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ORIGINAL ARTICLE

Ultrasound-guided Transversus Abdominis Plane Block for Pain Control in Patients' Intraoperative Cesarean Section

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Abstract

Background: **Transversus abdominis plane (TAP) block is a peripheral nerve block that anesthetizes the abdominal wall. The thoracolumbar nerves (T10−L1) are located in the fascial plane (TAP) among the internal oblique and transverse abdominis muscles.**

Aim: **The objective of the research is to analyze the evidence and assess the analgesic efficacy of ropivacaine TAP block for 24 h following Pfannenstiel incision cesarean surgery.**

Patients and methods: **A prospective randomized controlled clinical trial was conducted on 60 females undergoing cesarean section in the Department of Obstetrics and Gynecology of Al-Azhar University Hospital and El-Fayoum General Hospital. The participants were separated into two groups at random.**

Results: **The percentage of individuals in both groups requiring NSAIDs at 8, 12, and 24 h was substantially greater in group C, but there was not a significant distinction among the groups overall. There was also a substantial reduction over time in the proportion of individuals in each group who required NSAIDs.**

Conclusion: **Because abdominal incision pain is so prevalent in the postoperative period following a cesarean, the TAP block, when combined with other forms of analgesia, can lessen the need for pain medication in the first 48 h after surgery, improve the effectiveness of the first analgesic, and enhance postoperative patient satisfaction.**

Keywords: Cesarean section, Pain control, Ultrasound

1. Introduction

Delivery of a fetus via a surgically made incision in the anterior uterine wall is the traditional definition of a cesarean section. Some people prefer the terms 'cesarean delivery' and 'cesarean birth' to describe the surgery, since cesarean and section both refer to an incision. The terms 'primary cesarean' and 'repeat cesarean' refer, correspondingly, to the 'first-time' and 'second-time' cesareans.[1]

The number of mothers giving birth via cesarean section has increased rapidly over the past two decades, highlighting the importance of providing good postoperative analgesia, so that mothers can quickly regain their mobility and begin caring for their newborns.[2]

There is no 'gold standard' for postcesarean pain treatment; different factors, involving as individual needs and expectations, projected surgical difficulty, and length, can all impact the choice of analgesic regimen.[3]

Also Kelly and Malhotra,[4] suggested that transversus abdominis plane (TAP) blocks with a ropivacaine concentration of 0.5%+ or more have been shown to be effective in reducing the need for rescue analgesia, along with its potential adverse effects. TAP blocks have been shown to lessen the need for pain medication after a cesarean section. TAP blocks guided by ultrasound are a cutting-edge technique in anesthesia.

Moreover Jadon *et al.*,[5] concluded that when utilized as part of a multimodal analgesic regimen for

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pain treatment following cesarean section, TAP block lowers pain, delays the time to the first analgesic request, and minimizes the need for additional opioid analgesics.

2. Patients and methods

This research is a prospective randomized double-blind, controlled clinical trial performed on 60 females undergoing cesarean section in the Department of Obstetrics and Gynecology of Al-Azhar University Hospital and El-Fayoum General Hospital. The individuals were randomized in two equal groups. Group 1: patients who received ultrasound-guided TAP block with 0.5% ropivacaine, 15 ml on either side (group S). Group 2: patients who received ultrasound-guided TAP block with 0.9% normal saline ($n = 30$), 15 ml on either side (group C). Both groups were observed postoperatively to assess the pain scores at 1, 2, 4, 8, 12, 18, and 24 h and also to observe for any side effects or complications. The average maternal age was 28 years.

The trial was granted by the local institutional Ethical Review Committee and registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12614000648628). The patients, researcher, and the assistants were blinded regarding the method of analgesia to eliminate bias. A prior ethical approval was obtained from Faculty of Medicine Committee at 24/8/22021 and Obstetrics & Gynecology Department Council at 8/5/2021 and a written and signed informed consent was obtained by all the cases involved in the research.

2.1. Inclusion criteria

Represented by an age ranged from 21 to 45 years, healthy, full-term pregnant women, American Society of Anesthesiologists (ASA) physical status I–II, and elective cesarean section under general anesthesia.

