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Analgesic Efficacy of Ultrasound-Guided Erector Spinae Plane Block versus Transversus Abdominis Plane Block for Post-cesarean Delivery Pain under Spinal Anesthesia

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ABSTRACT

Background: Post cesarean delivery pain is a great problem that need approaches to enhance early recovery, activity, and encourages breastfeeding without any side effects. The perfect method for minimizing post-operative pain following cesarean delivery while under spinal anesthesia remains unknown. Although spinal or systemic opioids have been used to achieve effective painkillers, they are often accompanied by numerous adverse effects. The plane of the transversus abdominis (TAP) block's post-operative analgesic impact has already been applied to caesarean delivery women as a part of a multimodal analgesic strategy.

Objective: The aim of the current study was to minimize post cesarean delivery pain using either erector spinae plane (ESP) or TAP blocks after spinal anesthesia.

Patients and methods: A randomized controlled clinical trial was conducted in the Departments for Anesthesia, Intensive Care, and Pain Treatment at Zagazig University Hospitals, from September 2022 to March, 2023. The study was conducted on 36 women scheduled for category IV cesarean delivery and they were divided into 3 groups: Control group [group C]: n=12 patients underwent spinal anesthesia with (12.5mg hyperbaric bupivacaine) before cesarean delivery, ESP blocks group [group E]: n=12 patients were put under spinal anesthesia using (12.5mg hyperbaric bupivacaine) then they received an ultrasound-guided bilateral ESP block using (15 ml bupivacaine 0.25%) after finishing and dressing the cesarean delivery incision on each side, and TAP blocks group [group T]: n =12 patients underwent spinal anesthesia with (12.5mg hyperbaric bupivacaine) then they received an ultrasound-guided bilateral TAP blocks using (15 ml bupivacaine 0.25%) after completing and dressing the cesarean delivery wound on both sides.

Result: There were noticeable variations across the studied groups in terms of VAS on rest and movement in different follow-up periods, time to 1st analgesic request, total amount of pethidine iv and complications, with better outcomes in ESP blocks group. **Conclusion:** ESP block provided extended analgesia with appreciably lower analgesic requirements compared to TAP block and also associated with lower complications and higher patient satisfaction.

Keywords; Post cesarean delivery pain, Ultrasound, Erector spinae plane, Transversus abdominis plane, Clinical trial, Zagazig University.

INTRODUCTION

Cesarean deliveries are the most frequent obstetric surgeries performed and managing post-cesarean delivery pain is important for both patient satisfaction and quick recovery. In addition to uterine cramping, somatic discomfort during a cesarean delivery is also caused by skin incisions and visceral pain [1,2]. After a cesarean delivery, a number of patients experience moderate-to-severe pain that negatively affects their quality of life as a whole. As a result, an ideal analgesic approach that combines effectiveness and safety is essential [3].

Erector spinae plane (ESP) block is a method of anesthesia that enables local anesthetic dispersion into the space between the transverse process and the erector spinae muscles, resulting in a para-vertebral spread of three vertebral levels cranially and caudally, respectively. **Chin *et al.*** [4] covering the dorsal and ventral rami inhibits somatic and visceral pain [5, 6].

Transversus abdominis plane (TAP) block post-operative analgesia has already been utilized by caesarean patients as a part of a multimodal analgesic strategy [7]. The thoracolumbar nerves T10 to L1 are blocked, providing sufficient somatic analgesia with little to no inhibition of visceral pain [8].

The aim of the current study was to minimize post cesarean delivery pain using either ESP or TAP blocks after spinal anesthesia.

PATIENTS AND METHODS

A randomized controlled clinical trial was conducted in the Departments for Anesthesia, Intensive Care, and Pain Treatment at Zagazig University Hospitals, from September 2022 to March, 2023. The study was conducted on 36 women scheduled for category IV cesarean delivery and they were divided into 3 groups. A computer-generated database was used to assign these patients at random to one of the three trial groups (12 in each) as follows:

- Group (C): n=12 patients underwent spinal anesthesia before cesarean delivery.

