Transversus Abdominis Plane Block Combined with Peritoneal Block Versus Transversus Abdominis Plane Block Alone for Postoperative Analgesia after Cesarean Section: A Prospective Randomized Controlled Double-Blinded Study

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ABSTRACT

Background: Although the transversus abdominis plane block (TAP) has yielded excellent pain management outcomes in ladies undergoing cesarean section (CS), it only covers the somatic component of the pain, not the visceral one, and that could be distressing for some ladies with low pain threshold. Herein, we evaluated the clinical efficacy of adding peritoneal to the TAP block in such cases.

Patients and methods: This prospective randomized study included 180 pregnant ladies scheduled for elective CS, who were randomly allocated into three groups; Group A (TAP block alone), Group B (combined TAP and peritoneal block), and Group C (no block).

Results: All general patient characteristics, along with operative time, showed no significant difference between the three study groups. Pain scores expressed significantly higher values in Group C compared to the other two groups, and that was evident starting from three hours after surgery till the end of the first postoperative day. Group B tended to express lower scores compared to Group A. Group C expressed a significant decline in the duration of the first analgesic request compared to the other two groups. The degree of patient satisfaction was strongly in favor of the two block groups. Group B had a better satisfaction profile compared to Group A.

Conclusion: Although the TAP block alone could provide excellent pain relief after CS, the addition of a concomitant peritoneal block enhanced this effect, as it was associated with lower pain scores and better patient satisfaction.

Keywords: Peritoneal block; Transversus abdominis plane block; Cesarean section.

INTRODUCTION

Cesarean section (CS) rates have substantially grown over the past ten years, either as a result of obstetric indications or mother preference (on-demand CS) [1]. This procedure may save both the mother's and the fetus' lives. [2, 3].

In Egypt, CS represents about 50% of all Egyptian deliveries, according to the Egyptian demographic and health survey conducted in 2014, and that represents a more than 100% increase compared to the 2005 CS rates [4]. Nowadays, our country ranks third among world countries regarding CS rates, after the Dominican Republic and Brazil [2, 4].

The management of postoperative pain after CS is usually challenging for physicians. Although it poses no significant effect on the baby, it could lead to significant maternal dissatisfaction [5]. Multiple protocols have been assigned to manage such unpleasant sensations, including systemic analgesics, intrathecal opioids, and ultrasound-guided nerve blocks, including transversus abdominis plane (TAP), quadratus lumborum (QL), and erector spinae (ES) blocks [6-9].

Pain after CS is mainly composed of two components; somatic and visceral. The abdominal wall incision is responsible for the former, while the uterine incision accounts for the latter [10, 11].

The TAP block procedure, which entails the installation of the local anesthetic agent into the neurovascular plane between the internal oblique and transversus abdominis muscle, has gained wide popularity among pain physicians, especially in pain control after CS [12]. This blocking procedure achieves its analgesic effect by blocking the ventral rami of T6 – L1 spinal nerves, which provide the sensory supply to the anterior abdominal wall [13]. Therefore, this procedure is effective in controlling the somatic source of pain in such patients rather than the visceral one, and that could be irritating for some ladies who have a low pain threshold [10].

Visceral pain is usually reported to be dull, deep, and poorly localized. The patient may even report other forms of discomfort, including tightness, squeezing, or heaviness sensations. It may be associated with significant autonomic reflexes, including hemodynamic changes, nausea, and vomiting [10].

Initial investigations reported that the installation of local anesthesia into the peritoneal cavity caused reversible interruption of nociceptive impulses transmitted through the visceral afferent nerves. Consequently, this might help in decreasing the intensity of post-operative pain arising from a visceral source [14-16].

Although the intraperitoneal installation of local anesthetics appears to be simple and safe, there is a paucity of studies evaluating its efficacy in women undergoing cesarean section. This was a compelling reason for us to carry out the present study, which aimed

to evaluate the clinical efficacy of adding intraperitoneal local anesthetic to the TAP block technique regarding the post-cesarean analgesic profile.