2.2. Exclusion criteria

Represented by an age below 21 or above 45 years, ASA status III and above, cardiac, renal, hepatic impairment or neurologic problems, and dysrhythmia by ECG, contraindications to spinal anesthesia, undergoing general anesthesia, intrauterine growth restriction, or fetal compromise. Patients who had local anesthetic toxicity and morbidly obese patients.

2.3. Complete history-taking

A full detailed history included personal history (maternal age), menstrual history (accurate last menstrual dates and gestational age using Naegele rule), obstetric history (as regards parity, gravidity, number of previous cesarean sections, gestational age, medical disorders, and chronic diseases), present history, family history, and past history.

2.4. Physical examination

General examination [BMI (kg/m^2), systolic blood pressure (mmHg), diastolic blood pressure (mmHg) before and after operation, and heart rate (bpm)], chest and heart examinations, obstetric abdominal examination (fundal level, fetal presentation, estimation of fetal weight, amount of liquor, and scars of previous operations), and oxygen arterial saturation (SaO_2%).

2.5. Intraoperatively

The monitors were attached to the patients involving pulse oximetry, ECG, and noninvasive blood pressure. At the time, baseline measurements were taken. After inserting and securing an 18-G intravenous cannula, preloading with 15 ml/kg intravenous Ringer solution was initiated.

2.6. Spinal anesthesia

The subarachnoid block was administered to all of the patients while they were seated. After applying proper sterilization, 3 ml of 2% lidoacine hydrochloride (Lonza Netherlands, former PharmaCell) Urmonderbaan 20B, 6167 RD Geleen, Netherlands was administrated for skin infiltration at the level of L3–L4 or L4–L5 intervertebral space, then a 25-G spinal needle (Spinocan; B-Braun, Melsungen, Germany) was introduced at the same site of local anesthetic infiltration via the paramedian approach till cerebrospinal fluid back flow was obtained, and then 1.8 ml of 0.5% hyperbaric bupivacaine (Marcaine; spinal, AstraZeneca, Cambridge, UK) was injected together with 25 μg of fentanyl. The patient was then immediately placed in the supine position with 15° left tilt with slight pad elevating the head and neck of the patient. An oxygen facemask was applied with 3 l/min flow. After testing the success of the sensory and motor block by pin-brick test and Bromage scale, respectively, the surgeons were allowed to proceed with the surgery. After 20 min, if the sensory and motor block levels were unsatisfactory, the patient was excluded from the study.

Heart and breathing rates were monitored every 3 min for the first 15 min of the operation, and then every 5 min thereafter. Increases in intravenous fluid and recurrent doses of 6 mg of intravenous

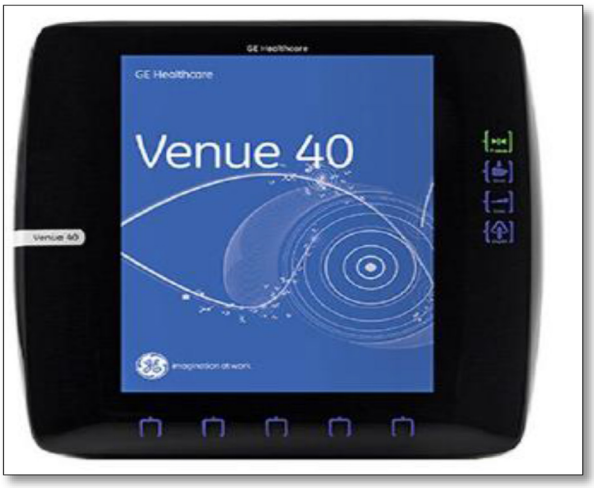

Fig. 1. GE Venue 40 point-of-care ultrasound machine (GE healthcare).

ephedrine were used to treat severe hypotension (a 20% drop from the patient's baseline blood pressure). Individuals having a heart rate of 55 beats per minute or below were given 1 mg of intravenous atropine.

After the surgeon has finished closing the wound, TAP block was performed to the selected patients as follows: all sections utilized a GE Healthcare (Milwaukee, Wisconsin 53201 U.S.A.) GE Venue 40 point-of-care ultrasound system equipped with a broadband high-frequency (5–13 MHz) linear array transducer (12 L-SC) (Fig. 1).