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- Group (E): n=12 patients underwent spinal anesthesia then they received ultrasound-guided bilateral ESP blocks on each side after finishing and covering the wound.
- Group (T): n=12 patients underwent spinal anesthesia then they received bilateral TAP blocks on each side after finishing and covering the wound.

Inclusion criteria:
1. Acceptance and written consent from the patients.
2. Elective cesarean delivery, age 21 – 39 years old.
3. Body mass index (BMI) 19 – 29.9 Kg/m².
4. American Society of Anesthesiologists (ASA) physical status II and normal pregnancy (with a gestational age at minimum 37 weeks).

Exclusion criteria:
1. Local infection and anatomical abnormalities at the site of spinal anesthesia or spinal diseases and contraindication for regional anesthesia.
2. History of allergy to local anesthetics and other drugs used.
3. Coagulation disorders.
4. Pre-existing cardiac, hepatic, renal or neurological diseases and complications during pregnancy as (Gestational diabetes, preeclampsia, placenta previa, etc.).
5. A history of cognitive delay or mental retardation.

Sample size: By assuming the mean, open Epi-Info was used to determine the sample size, numerical rating scales (NRSs) was 2±1 vs 3±1 in ESPB vs control **Malawat *et al.*** [9] at 80% power and 95% CI, the estimated sample will be 36 subject, 12 cases in each group.

Parameters of the study were included:
1. Preoperative: During pre-operative visit, patient's age, weight, height, baseline vital parameters were recorded. Full history and clinical examination were done. Investigations such as complete blood count (CBC), Prothrombin Time (PT), bleeding time, and partial thromboplastin time (PTT) were carried out. All patients kept fasting as per institutional protocol 2 hours for clear liquid and 8 hours for solid food.
Patients were familiar with its application of ten centimeters visual analogue scale (VAS) identifying and the patient was asked to mark on this line where the intensity of the pain lies and the patient satisfaction scale by 1-4 degrees (completely dissatisfied, dissatisfied, satisfied or completely satisfied) was explained.
Before surgery and before operation written and informed consent were taken from the parents.

2. Intraoperative: On arrival to the operating room, inserted intravenous access for all patients by using a non-dominant hand or arm was inserted with an 18 gauge IV cannula and lactated ringer (8-10 ml/kg) was started connected to the monitor including ECG, NIBP, and SpO_2, as basally and all surgery time. All patients are positioned in the sitting position, leg hanging from the side of the bed and take spinal anesthesia at level L3–L4 with providing 12.5 mg of hyperbaric bupivacaine.

3. Postoperative: At the end of surgery and covering the wound of cesarean delivery, the patient was fully monitored.
- Group (C): Transfer to post-anesthesia care unit (PACU) then to ward with fully monitored and VAS follow-up for first 24h as immediately post-operative, 4h, 8h, 12h, 16h, 20h and 24h.
- Group (E): Received on operation bed an ultrasound-guided bilateral (ESP) Blocks using (15 ml bupivacaine 0.25%) in each side after finishing and covering the wound of cesarean delivery on lateral position, approximately 2-3cm away from the midline at 10th thoracic spinous process, the needle was inserted in-plane from a cranial to caudal direction until the needle tip on the deep side of the erector spinae muscle and just above the transverse process, inject 1-3 mL of local anesthetic was done to confirm proper injection plane by visualization of a spread deep to the erector spinae muscles and superficial to the transverse process then complete 15 ml of local anesthetic **(Figure 1)**.

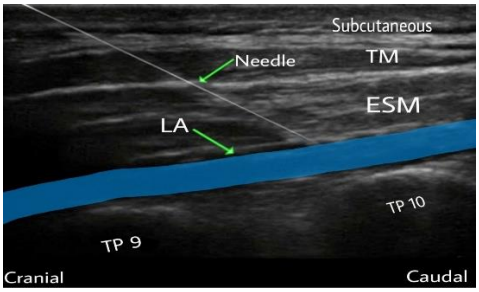

Figure 1: Ultrasound visualization from cranial to caudal on sagittal orientation for ESP block with needle insertion in-plan: TM, Trapezius muscle; ESM, Erector spinae muscle; TP, Transverse process; LA, Local anesthesia spread (blue).