PATIENTS AND METHODS

This prospective randomized study was carried out in the Anesthesiology Departments of Tanta University Hospitals. The study was designed for pregnant ladies aged between 18 and 40 years, having singleton full-term pregnancies and scheduled for elective CS.

Ethical considerations:

All participants completed informed written consent before being recruited in this study. An approval from the Institutional Review Board (code 35030 / 11 / 21), protocol registered in the Pan African Trial Registry PACTR202003463247180. Observing the Consolidated Standards for Reporting Trials' guidelines (CONSORT).

Sample size:

Our sample size was estimated using the PASS software program for windows. We used the data obtained from a pilot study conducted at our university hospitals which considered the time to the first analgesic request as the primary outcome. This parameter had mean values of 12.2 ± 2.56 and 13.8 ± 48 hours in the groups receiving TAP and combined blocks, respectively. Fifty-four patients needed to be allocated to each group to achieve a 90% power and a 0.05 significance level. As six patients were expected to be dropped, we decided to enroll 60 patients in each group.

Our study was designed to include a total of 180 ladies prepared for elective CS during the period between April 2022 and August 2022. Before the operation, all of these ladies were subjected to history taking, clinical examination, and routine preoperative laboratory investigations. In addition, patients were asked about any existing medical comorbidities, and they were classified according to the American Society of Anesthesiologists (ASA) [17]. After proper assessment, we excluded ladies with emergency CS, twin pregnancy, ASA class more than III, body mass index (BMI) more than 40 kg/m2, bleeding diathesis, known allergy to the study medications, or contraindication to spinal anesthesia.

The included 180 ladies were divided into three equal groups; Group A included ladies who received TAP block alone, Group B included ladies who received combined TAP and peritoneal block, and Group C included the remaining ladies who received no block. Randomization was performed via the sealed envelope method, and double-blinding was ensured as both the investigator and the patient were blind about the procedure. All participants signed a written consent after a simple explanation of the benefits, advantages, and possible complications of each intervention. In addition, they were informed how to express their pain using the visual analog scale (VAS), which is graded from 0 to 10, with 0 for no pain and 10 for the worst pain ever [18].

Patients were admitted to the inpatient department the night before surgery, and they were kept fasting for 4 hours before the operation. On the next morning, they were transferred to the obstetric operative theater at the same hospital, where basic hemodynamic monitoring was established. All patients received 1000 ml of ringer lactate solution as a preload before anesthesia. The spinal anesthesia was performed when the patient was in the sitting position using a 25-gauge needle that was inserted into the L3-L4 or L4-L5 interspace. After confirming the free flow of the cerebrospinal fluid, intrathecal administration of 12.5 ml hyperbaric bupivacaine (0.5%) was done. After that, the needle was removed, and the patient was turned to the supine position.

The skin incision was done when the sensory block reached T6 or a higher level (tested via the pinprick). All patients underwent lower segment CS via the Pfannenstiel incision. Any reported pain or discomfort during surgery was managed by IV midazolam (2 mg). Continuous hemodynamic monitoring was done throughout the operation. Bradycardia (heart rate below 50 bpm) was managed by IV atropine (0.25 mg), while hypotension (fall of systolic blood pressure > 30% of its baseline value) was managed by IV ephedrine (5 mg).

Before abdominal wall closure in Group B, the peritoneal block was performed by intraperitoneal instillation of 20 ml bupivacaine 0.25% prepared by adding 10 ml of sterile saline solution 0.9% to 10 ml of 0.5% bupivacaine. In Group A the same volume of sterile saline solution 0.9% was installed intraperitoneal. The local anesthetic agent and the sterile saline were installed via a sterile syringe over the operative bed and the pelvis. Care was taken to dry the pelvis from the amniotic fluid and the collected blood before that installation.