SonoPlex echogenic needles by Pajunk (21 G, 100 mm) were utilized to carry out the blocks (Fig. 2). Patients were positioned supine during the whole procedure, and antiseptic chlorhexidine solution was employed to prepare the skin at the block location. Sterile gloves, overhead caps, masks, drapes, and ultrasound probe coverings were utilized in a strict aseptic technique.

The ultrasound probe was positioned in the midaxillary line, directly between the individual's lower costal border and iliac crest, on the side that would be blocked. Sliding the probe front to back along the lateral abdominal wall allowed us to get a good look at the external oblique, internal oblique, and transversus abdominis muscles that make up the abdominal wall, from superficial to deep

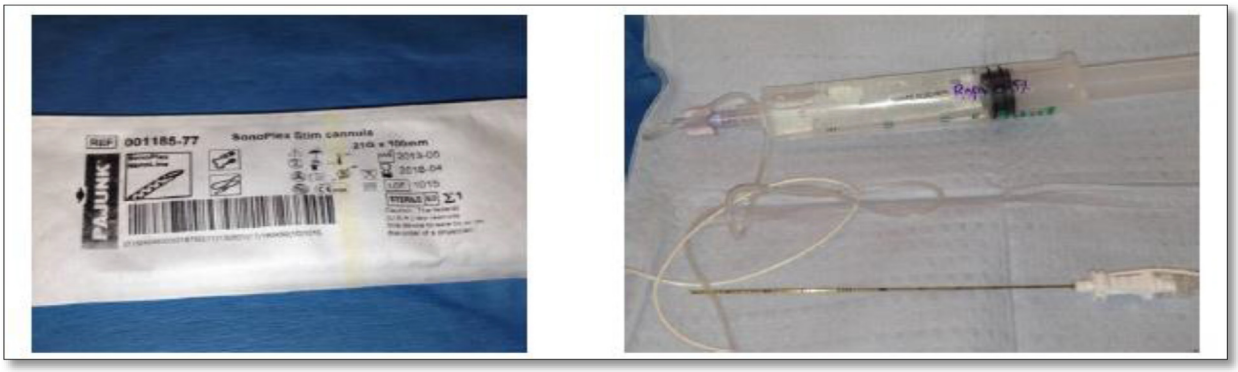

Fig. 2. About 21-G (100-mm) SonoPlex echogenic needle by Pajunk.

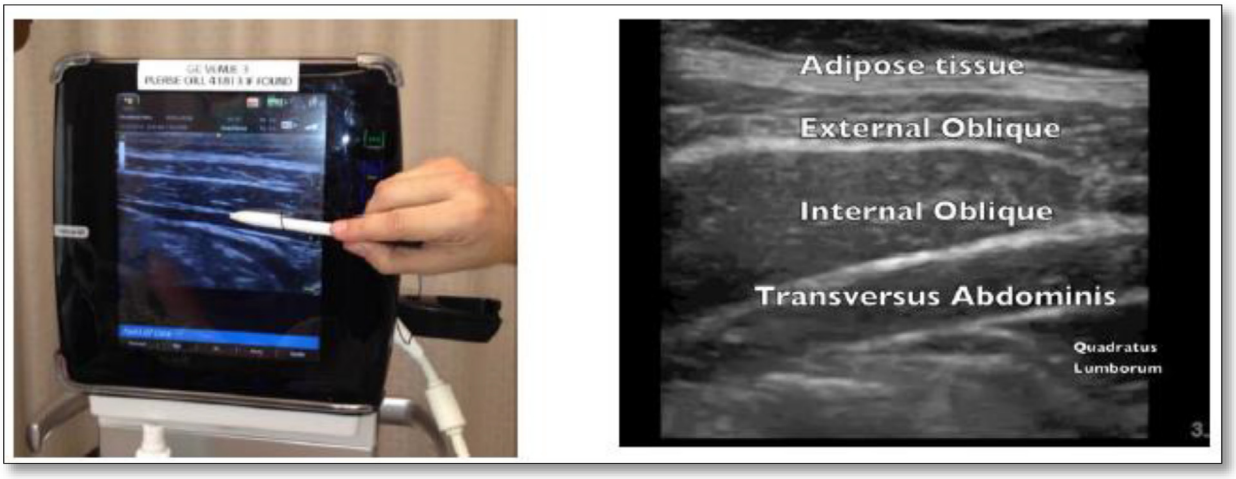

Fig. 3. Muscular layers forming the abdominal wall, with the area of the abdomen defined by the transversus abdominis and internal oblique muscles.