Transfer to post-anesthesia care unit (PACU) then to ward with fully monitored and VAS follow-up for first 24h as immediately post-operative (0), 4h, 8h, 12h, 16h, 20h and 24h.
- Group (T): Received bilateral TAP Blocks using (15 ml bupivacaine 0.25%) on each side after finishing and covering the wound of cesarean delivery, on supine position, the needle was inserted in-plane from anterior to posterior until the needle tip was on the fascial plane between the IO and TA muscles, and the transducer was placed on the midaxillary line at the midpoint between the subcostal margin and iliac crest, inject 2-3 mL of local anesthetic was done to confirm injection plane by visualization of a spread between the IO and TA muscles then complete 15 ml of local anesthetic **(Figure 2)**.

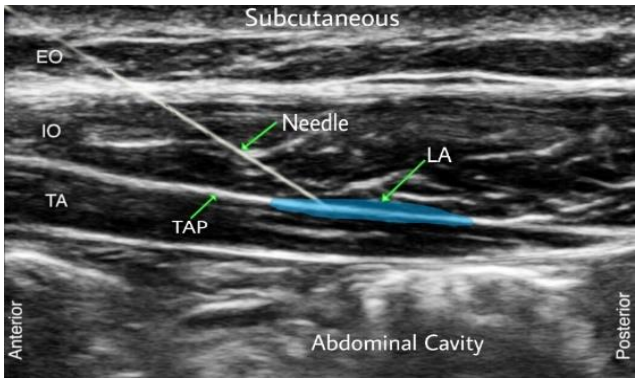

Figure 2: Ultrasound visualization from anterior to posterior on transverse orientation for Lateral TAP block with needle insertion in-plan: TA=Transversus abdominis muscle, IO=Internal oblique muscle, EO=External oblique muscle, LA= Local anesthesia spread (blue), TAP= Transversus Abdominis Plane.

Transfer to post-anesthesia care unit (PACU) then to ward with fully monitored and VAS follow-up for first 24h as immediately post-operative, 4h, 8h, 12h, 16h, 20h and 24h.

Ethical Approval: This study was ethically approved by the Institutional Review Board of the Faculty of Medicine, Zagazig University Hospitals (IRB#9689). Written informed consent was obtained from all participants. This study was executed according to the code of ethics of the World Medical Association (Declaration of Helsinki) for studies on humans.

Statistical Analysis

The collected data were introduced and statistically analyzed by utilizing the Statistical Package for Social Sciences (IBM SPSS, Armonk, NY: IBM Corp) version 20 for windows. Qualitative data were defined as numbers and percentages. Chi-square test was used for comparison between categorical variables as appropriate. Quantitative data were tested for normality by Kolmogorov-Smirnov test. Normal distribution of variables was described as mean standard deviation (SD), median and interquartile range (IQR) whenever possible. ANOVA test was used for comparison between groups. P value ≤0.05 was considered to be statistically significant.

