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Ultrasound Guided TAP Block Efficacy Compared to Patient-Controlled Analgesia in Women Undergoing Caesarean Section

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ABSTRACT
Background: Ultrasound-Guided Transversus Abdominis Plane (USG-guided TAP) block is now utilized as an auxiliary analgesic to reduce the usage of opioids during surgery and to reduce the use of systemic analgesics for postoperative pain management. **Objective:** The aim of the current work was to compare USG-guided TAP block efficacy and patient-controlled analgesia in women undergo caesarean section.
Patients and Methods: This study conducted on 60 pregnant women aged 19-40 years who were scheduled to undergo caesarean section under general anaesthesia, attended at Department of Obstetrics and Gynaecology, Faculty of Medicine, Menoufia University.
Results: Both groups' VAS values declined considerably over time (p=0.05) in the within-group comparison. The SpO2 values did not show any significant difference between the study groups and in the within-group comparison. While, they were considerably higher in Group 1 patients at the postoperative 30th minute and 1st, 2nd, 3rd, 6th, 12th, and 24th hours (p=0.003) in the between-groups comparison. In the between-groups comparison, there were no significant differences in VAS values**.** Nausea-vomiting were significantly increased among patients of group II (2.0 ±0.7) than group I (1.2±0.4) at 30th minute (p=0.015). On contrast, Nausea-vomiting did not show any significant differences among group I and II after, 1, 2, 3, 6, 12 and 24 hours postoperatively.
Conclusion: TAP block could be considered a more desirable approach than intravenous patient-controlled analgesia (PCA) since it avoids the systemic effects of morphine used in PCA and its analgesic impact begins sooner.
Keywords: Caesarean section, Controlled Analgesia, Lower Abd, USG-guided TAP block.

INTRODUCTION

In patients undergoing lower abdominal surgery, systemic opioids or neuraxial methods are frequently used to alleviate postoperative pain [1]. The downsides of this procedure include sedation associated with opioids, respiratory depression, itching, nausea, and vomiting, as well as probable complications of neuraxial techniques such as paraplegia or haemorrhage [2]. The transversus abdominis plane (TAP) block is a technique used for both intraoperative and postoperative anaesthesia. TAP block has been shown to improve multimodal postoperative pain control in lower abdominal surgeries [3].

Rafi was the first to define the TAP block in 2001. Two facial nerve clicks are felt while travelling via the external and internal oblique muscles, taking use of the 'triangle of Petit,' and local anesthetic is applied to the area [4]. This approach was re-defined in 2007 using ultrasonography (USG) guiding.

Ultrasound-guided TAP block involves blocking the frontal branches of T6-L1 nerves and giving local anesthetic drugs in the region between the internal oblique muscle and the transversus abdominis muscle, known as 'TAP' [5]. TAP block is now utilized as an auxiliary analgesic to reduce the usage of opioids during surgery and to reduce the use of systemic analgesics for postoperative pain management [6].
The aim of the current work was to compare USG-guided TAP block efficacy and patient-controlled analgesia in women undergo caesarean section.

PATIENTS AND METHODS

This prospective, randomised study included a total of 60 pregnant women aged 19-40 years who were scheduled to undergo caesarean section under general anaesthesia, attended at Department of Obstetrics and Gynaecology, Faculty of Medicine, Menoufia University.

Ethical consideration:

All procedures were carried out in accordance with the ethical standards of the institutional committee. The study received the approval of Ethical Committee of Faculty Medicine, Menoufia University. A written informed consent was taken from all participants after explaining the aim of study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

The included subjects were divided randomly into two groups with the use of a computer; **Group I (**USG-guided TAP block**)** consisted of 30 pregnant women, and **Group II (**patient-controlled analgesia**)** consisted of 30 pregnant women.

Inclusion criteria: pregnant women, aged 19-40 years who underwent caesarean section under general anaesthesia**.**

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Exclusion criteria: Patients with dementia, depression, persistent pain, or a known allergy to any anesthetic medication.

The patients were brought to the operating room with a 20-gauge cannula put in the back of their left hand, and a 4 mL kg1 0.9% infusion was started.

All participants included in this study were subjected to patients' name, age, and weight, were recorded, and then an electrocardiogram, peripheral oxygen saturation (SpO2) and non-invasive blood pressure monitoring were conducted.

Routine anesthetic induction was performed with 2 mg kg1 propofol, 0.1 mg kg1 morphine, and 0.6 mg kg1 rocuronium in both groups, and anaesthesia was maintained with 50 percent /50 percent O2/air, 2% sevoflurane, and 0.05–0.1 g kg1 min1 remifentanil infusion in both groups.