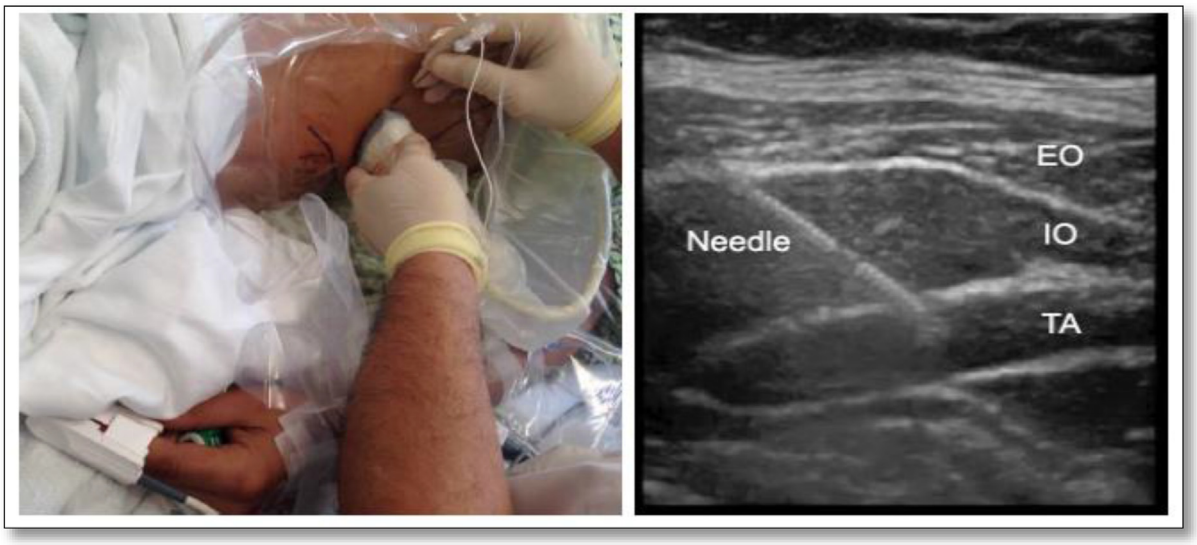

Fig. 4. Needle tip appears in the transversus abdominis plane between the internal oblique and transversus abdominis (in-plane approach of the needle). EO, external oblique muscle; IO, internal oblique muscle; TA, transversus abdominis muscle.

(Fig. 3). The deeper fascia transversalis that separates the muscles from the preperitoneal fat and the peritoneum was carefully identified and distinguished from the prospective plane between the internal oblique muscle and the transversus abdominis.

The ultrasound-guided TAP block is administered behind the anterior axillary line, between the iliac crest and the lowest point of the rib cage. The probe is positioned transverse to the abdomen, in a plane across the internal oblique and transversus muscles, which is about along the anterior axillary line. Attaching normal saline to the needle, hydrodissection was performed between the internal oblique (superficial) and transversus abdominis (deep) until the tip of the needle was accurately recognized in the TAP (Fig. 4).

After a negative aspiration, 20 ml of bupivacaine 0.25% is injected into the space among the two targeted muscles in incremental increments over a few minutes (Fig. 5). During the injection, participants were observed for any signs of neurologic or cardiopulmonary distress, as well as any toxicity from the local anesthetic. The anesthesiologist who performed the spinal anesthesia also performed the TAP block.