RESULTS

A total of 12 women were enrolled in each group **(Figure 3).**

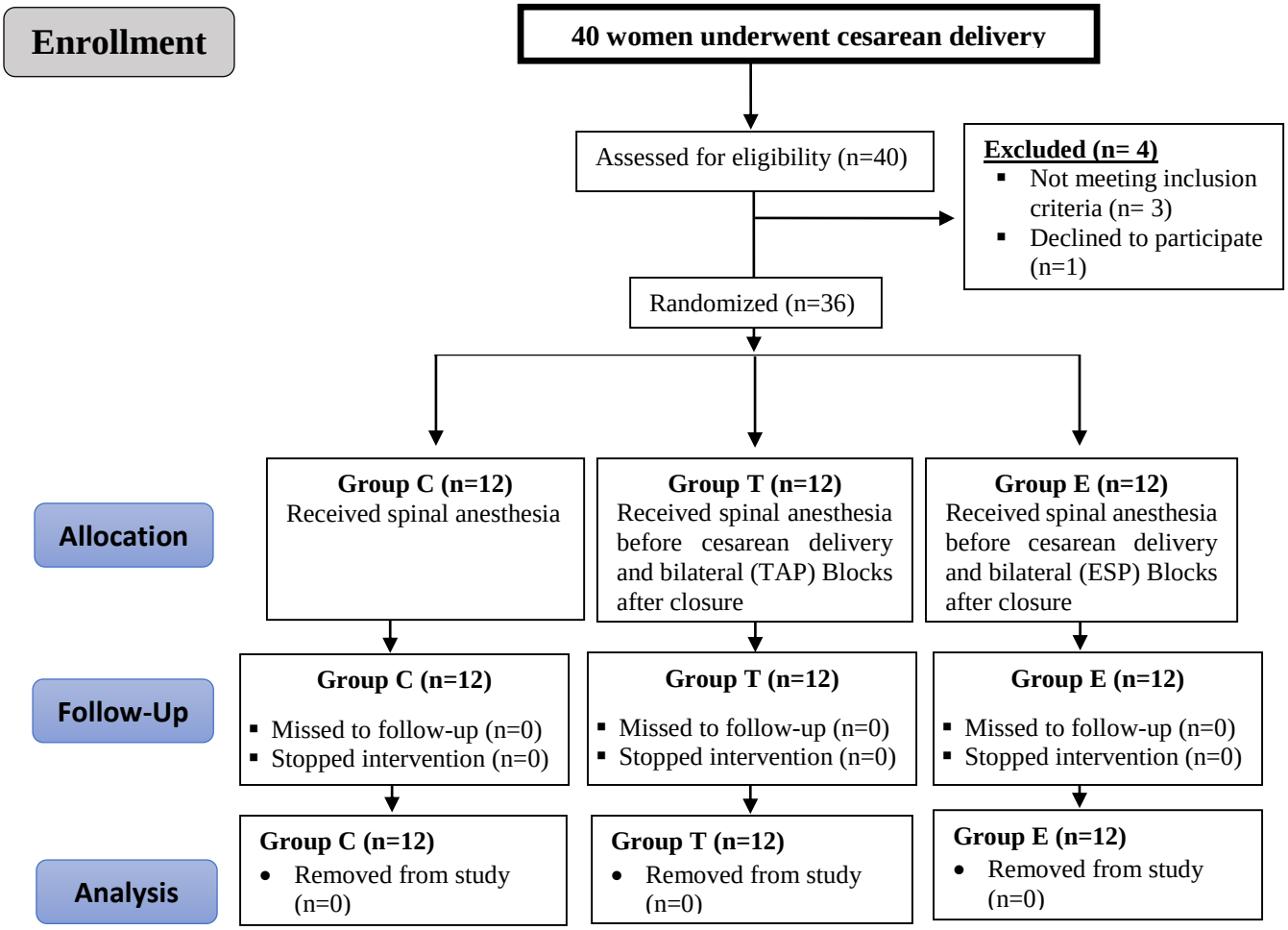

Figure (3): Patients' Recruitment Flowchart.

Table 1 shows that there were no statistically significant variation between the 3 groups regarding age, weight, height and BMI **(P>0.05)**.

Table (1): Demographic data among the 3 studied groups.