Following the surgery:

- **Group 1 patients** received 1 mg kg1% lidocaine and 1 mg kg10.5% bupivacaine in a total volume of 30 mL during TAP block. TAP block was carried out in compliance with asepsis and antisepsis rules. The injection site was validated with ultrasound by injecting a test dose of 0.5–1 mL 0.9% NaCl into the internal oblique and transversus abdominis muscles, then local anesthetic drugs into TAP when swelling muscle fascia was detected.10 minutes before extubating.
- **Group 2 patients** received 1 mg kg1 intravenous tramadol. The patients were decurarized with 0.01 mg kg1 intravenous atropine and 0.02 mg kg1 intravenous neostigmine and extubated after the operation. They were brought to the recovery unit after that. Also, patients in group 2 received 1 mL intravenous morphine at a concentration of 1 mg mL1 as PCA with a 10-min lock time.

At the 30th minute and 1st, 2nd, 3rd, 6th, 12th, and 24th hours after surgery, a visual analogue scale (VAS), further analgesic need, and the existence of nausea-vomiting were assessed. Heart rate (HR), mean arterial pressure (MAP), respiratory rate (RR), and oxygen saturation (SpO2) were also measured before induction and at the 30th minute, 6th, 12th, and 24th hours after surgery.

The nausea-vomiting scale, which ranges from 0 to 3, was used to assess nausea and vomiting (0: no nausea-vomiting, 1: moderate nausea-vomiting; 2: severe nausea-vomiting; 3: severe nausea-vomiting; 4: severe nausea-vomiting; 5: severe nausea-vomiting; 6: severe nausea-vomiting; therapeutic required, 3: severe nausea-vomiting; treatment resistance).

Statistical analysis

Data was collected, tabulated and statistically analyzed using an IBM compatible personal computer with Statistical Package for the Social Sciences (SPSS) version 25 (SPSS Inc. Released 2020. IBM SPSS statistics for windows, v. 25.0, Armnok, NY: IBM Corp.) and MEDCALC V.19.6.1 programs. Descriptive statistics included Percentage (%), mean (x), median, range and standard deviation (SD) and analytic statistics included chi-square test ($\chi 2$) Student's t-test and Fisher's test. P value<0.05 was considered statistically significant.

RESULTS

Table 1 shows that there were no statistically significant differences between group I and group II regarding age, height, weight, body mass index and diagnosis, with p value >0.05.

Table (1): Demographic data for the study patients.

	Group I N=30	**Group II N=30**	**P value**
Age (year) mean± SD	47.7±12.0	50.5±10.3	0.678
Hight (cm) mean± SD	165.6±5.88	169.9±9.32	0.342
Weight (kg) mean± SD	70.5±15.09	76.12±18.43	0.501
BMI (kg/m^2) Mean± SD	25.95±3.11	26.70±2.87	0.379
Diagnosis Inguinal hernia varicocele	23 (76.7%) 7 (23.3%)	19 (63.3%) 11 (36.7%)	0.311

SD: standard deviation

Table 2 shows **that,** VAS score was significantly higher at 30 minutes, then start decreased gradually after 1 hours, 2 hours to 24 hours postoperatively. Also, Vas score was significantly different after 1, 2, 3, 6, 12 and 24 hours compared 30 minutes (p<0.05).

Table (2): VAS values among group I and II preinduction and after 12 hours postoperatively.

	VAS values						
	30 min	**1h**	**2h**	**3h**	**6h**	**12h**	**24h**
Group I mean± SD	3.4±2.7	3.1±1.9*	2.8±1.8*	2.3±1.5*	1.7±1.2*	0.8±1.4*	0.6±1.2*
Group II mean± SD	4.9±1.8	4.3±1.6	2.2±1.8*	1.3±1.5*	0.6±1.2*	0.5±0.8*	0.0±0.2*

VAS: Visual analogue scale; SD: standard deviation; *p=0.001 in within-group comparison

Table 3 shows that, In the within-group comparison for Group 1 patients, there was no statistically significant difference in heart rate values across all time periods. In Group 2 patients there was no significant difference between the HR values at the 30th minute and the 1st, 2nd, 3rd, 6th, 12th, and 24th hours. After surgery, a significantly lower of the preinduction HR values of Group 2 patients at the 30th minute compared 1st, 2nd, 3rd, 6th, 12th, and 24th hours. While the preinduction HR values of Group 1 and Group 2 participants did not change significantly. Also, HR values of Group 1 patients were substantially lower than those of Group 2 patients at the 30th minute and 1st, 2nd, 3rd, 6th, 12th, and 24th hours after surgery. On contrast, there was no significant difference in mean arterial pressure readings in the comparisons between groups and within groups.