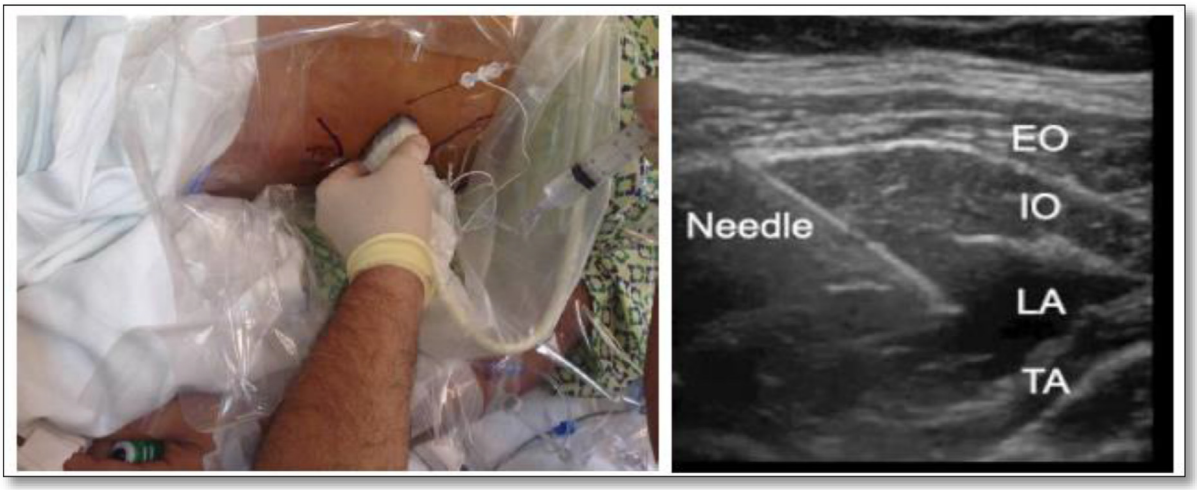

Fig. 5. Injection of the study solution (local anesthetic or saline), which appears in the transversus abdominis plane between the internal oblique and transversus abdominis.

2.7. Postoperatively

Cases were transferred to the postanesthesia care unit and then to the ward. All patients received paracetamol on demand as intravenous infusion analgesia at a dose of 15 mg/kg every 8 h (maximum dose: 4 g/day). The patients also received diclofenac sodium when needed as intramuscular injection of 75 mg (maximum dose: 225 mg/day).

After explaining the pain scale as a 100-mm horizontal line with verbal anchors at both ends at the preoperative appointment, participants rated their postoperative pain on a conventional 10-cm visual analog scale for scoring at 1, 2, 4, 8, 12, 18, and 24 h.

2.8. Statistical analysis

Data that were entered, checked, and analyzed utilized Epi-Info, version 6 and SPSS (Armonk, New York, U.S.A.) for Windows, version 8.[6]

3. Results

There is not a statistically significant distinction in age, BMI, pregnancy, parity, abortion, or gestational age across the groups that were analyzed (Table 1).

There is no substantial variation in systolic blood pressure across the groups at baseline or throughout time. There is a substantial variation (fluctuation) in systolic blood pressure over time in both groups (Table 2).

Table 1. Comparison among the examined groups as regards baseline criteria.

Parameters	Groups		Test	
	Group S ($N = 30$)	Group C ($N = 30$)	$\chi^2/t/Z$	P
Age (years)				
Mean ± SD	28.06 ± 5.4	27.44 ± 3.43	0.391	0.698
Range	21–45	24–35		
BMI (kg/m^2)				
Mean ± SD	27.94 ± 6.55	26.88 ± 7.03	0.442	0.661
Range	17–34	17–34		
Gravidity				
Median	3.5	3.5	−0.77	0.441
Range	1–8	1–8		
Parity				
Median	2	2.5	−0.832	0.405
Range	0–5	0–5		
Abortion				
Median	0	1	−1.148	0.251
Range	0–2	0–2		
Gestational age (weeks)				
Mean ± SD	38 ± 0.89	37.31 ± 2.75	0.922	0.364
Range	37–39	37–39		

χ^2, χ^2 test; t, independent sample t-test; Z, Mann–Whitney test.

Table 2. Comparison among the examined groups as regards systolic blood pressure over time.

