± 0.98	6.98 ± 0.72	46.868•	0.000	HS
Range	4–8.5	4.5–8.5	5.5–8.5			
Post-hoc analysis						
	PCA vs. TAP		PCA vs. local inf.	TAP vs. local inf.		
Time for ambulation (h)	0.000		0.000	0.002		

PCA, patient-controlled analgesia; TAP, transversus abdominis plane.

analgesic use in patients getting either bilateral TAP block, PCA, or wound infiltration for pain reduction after cesarean birth.

Ultimately, the analysis was based on the data of 300 women who underwent elective CS.

The current study revealed that there was no statistically significant variation between PCA, TAP, and local wound infiltration group regarding age and number of the parity among the studied patients ($P = 0.056, 0.101$), respectively.

This study evaluated and compared the baseline preoperative hemodynamics, which were indicated as systolic and diastolic arterial blood pressure, temperature, respiratory rate, and pulse rate with

Table 6. Comparison between the three study groups as regard visual analog scale.

Visual analogs scale (h)	PCA group	TAP group	Local inf group	Test value	*P* value	Significance
	N = 100	*N* = 100	*N* = 100			
VAS 2						
Mean ± SD	1.03 ± 0.86	1.52 ± 0.66	1.79 ± 0.69	37.706≠	0.000	HS
Median (IQR)	1 (0–2)	1 (1–2)	2 (1–2)			
Range	0–2	1–4	1–4			
VAS 4						
Mean ± SD	1.32 ± 0.74	1.74 ± 0.84	3.13 ± 0.96	143.837≠	0.000	HS
Median (IQR)	1 (1–2)	2 (1–2)	3 (2–4)			
Range	0–4	1–5	2–5			
VAS 8						
Mean ± SD	1.25 ± 0.82	1.72 ± 0.78	4.36 ± 0.80	207.910≠	0.000	HS
Median (IQR)	1 (1–2)	2 (1–2)	4 (4–5)			
Range	0–4	1–4	3–7			
VAS 12						
Mean ± SD	1.39 ± 0.86	1.45 ± 0.88	4.98 ± 0.86	205.131≠	0.000	HS
Median (IQR)	1 (1–2)	1 (1–2)	5 (4.5–5)			
Range	0–4	0–5	3–7			
Post-hoc analysis						
	PCA vs. TAP		PCA vs. local inf.	TAP vs. local inf.		
VAS 2	0.000		0.000	0.002		
VAS 4	0.001		0.000	0.000		
VAS 8	0.000		0.000	0.000		
VAS 12	0.802		0.000	0.000		

PCA, patient-controlled analgesia; TAP, transversus abdominis plane; VAS, visual analog scale.

Table 7. Comparison between the three study groups as regard percentage of patients with postoperative nausea, vomiting, and allergy.

	PCA group	TAP group	Local inf group	Test value	*P* value	Significance
	N = 100	*N* = 100	*N* = 100			
Postoperative nausea and vomiting [*n* (%)]						
No	93 (93.0)	100 (100.0)	100 (100.0)	14.334*	0.001	HS
Yes	7 (7.0)	0	0			
Allergy [*n* (%)]						
No	93 (93.0)	100 (100.0)	100 (100.0)	14.334*	0.001	HS
Yes	7 (7.0)	0	0			

PCA, patient-controlled analgesia; TAP, transversus abdominis plane.

the SD for each, among the three investigated groups. It was observed that there was no statistically considerable variation between the three researched groups and the baseline preoperative hemodynamics ($P < 0.05$).

This investigation also assessed and compared baseline postsurgical hemodynamics in the first 24 h at 2, 6, and 12 h, which were indicated as systolic and diastolic arterial blood pressure and pulse rate with the SD for each, respectively, among the three investigated groups. It was discovered that there was no statistically significant distinction between the three investigated groups and baseline hemodynamics preoperatively at 2, 6, and 12 h ($P < 0.05$).

As regards the time to first analgesia, our study results revealed that there was statistically significant variation between PCA and other studied groups and also, significant variations between TAP block and local infiltration regarding of first analgesia demand as the time to first analgesia was longest in PCA group, followed by TAP block group and shortest in local infiltration group ($P < 0.001$).

Guo et al.[11] assess the efficiency and safety of TAP block with wound infiltration for pain relief following surgery in nine studies with 500 participants, as part of a systematic review and meta-analysis that included randomized controlled trials from the PUBMED, EMBASE, and CENTRAL databases. All of the studies used general anesthesia.