Parameter	Group C (n=12)				Group T (n=12)				Group E (n=12)				P-value
	Mean	SD	Range		Mean	SD	Range		Mean	SD	Range		
Age (years)	29.92	5.45	23	39	28.75	5.5	21	37	27.92	5.76	21	38	0.680
Weight (kg)	73.08	6.46	62	85	73.17	5.29	65	82	70.58	5.76	59	78	0.478
Height (cm)	164.3	3.96	157	170	165.9	5	157	174	166.00	3.69	160	170	0.563
BMI (kg/m²)	26.96	1.88	23.6	29.4	26.57	1.62	23.9	29	25.61	1.86	22.8	27.6	0.179

Analysis done by One way ANOVA Test and Chi-Square Test. Data are expressed as mean ± standard deviation (SD), P value >0.05: Not significant (NS), P value <0.05 is statistically significant (S), p<0.001 is highly significant, n=patient numbers, BMI=Body Mass Index

Visual Analog Scale (VAS) pain scores at rest were significant below in group T versus group C at 4, 8 hours (P<0.001) and at 12 hours (P<0.002). In addition, they were significant below in group E versus group C at 4, 8, 12, 16, 20 and 24 hours (P<0.001). At 16, 20 and 24 hours, they were significant (P<0.001) below in group E versus group T (Figure 4).

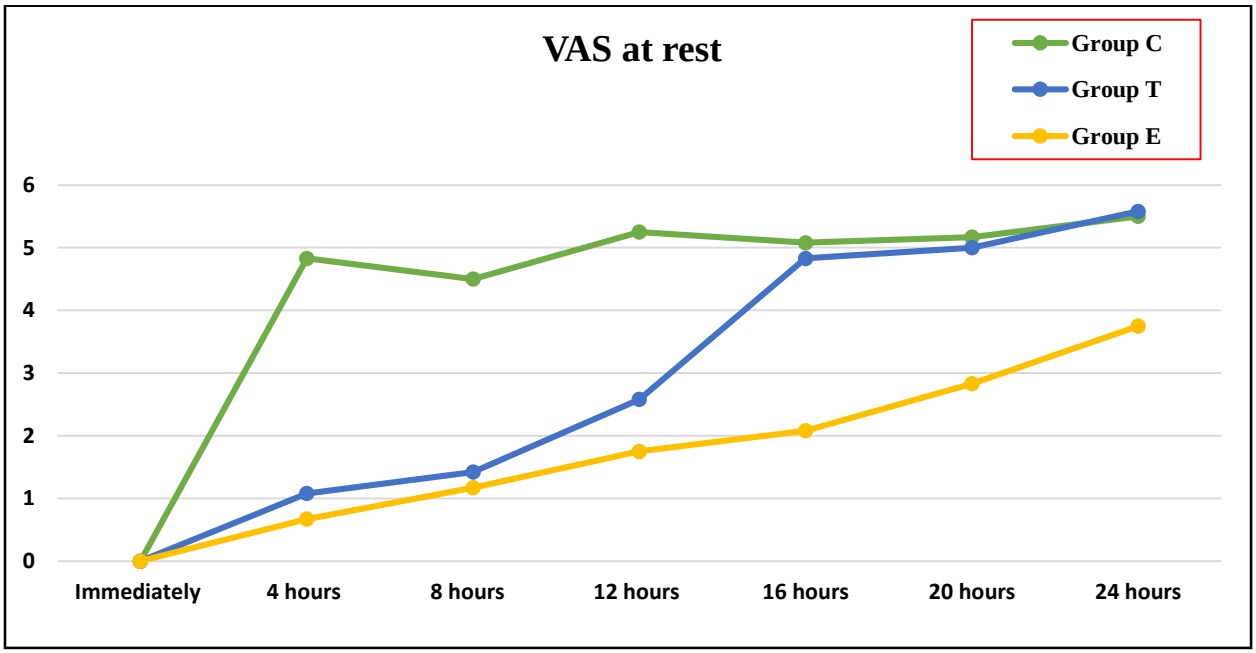

Figure (4): VAS at rest in different follow up periods among the three studied groups.

VAS pain scores at movement were significant lower in group T compared to group C at 4, hours (P=0.005), 8 hours (P=0.004) and at 12 hours (P=0.006). In addition, they were significant lower in group E compared to group C at 4, 8, 12, 16, 20 and 24 hours (P<0.001). At 4 hours (p=0.005), 8 hours (P=0.004), 12 hours (P=0.004), 16, 20 and at 24 hours (P<0.001), they were significant below in group E versus group T (**Figure 5**).