SBP (mmHg)	Groups		Test	
	Group S ($N = 30$)	Group C ($N = 30$)	t	P
Baseline	130.63 ± 9.81	126.25 ± 13.6	1.043	0.306
In the first hour	122.5 ± 6.83	118.75 ± 8.06	1.419	0.166
In the second hour	123.75 ± 13.1	121.25 ± 11.17	0.581	0.566
After 4 h	126.25 ± 19.28	120 ± 17.89	0.951	0.349
After 8 h	125 ± 12.65	121.25 ± 12.04	0.859	0.397
After 12 h	123.13 ± 11.82	122.81 ± 12.11	0.074	0.942
After 18 h	123.13 ± 11.82	122.81 ± 12.11	0.074	0.942
After 24 h	126.56 ± 7.47	126.25 ± 5	0.139	0.89
P (F)	<0.001[a]	<0.001[a]		

F, repeated measure analysis of variance; SBP, systolic blood pressure.

[a] P value less than or equal to 0.001 is statistically highly significant.

There are no variations in diastolic blood pressure among the groups at baseline or at any time point investigated. There is a substantial time-to-time variation (fluctuation) in diastolic blood pressure in both groups (Table 3).

There is no significant distinction in heart rate among the groups at baseline or throughout time. The heart rate fluctuates significantly over time in every group (Table 4).

There is not a significant distinction in oxygen saturation levels among the groups at baseline or at any time point investigated. Oxygen saturation levels significantly fluctuate over time in all three groups (Table 5).

Visual analog scale (VAS) pain scores varied substantially among groups at baseline and over time (being significantly lower in group S). In both groups, the VAS pain score significantly increased with time (Table 6).

Table 3. Comparison among the examined groups regarding diastolic blood pressure over time.

DBP (mmHg)	Groups		Test	
	Group S ($N = 30$)	Group C ($N = 30$)	t	P
Baseline	81.88 ± 8.54	75.63 ± 12.5	1.651	0.11
In the first hour	77.5 ± 12.5	71.25 ± 12.04	1.517	0.14
In the second hour	80.63 ± 7.93	77.5 ± 10	0.979	0.336
After 4 h	76.88 ± 12.76	73.13 ± 11.24	0.882	0.385
After 8 h	76.25 ± 12.65	72.5 ± 4.47	1.772	0.089
After 12 h	73.75 ± 11.18	72.81 ± 7.3	0.281	0.891
After 18 h	74.69 ± 6.95	74.06 ± 9.87	0.207	0.837
After 24 h	75.63 ± 8.54	77.5 ± 6.33	−0.706	0.486
P (F)	0.024[a]	<0.001[b]		

DBP, diastolic blood pressure.

[a] P value less than 0.05 is statistically significant.

[b] P value less than or equal to 0.001 is statistically highly significant.

Table 4. Comparison among the examined groups as regards heart rate over time.

Heart rate (beat/min)	Groups		Test	
	Group S ($N = 30$)	Group C ($N = 30$)	t	P
Baseline	84.13 ± 6.86	84.44 ± 6.22	−0.135	0.89
In the first hour	88.5 ± 1.37	87.75 ± 1.61	1.42	0.17
In the second hour	80.25 ± 3.17	81.94 ± 4.42	−0.742	0.46
After 4 h	81.94 ± 3.15	83.56 ± 3.56	0.992	0.385
After 8 h	83 ± 3.72	84.5 ± 4.47	−1.368	0.182
After 12 h	84 ± 4.13	86 ± 3.58	−1.464	0.154
After 18 h	82.69 ± 3.98	82.75 ± 3.26	−0.094	0.96
After 24 h	82.63 ± 5.01	83 ± 4	−0.234	0.816
P (F)	<0.001[a]	<0.001[a]		

[a] P value less than or equal to 0.001 is statistically highly significant.

Table 5. Comparison among the investigated groups concerning oxygen saturation over time.

Oxygen saturation (%)	Groups		Test	
	Group S ($N = 30$)	Group C ($N = 30$)	t	P
Baseline	98.13 ± 0.72	97.75 ± 0.45	1.772	0.087
In the first hour	96.13 ± 1.2	96.88 ± 1.2	−1.762	0.09
In the second hour	96.63 ± 0.72	96.38 ± 0.5	1.142	0.26
After 4 h	97.19 ± 0.83	96.75 ± 1	1.344	0.189
After 8 h	96.81 ± 0.66	96.5 ± 0.73	1.274	0.21
After 12 h	97.88 ± 1.02	96.88 ± 1.15	2.007	0.05
After 18 h	96.5 ± 0.63	96.25 ± 0.45	0.291	0.21
After 24 h	96.56 ± 1.15	96.25 ± 1.07	0.797	0.432
P (F)	<0.001[a]	<0.001[a]		

[a] P value less than or equal to 0.001 is statistically highly significant.