In concordance with our results, Aydogmus et al.[12] 70 pregnant women participated in a prospective randomized research that compared the efficiency of ultrasound-guided TAP block with local anesthetic infiltration on a wound site under spinal anesthesia. The results are consistent with our findings because it showed decreased pain scores at 2, 6, 12, and 24 h and enhanced time to the initial analgesic with TAP block group.

As regards the time for ambulation, our study findings showed that there was statistically significant variation between PCA and other studied groups and significant variation between TAP block and local infiltration as the onset of mobilization was shortest in PCA group, followed by TAP block group and longest in local infiltration group ($P < 0.001$).

These outcomes are in agreement with results of previous investigations done by Salem et al.[13] and Abouhi et al.[14] demonstrated significant early case mobilization in the PCA group compared with the TAP block group because PCA delayed patient mobilization owing to its sedative effect.

As regards the postoperative pain score (VAS), our study results showed that there was statistically significant variation between PCA and other studied groups and significant variation between TAP block and local infiltration group as postsurgical pain perception (VAS) at hours 2, 4, 8, and 12 was lowest in PCA group, followed by TAP block group and highest in local infiltration group.

In contrast to TAP block, which solely affects somatic pain in the anterior abdomen wall, the systemic effects of PCA combination treatments on visceral pain may account for PCA's benefit over TAP block as regard pain reduction and patient satisfaction.[13]

In concordance with our results, Abouhi et al.[14] revealed that the PCA group's postoperative pain score (VAS) values were considerably reduced than those in the TAP block group's, indicating a considerable reduction in pain. After 2, 4, 8, and 6 h, women who received intravenous PCA reported much less discomfort than those who received TAP block ($P > 0.001$).

This is in line with earlier investigations by Salem et al.[13] who revealed that at all time periods, the level of pain was considerably reduced in the PCA group compared with the TAP block group ($P < 0.001$).

PCA's benefit over TAP block as regard pain relief and patient satisfaction may be explained by its systemic impacts on visceral pain as compared with TAP block, which only targets physical discomfort in the anterior abdominal wall in agreement with Abouhi et al.[14]

Contrary to what we found, Erbabacan et al.,[15] showed that since the TAP block avoids the systemic impacts of the meperdine used in PCA and its analgesic effect starts sooner, it is thought to be the preferred technique. Nevertheless, this study has focused on lower abdominal procedures rather than CS, which do not include postoperative uterine contraction discomfort.

Görkem et al.[16] carried out a prospective randomized study, and the findings were consistent with ours in that in patients receiving elective CSs under general anesthesia, a single TAP block injection effectively gave pain relief for 12 h after surgery; however, this benefit was limited in patients receiving wound infiltration with regional anesthesia at comparable dosages.

In agreement with our findings, Guo et al.[11] revealed that TAP block showed significant reduce postoperative pain scores at 8 h ($P = 0.009$) and 24 h ($P = 0.03$) than wound infiltration.

As regards the postoperative complications, our study results noted that there was statistically significant variation between PCA and other studied groups regarding percentage of patients with postoperative nausea, vomiting, and allergy as postoperative nausea, vomiting, and allergy were significantly more frequent in PCA group than in TAP block and local infiltration group, the variations were statistically significant ($P < 0.001$).

In line with our results, Salem et al.[13] and Abouhi et al.[14] revealed that moreover, women in the PCA group had considerably more nausea and vomiting than women in the TAP block group ($P = 0.03$ and $P = 0.04$, and $P < 0.001$, respectively). This variation could be due to the nalbuphine dosage used in the PCA group.

Also, Guo et al.[11] revealed that no significant variation in postsurgical vomiting and nausea incidence between TAP group and local wound infiltration group [RR = 1.08, 95 % CI (0.69, 1.71), $P = 0.73$] which agreed with our results.

4.1. Conclusion

Management of pain after a CS is increasingly seen as a major desire from women, as is shown from the present research. TAP block, IV PCA, and local wound infiltration were investigated because of how well they reduced postoperative pain. Nevertheless, because to its visceral impact, IV PCA was preferable than TAP block and local wound infiltration, but TAP block was favored to prevent the systemic action of opioids utilized in PCA.

TAP block requires hand skills, while PCA may be applied with ease. These pain management techniques had few complications and negative effects when medicine dosages were changed.

Conflicts of interest

No conflict of interest of authors.

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