Table (3): HR and MAP values among group I and II preinduction and after 12 hours postoperatively.

	HR		**MAP**	
	Group I Mean± SD	**Group II** Mean ± SD	**Group I** Mean ± SD	**Group II** Mean ± SD
Preinduction	76.7±12.1	78.7±9.6	100.3±14.2	101.1±13.7
30 min	66.4±11.6	86.0±13.2*	102.3±16.2	106.2±15.4
1h	76.1±11.5	83.6±9.3*	103.0±13.4	102.5±16.1
2h	73.7±12.8	80.3±8.8*, †	98.8±15.1	101.3±13.1
3h	72.7±10.7	75.0±8.2*, †	103.3±13.0	102.3±14.7
6h	70.4±11.7	78.1±7.9*, †	101.3±16.1	99.4±14.1
12h	66.6±8.9	75.0±7.9*, †	105.2±14.4	103±13.1
24h	70.1±9.3	78.0±7.6*, †	106.1±12.9	104.8±13.3

HR: heart rate; MAP: mean arterial pressure; SD: standard deviation; *p<0.01 in the comparison of Group 1 to Group 2, † p<0.05 in within-group comparison, preinduction values according to other time periods

Table 4 shows that, The SpO2 values did not show any significant difference between the studied groups and in the within-group comparison. While, they were considerably higher in Group 1 patients at the postoperative 30th minute and 1st, 2nd, 3rd, 6th, 12th, and 24th hours (p=0.003) in the between-groups comparison.

Table (4): SpO2 values among group I and II preinduction and after 12 hours postoperatively.

	Group I	**Group II**
Preinduction	98.1±1.1	98.4±1.4
30 min	99.5±1.2	97.4±2.4*
1h	98.9±1.9	97.6±1.7*
2h	97.4±2.3	97.2±1.4*
3h	97±2.1	96.8±1.1*
6h	97.4±2.2	97±1.0*
12h	97.5±1.9	96.8±0.8*
24h	97.8±1.6	97.1±0.9*

* p<0.003 in the comparison of Group 1 to Group 2

Results in **table 5** indicated that, respiratory rates did not show any significant differences in the studied group I and group II, and within-group (p>0.05).

Table (5): Respiratory rate per minute preinduction and after 12 hours postoperatively among group I and II.

	Preinduction	30 min	1h	2h	3h	6h	12h	24h
Group I mean± SD	15.1±2.4	19.8±2.3	19.8±1.6	19±2.5	16.0±2.5	15.8±2.8	15.7±2.8	15.3±3.0
Group II mean± SD	14.9±1.8	19.2±1.8	19.2±1.1	18.8±1.2	18.0±1.0	15.6±1.5	15.8±1.6	16.4±1.2

Results in **table 6** indicated that, Additional analgesic needs did not show any significant differences in the studied group I and group II, and within-group ($p>0.05$).

Table (6): Additional analgesic needs among group I and II preinduction and after 12 hours postoperatively.

	Preinduction	30 min	1h	2h	3h	6h	12h	24h
Group I								
Existing	1	0	0	0	0	0	0	0
not existing	25	25	25	25	25	25	25	25
Group II								
Existing	3	1	0	0	0	0	0	0
not existing	23	24	25	25	25	25	25	25

Table 7 shows that nausea-vomiting were significantly increased among patients of group II (2.0 ±0.7) than group I (1.2±0.4) at 30th minute ($p=0.015$). On contrast, Nausea-vomiting did not show any significant different among group I and II after, 1, 2, 3, 6, 12 and 24 hours postoperatively.

Table (7): Nausea-vomiting among group I and II preinduction and after 12 hours postoperatively.