Table 6. Comparison among the investigated groups concerning visual analog scale.

VAS pain score	Groups		Test	
	Group S ($N = 30$) [median (range)]	Group C ($N = 30$) [median (range)]	Z	P
In the first hour	0 (0)	0 (0–2)	−2.39	0.017[a]
In the second hour	0 (0)	0 (0–2)	−2.39	0.017[a]
After 4 h	1 (1–2)	2 (1–3)	−1.989	0.047[a]
After 8 h	2 (1–2)	2 (1–4)	−2.422	0.015[a]
After 12 h	2 (1–3)	3 (2–5)	−3.077	0.002[a]
After 18 h	3 (2–4)	4 (4–5)	−4.346	<0.001[b]
After 24 h	3 (2–5)	5 (4–5)	−3.187	0.001[b]
P (F)	<0.001[b]	<0.001[b]		

F, Friedman test; VAS, visual analog scale; Z, Mann–Whitney test.

[a] P value less than 0.05 is statistically significant.

[b] P value less than or equal to 0.001 is statistically highly significant.

The percentage of individuals in both groups who require an NSAID after 8, 12, and 24 h is substantially different among the groups tested (all significantly greater in group C). Over time, the percentage of individuals in each group who require NSAIDs has reduced significantly (Table 7, Fig. 6).

While there is no statistically significant distinction among the groups after 8 or 12 h, there is significant variation between the groups after 24 h (much greater in group C) in the percentage of individuals requiring acetaminophen. In group S, the percentage of patients requiring acetaminophen has decreased significantly over time, whereas in group C, the decline has been minimal (Table 8, Fig. 7).

Table 7. Comparison among the examined groups regarding frequency of those needing NSAIDs.

NSAIDs	Groups [n (%)]		Test	
	Group S ($N = 30$)	Group C ($N = 30$)	χ^2	P
After 8 h	15 (50)	28 (93.33)	7.575	0.016[a]
After 12 h	11 (36.67)	26 (86.67)	8.533	0.003[a]
After 18 h	2 (6.67)	15 (50)	Fisher	0.015[a]
P (Q)	0.002[a]	<0.001[b]		

Q, Cochran test; χ^2, χ^2 test.

[a] P value less than 0.05 is statistically significant.

[b] P value less than or equal to 0.001 is statistically highly significant.

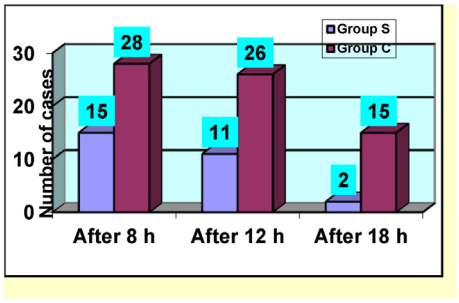

Fig. 6. Comparison among the examined groups concerning frequency of those needing NSAIDs.

Table 8. Comparison between the studied groups regarding frequency of those needing acetaminophen.

Acetaminophen	Groups [n (%)]		Test	
	Group S ($N = 30$)	Group C ($N = 30$)	χ^2	P
After 8 h	30 (100)	30 (100)	0	>0.0999
After 12 h	21 (70)	26 (86.67)	Fisher	0.394
After 18 h	17 (56.67)	28 (93.33)	Fisher	0.037[a]
P (Q)	0.02[a]	0.223		

[a] P value less than 0.05 is statistically significant.