After skin closure, the TAP block procedure was performed in Groups A and B. The TAP block procedure was performed under ultrasound guidance (Toshiba Xario) using the superficial probe. At the level of the anterior axillary line, the probe was positioned in the region between the costal margin and the iliac crest. The three anterior abdominal wall muscles were then identified, and a 20-gauge sono visible needle was inserted till reaching the plane between the internal oblique and transversus abdominis muscles. Negative aspiration was initially done to avoid intravascular injection. Then, 20 ml of 25% bupivacaine was injected into that plane, and dissection of the two muscle layers was noticed on ultrasound. The procedure was repeated on the opposite side.
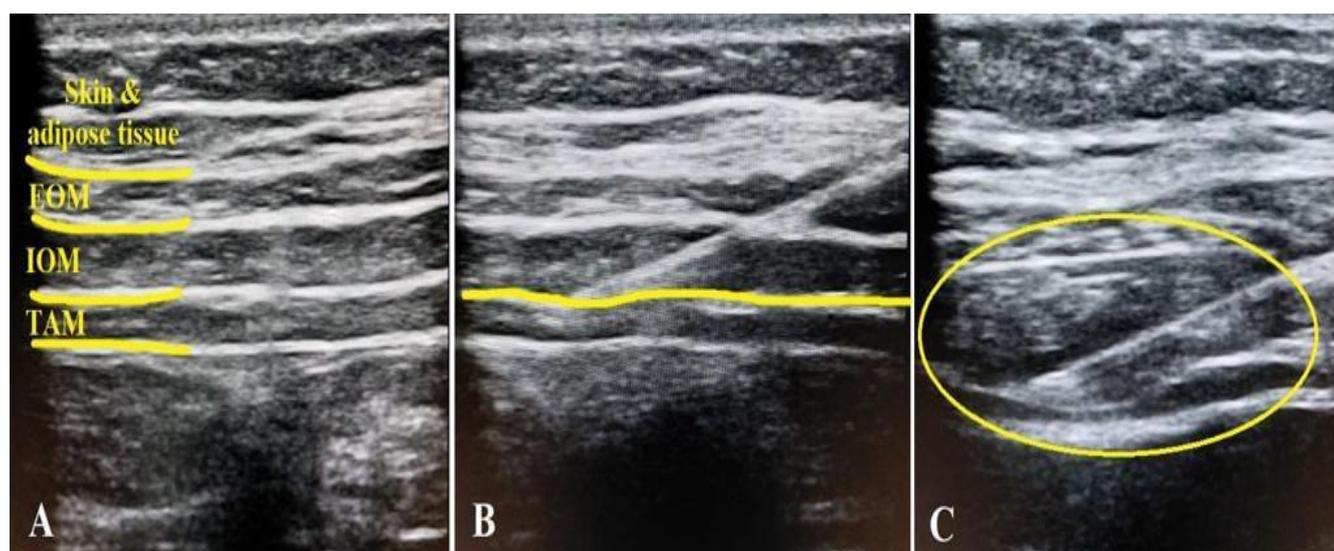
Figure (1): (A) Ultrasound-guided cross-sectional view showing abdominal wall layers. EOM: External oblique muscle, IOM: Internal oblique muscle, TAM: Transversus abdominis muscle. (B) Ultra sonographic view of directing the needle toward the required neurovascular plane, between the IOM and TAM (marked by the yellow line). (C) Ultra sonographic view showing distension of the transversus abdominis plane following injection of the local anesthetic injectate.

The patient was transferred to the PACU after the surgery and then to the internal ward unless any complications were encountered. All patients were commenced on IV paracetamol (1 gm/8h). Patients were asked about their pain, and the VAS was recorded immediately after surgery, then at 1h, 3h, 6h, 12h, and 24h postoperatively. If the patient reported VAS of more than three, IV ketorolac 30 mg was infused. If no response was noted within 15 minutes, IV fentanyl 1 μg/kg was administered, and it was repeated every 4 hours until desirable or side effects occurred. The time to the first analgesic request, the total number of cases requiring rescue analgesics, and the total amount of post-operative opioid consumption were recorded. Before discharge, the ladies were asked to express their satisfaction with their pain management plan on a five-point scale, from 0 to 4, as follows; weak, medium, good, very good, and excellent, respectively [19].