	30 min	1h	2h	3h	6h	12h	24h
Group I mean± SD	1.2±0.4	0.9±0.5	0.5±0.4	0.3±0.4	0.6±0.4	0.4±0.4	0.0±0.2
Group II mean± SD	2.0 ±0.7*	1.2 ±0.9	0.8 ±0.9	0.5 ±0.6	0.9±0.7	0.4±0.4	0.5±0.6

DISCUSSION

Ultrasound-guided TAP block (USG-guided TAP) is now utilised as an auxiliary analgesic to reduce the usage of opioids during surgery and to reduce the use of systemic analgesics for postoperative pain management [7]. It is feasible to reduce the harmful effects of medications with systemic action by improving regional anesthetic procedures in postoperative pain management, and pain therapy can be administered more efficiently. Although several studies by **Elkassabany *et al.*** [8] **and McDonnell *et al.*** [9] have shown that TAP block reduces postoperative pain following lower abdominal surgery, **Cahrlton *et al.*** [10] stated that there is no study that compares TAP block to another pain management strategy. Similarly, we found no study comparing the analgesic effects of intravenous morphine PCA and TAP block in our literature review. **Sharma *et al.*** [11] examined the analgesic effects of tramadol PCA against TAP block administered in addition to PCA, finding that VAS values were lower in TAP block patients than in non-TAP block patients. **Peterson *et al.*** [12], on the other hand, used postoperative TAP block under USG in one group of patients who had inguinal hernia surgery and assured the surgeon to execute both blind local anesthetic infiltration and ilioinguinal nerve block in another group. Both groups were compared to a placebo group. They claimed that VAS values in the TAP block group were much higher than in the infiltration group, but that they were not different from the placebo group. The TAP group received 25 mL of 0.75 percent ropivacaine, whereas the infiltration group received 40 ml. Moreover, the ilioinguinal block was performed with 10 mL 0.375 percent ropivacaine. Every 6 hours, all patients were given 1 g oral paracetamol and 400 mg ibuprofen.

Although the amount and volume of local anesthetic agent administered in the infiltration group was higher than in the TAP block group, an ilioinguinal block was also provided, which could explain the discrepancies in VAS scores. Furthermore, regardless of the presence of pain, the dose of paracetamol and ibuprofen given to the placebo group is much higher for postoperative pain therapy after inguinal hernia surgery, obviating the need for extra intervention. An example of systemic drug use that we aimed to prevent in our study is a pain management strategy that includes an additional dose regardless of VAS levels. Similarly, during gynaecological lower abdominal procedures, **Sivapruapu *et al.*** [13] used local anesthetic infiltration in one group and TAP block in another, in addition to morphine PCA. TAP block reduces postoperative pain as well as the need for extra narcotics, according to the researchers. In our investigation, there was no significant difference in VAS values or additional analgesic demand between patients who got only intravenous morphine PCA and those who received only TAP block in the first 24 hours.

Because the block is volume-dependent, which boosts efficiency, the volume of 30 mL, rather than 20 mL or less, could be the explanation for increased apparent efficiency in the TAP block. The effect of the TAP block began throughout the patient's recovery because it was applied before extubation. Because opioids were not required for postoperative pain control during this time, patients who received TAP block awoke more easily and without pain. We believe that this impact prevented pain from restricting breathing, resulting in a higher SpO2 than in the PCA group. The use of TAP block prior to surgery has been shown to significantly reduce the use of opioids during operation **[14].** However, we employed TAP block after surgery because we found in our preliminary study that preoperative TAP block, especially at large dosages, made it difficult for the surgeon to determine the anatomy and lengthened surgery times in upper abdominal surgeries such inguinal hernia and varicocele. HR values were observed to be significantly lower in the TAP block group than in the PCA group in our investigation, which could be due to decreased sympathetic system activation and fewer patient complaints of discomfort. The lack of a substantial difference in mean arterial pressure values does not support this impact. This effect may be due to morphine PCA's vasodilation impact. The change in HR values was statistically significant but not clinically meaningful. While the TAP block group had considerably higher SpO2 readings, there was no change in frequency.

The depressed effect of opioids on respiration and the favourable effect of low pain scores on respiration can both be explained by this observation. Except at the 30th minute, no significant difference in nausea-vomiting frequency was detected in our investigation. The PCA group, on the other hand, had a higher rate of nausea and vomiting at the 30th minute. This finding is in line with the findings of **Sivapurapu *et al.* [13].** We believe the increased nausea and vomiting was due to the emetic effect of tramadol given to the PCA group before to extubating. Because TAP block and PCA are two separate procedures, our study's disadvantage is that the people who evaluated and the patients were not blinded.

CONCLUSION

When TAP block is given in a volume of 30 mL during a caesarean section, it is equally effective as intravenous PCA in pain relief. TAP block could be considered a more desirable approach than intravenous PCA since it avoids the systemic effects of morphine used in PCA and its analgesic impact begins sooner.

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Author contribution: Authors contributed equally in the study.

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