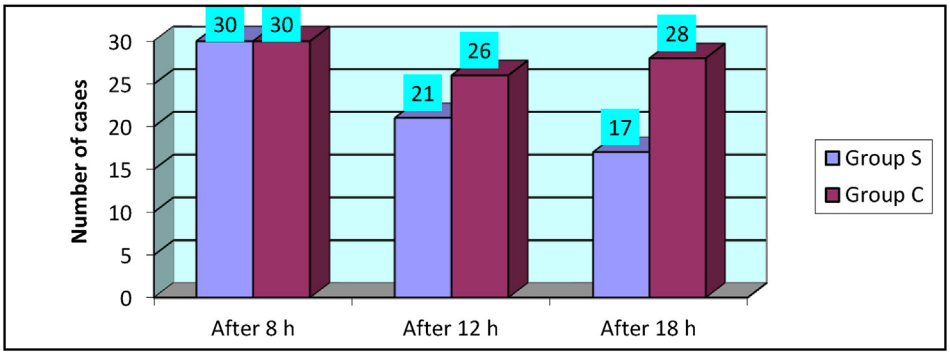

Fig. 7. Comparison among the examined groups regarding frequency of those needing acetaminophen.

4. Discussion

Cesarean delivery is a common surgical procedure. Postoperative pain is the greatest concern for women after cesarean section. Postoperative pain may be severe and can lead to delayed patient ambulation, prolongation of hospitalization and recovery, atelectasis, vascular thrombosis, and ultimately patient dissatisfaction.[7]

We performed a prospective, randomized, double-blind, controlled clinical trial employing ropivacaine TAP block for 24 h following a cesarean section through a Pfannenstiel incision to evaluate its analgesic effectiveness.

In our study, BMI, age, gravidity, abortion, parity, and gestational age did not show marked variation.

Moreover Mankikar *et al.*,[8] TAP block with ropivacaine for 24 h following a Pfannenstiel incision cesarean section was investigated for its analgesic efficiency. Sixty people participated in the trial, with 30 receiving TAP blocks with 0.5% ropivacaine and the other 30 receiving placebo. The demographic profile of both groups was comparable.

Here, in the study, the pain scores were evaluated at 1, 2, 4, 8, 12, 18, and 24 h in both groups. The VAS pain score was substantially lower in group S at baseline and throughout the study, indicating a statistically significant distinction among the groups. The VAS pain scores of both groups significantly rise with time. In 2008, researchers blindly administered ropivacaine (1.5 mg/kg, maximum 150 mg) or saline to examine the effects of TAP block during cesarean birth. TAP block was shown to be effective, as evidenced by a lower VAS, depending on this research.[9]

Similarly Belavy *et al.*,[10] found that VASs reduced in the active group in contrast to placebo group.

Two investigations utilizing TAP block, each employing 20 ml of 0.25% bupivacaine or levobupivacaine for spinal anesthesia, were undertaken on ASA-I and ASA-II individuals undergoing elective cesarean delivery.

The percentage of the participants in both groups requiring NSAIDs at 8, 12, and 24 h was significantly higher in group C, but there was not a substantial distinction among the groups overall. Over time, the percentage of individuals employing NSAIDs has decreased significantly across all participant subsets.

Regarding the frequency of those needing acetaminophen, participants in both groups require acetaminophen after 24 h, although this requirement is much higher in group C than in either group A or B. Nevertheless, there is not a statistically significant distinction among the groups in how quickly they require pain relief (8 or 12 h). Over time, the percentage of patients in group S who require acetaminophen drops significantly, but in group C, the drop is not statistically significant.

There is a statistically significant variation among the groups investigated in terms of time for first analgesia (much longer in the TAP block group) and the need for nalbuphine. The number of tramadol-dependent patients was substantially larger in group C than in group S (19 cases in group C vs. 2).

Our study found a statistically significant distinction among groups in the amount of time it took for participants to regain bowel function; group S recovered faster.

We also revealed a statistically significant distinction in patient satisfaction levels among the groups. Patients in group S were more likely to be extremely satisfied (56.2 vs. 50%) than those in group C (who were equally likely to be neither satisfied nor dissatisfied).

4.1. Conclusion

Effective postoperative analgesia and patient satisfaction will be always the hallmark of any surgical procedures, especially, after cesarean section where early ambulation and recovery is desired. Because abdominal incision pain is so prevalent in

the postoperative period following a cesarean, the TAP block, when combined with other forms of analgesia, can lessen the need for pain medication in the first 48 h after surgery, increase the efficacy of the first analgesic, and boost postoperative satisfaction among cases.

Conflict of interest

There are no conflicts of interest.

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