Our primary outcomes included the time to the first analgesic request together with postoperative pain scores. Secondary ones included analgesic requirements, the incidence of side effects, and patient satisfaction.

Data collection:

Tabulation and analysis were conducted by the SPSS software program. Quantitative and categorical data were expressed as mean (SD) and frequency (percentage), respectively.

Statistical analysis

For comparing three groups of parametric and non-parametric quantitative data, One-way analysis of the variance (One-Way ANOVA) and the Kruskal-Wallis test were applied, respectively. Moreover, Bonferroni and Dunn's tests were applied to obtain post hoc analysis for parametric and non-parametric data, respectively. For categorical data, the Chi-square (or Fisher's exact test) was used for comparing two or more data groups of categorical data, whereas the Z test and Bonferroni correction were applied for post hoc analysis. A p-value less than 0.05 was considered significant for all the previous tests.

RESULTS

All general patient characteristics, along with operative time, showed no significant difference between the three study groups (**Table 1**). Their ages had mean values of 26.62, 27.35, and 27.2 years, whereas their BMI had mean values of 30.05, 29.81, and 29.43 kg/m2 in Groups A, B, and C, respectively. Most cases in the three groups had class II according to the ASA classification. These cases represented 71.7%, 75%, and 73.3% of cases in the same three groups, respectively, whereas the remaining cases had class III. The duration of the CS procedure had an average of 45.92, 49.08, and 46.92 minutes in the same three groups, respectively.

Table (1): Demographic data, ASA class, and duration of operation in the three groups.

		Group A (n= 60)	Group B (n= 60)	Group C (n= 60)	P	P1	P2	P3
Age (years)		26.62 ± 5.289	27.35 ± 5.112	27.20 ± 4.558	0.698	0.422	0.523	0.870
Weight (kg)		80.07 ± 16.802	79.92 ± 15.106	79.80 ± 16.476	0.996	0.960	0.929	0.969
Height (m)		1.63 ± 0.082	1.64 ± 0.071	1.64 ± 0.079	0.629	0.696	0.339	0.571
BMI (kg/m²)		30.05 ± 5.269	29.81 ± 4.797	29.43 ± 4.986	0.798	0.799	0.506	0.681
ASA	**II**	43 (71.7%)	45 (75.0%)	44 (73.3%)	0.918	> 0.05	> 0.05	> 0.05
	III	17 (28.3%)	15 (25.0%)	16 (26.7%)				
Surgery Duration (min)		45.92 ± 11.516	49.08 ± 13.482	46.92 ± 13.022	0.379	0.174	0.667	0.351

Data are expressed as a mean and standard deviation or as percentage and frequency. P is significant when < 0.05. P1: Group A vs Group B. P2: Group A vs Group C. P3: Group B vs Group C.

Pain scores expressed significantly higher values in Group C compared to the other two groups. This was evident starting from three hours after surgery till the end of the first post-operative day (p < 0.001). Although Groups A and B showed statistically comparable pain scores at most time points, Group B tended to express lower scores compared to Group A **(Table 2).**

Table (2): Postoperative VAS score in the three groups.

VAS	Group A (n= 60)	Group B (n= 60)	Group C (n= 60)	P	P1	P2	P3
PACU	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	1	1	1	1
One hour	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	1	1	1	1
Three hours	1.05 ± 0.891	0.80 ± 0.777	2.50 ± 1.066	**< 0.001**	0.138	**< 0.001**	**< 0.001**
Six hours	1.97 ± 1.178	1.60 ± 1.123	3.78 ± 1.106	**< 0.001**	0.079	**< 0.001**	**< 0.001**
12 hours	3.57 ± 0.871	3.13 ± 1.112	4.25 ± 1.643	**< 0.001**	0.059	**0.003**	**< 0.001**
24 hours	4.23 ± 1.466	3.63 ± 1.314	5.07 ± 1.436	**< 0.001**	**0.021**	**0.001**	**< 0.001**

Data are expressed as a mean and standard deviation. P is significant when < 0.05.   P1: Group A vs Group B. P2: Group A vs Group C. P3: Group B vs Group C.\

During the postoperative period, rescue analgesia was needed in 86.7%, 85%, and 98.3% of cases in Groups A, B, and C, respectively, with a significant increase in Group C. In addition, fentanyl consumption was markedly increased in the same group (138.25 µg compared to 86.08 and 73.67 µg in Groups A and B, respectively). The same group also expressed a significant decline in the duration of the first analgesic request compared to the other two groups (p < 0.001). It is worth mentioning that Groups A and B were statistically comparable regarding the previous three parameters (p > 0.05). **Table 3** illustrates the previous data.

Table (3): Postoperative analgesic profile in the three groups.

	Group A (n= 60)	Group B (n= 60)	Group C (n= 60)	P	P1	P2	P3
Patients who required rescue analgesia	52 (86.7%)	51 (85.0%)	59 (98.3%)	**0.030**	> 0.05	**< 0.05**	**< 0.05**
1ˢᵗ Request for analgesia	14.77 ± 6.226	16.35 ± 6.690	7.83 ± 5.975	**< 0.001**	0.203	**< 0.001**	**< 0.001**
Fentanyl consumption (µg)	86.08 ± 57.924	73.67 ± 52.882	138.25 ± 49.256	**< 0.001**	0.205	**< 0.001**	**< 0.001**

Data are expressed as a mean and standard deviation or as percentage and frequency. P is significant when < 0.05. P1: Group A vs Group B. P2: Group A vs Group C. P3: Group B vs Group C.

The degree of patient satisfaction with her pain management plan was strongly in favor of the two block groups. In addition, Group B had a better satisfaction profile compared to Group A **(Table 4).**

Table (4): Patient satisfaction score in the three groups.

	Group A (n= 60)	Group B (n= 60)	Group C (n= 60)	P	P1	P2	P3
Weak	0 (0.0%)	0 (0.0%)	14 (23.3%)				
Medium	4 (6.7%)	0 (0.0%)	17 (28.3%)				
Good	28 (46.7%)	18 (30.0%)	22 (36.7%)	**< 0.001**	**< 0.05**	**< 0.05**	**< 0.05**
Very good	22 (36.7%)	36 (60.0%)	6 (10.0%)				
Excellent	6 (10.0%)	6 (10.0%)	1 (1.7%)				

Data are expressed as a percentage and frequency. P is significant when < 0.05.   P1: Group A vs Group B. P2: Group A vs Group C. P3: Group B vs Group C.

DISCUSSION

The current study was performed to elucidate if adding a peritoneal block to the TAP block would be beneficial in pain management following CS. Our cases were divided into three groups; Group A (TAP block alone), Group B (combined TAP and peritoneal block), and Group C (no block). After intensive literature research, no previous study has handled such a comparison in obstetric practice, and that poses an advantageous point in favor of our investigation.

On looking at our pre-procedural parameters, the reader should notice no significant difference between our three groups. This indicates our good randomization, which negates any bias which might have skewed our results towards one group rather than the others.

Our findings showed the superiority of the TAP block (Group A) to controls, as evident in all analgesic profile parameters, including pain scores, rescue analgesic need, rescue analgesic consumption, and time to first analgesic request. This, in turn, was reflected in patient satisfaction, which was significantly better with the TAP block compared to controls.

This is following multiple previous studies, which reported that TAP block is associated with a significant positive impact on postoperative pain scores, especially during the initial 24 hours after the operation [11, 20, 21]. Moreover, the same block led to a significant increase in the duration of the first rescue analgesia [22, 23], whereas opioid consumption was markedly decreased during the early 24 and 48 hours following CS [11, 21, 24].

When it comes to the peritoneal block, one should mention that the visceral nociceptive impulses are difficult to be controlled with opioid analgesics compared to somatic pain (arising from the skin and underlying muscles) [14]. This fact could be explained by different pain pathways and different responses to analgesics by the patients [25, 26]. Nonetheless, intraperitoneal instillation of local anesthetic agents has been described as an effective part of the multimodal analgesic regimen following abdominal operations [27].

It is believed that suturing, stretching, and approximating the upper and lower uterine walls with their covering peritoneum could induce tissue ischemia, which is the major source of visceral pain after CS [14, 28]. Prevention of the transmission of nociceptive impulses via the blockade of peritoneal nerve terminals would be a reasonable and effective method for controlling such an annoying pain source.

Our findings showed that adding the intraperitoneal block to the TAP would have a beneficial effect on pain scores and patient satisfaction without increasing the risk of toxicity (not encountered in the current study). Although the time to the first analgesic request and postoperative opioid consumption were not significantly affected by that combination, the combined group still expressed lower values in both parameters. We think that combining control of both somatic and visceral pain attributed to that outcome and that perspective should be kept in the mind of the anesthesiologist performing the block for any operative procedure. One should put his pain management plan to block all sources of pain to reach an optimum satisfaction level for the served patient.

Pain relief mediated by the peritoneal block is mainly mediated through the blocking of the sodium channels in the peritoneal nociceptive receptors along with its anti-inflammatory effects [29-31].

Our idea was confirmed earlier in a previous study conducted in 2008, in which the authors evaluated the effect of the administration of ropivacaine 0.75% (30 ml) into the layers of the abdominal wound and its spraying along the peritoneum exposed during the CS operation. Installation of local anesthetic was associated with a significant decrease in pain scores, opioid, and non-opioid analgesic consumption [32].

In the same context, Shahin and Osman confirmed the efficacy of intraperitoneal lidocaine in CS patients as they administered 200 mg lidocaine before the closure of the parietal peritoneum. Patients in the lidocaine group expressed a lower incidence of global abdominal pain and wound pain compared to controls. Additionally, pain scores were significantly decreased with the peritoneal block, which led to a significant opioid-sparing effect in the same group. Furthermore, in the intermediate-term follow-up, lidocaine infiltration was associated with a significant decrease in the incidence of chronic post-CS pain compared to controls (10.8% vs. 20.8% respectively – p < 0.001) [14]. Although the previous authors reported the installation of the local anesthetic agent only inside the peritoneal cavity, they attributed the decreased wound pain in their cases to the decreased central sensitization by better visceral pain control, which was also reflected in a better perception of the somatic pain.

Patel et al. applied the same concept using 20 ml lidocaine 2% with epinephrine, which was installed into the peritoneal cavity before closure. The lidocaine group was associated with significantly decreased pain scores during movement and rest. In addition, the need for systemic opioids was significantly decreased in the same group (40% vs. 65% in controls – p = 0.001) [33]. The previous two studies used lidocaine, and we used bupivacaine instead to provide a prolonged analgesic action, as the early postoperative period is often pain-free due to the effect of spinal anesthesia.

The previous studies did not typically apply our idea. However, all of their findings confirmed the efficacy of peritoneal block in pain management, which is in line with our findings.

Although our study has discussed a novel topic that is poorly discussed in the current literature, it has some limitations. The relatively small sample size is one

of them. Also, the effect of the block technique on the incidence of chronic post-CS pain should have been evaluated. These drawbacks wait to be discussed in the upcoming investigations.

CONCLUSION

According to the previous findings, although the TAP block alone could provide excellent pain relief after CS, the addition of a concomitant peritoneal block enhanced this effect, as it was associated with lower pain scores and better patient satisfaction.

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