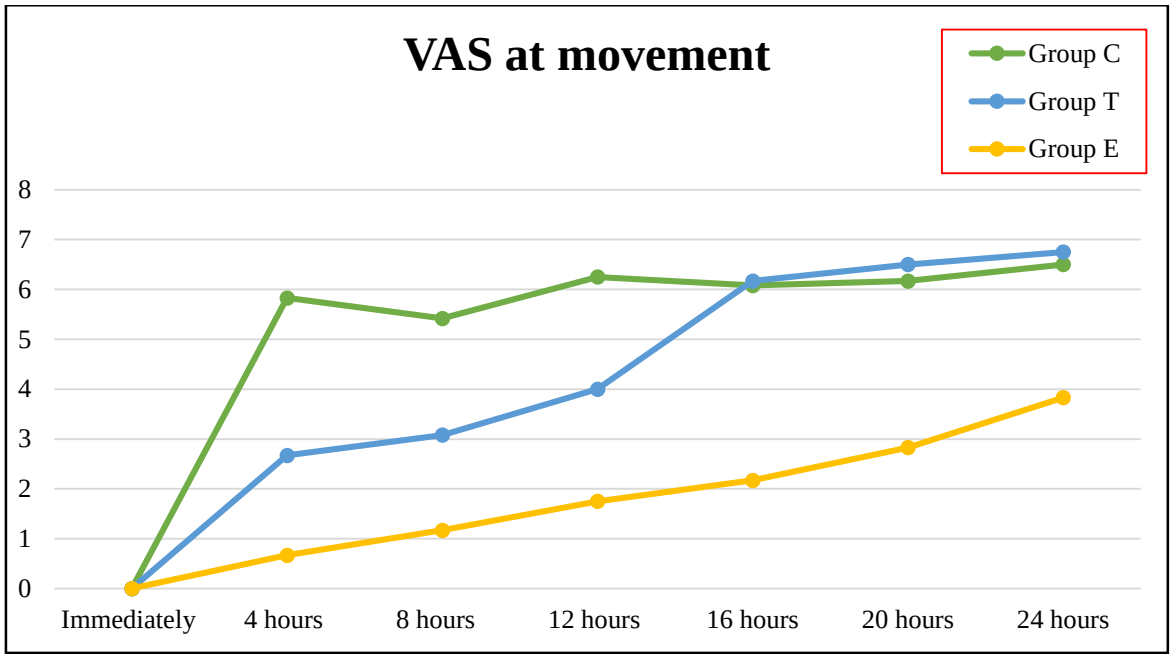

Figure (5): VAS at movement in different follow up periods among the three studied groups.

It was observed in **Table 3** that time to first analgesic request was highly significantly below in group C versus group T (P=0.001) and group E (P<0.001). Also, it was significantly below in group T versus group E (P=0.028).

Table (3): Comparison between the three blocks groups as regards Time to 1st analgesic request.

Variables		Group C (n=12)	Group T (n=12)	Group E (n=12)	Kruskal Wallis Test			
					P	P1	P2	P3
Time to 1st Analgesic Request (hours)	**Mean±SD**	2.84±0.14	13.18±0.86	23.37±0.65	**<0.001**	**0.001**	**<0.001**	**0.028**
	Range	2.65-3.03	11.83-14.6	22-23.83				

Analysis done by One way ANOVA Test and Chi-Square Test. Data are expressed as (SD), P value >0.05: (NS), P value <0.05: (S), P<0.001: (HS). P: P value for Independent-Samples Kruskal-Wallis Test for differentiate between the studied groups; P1: P value for g group C versus group T. P2: P value for group C versus group E. P3: P value for group T versus group E.

It was observed in **Table 4** that total amount of rescue analgesia was highly significantly more in group C versus group T (P=0.001) and group E (P<0.001). Also, it was significantly higher in group T versus group E (P=0.034).

Table (4): Comparison between the three blocks total amount of rescue analgesia.

Variables		Group C (n=12)	Group T (n=12)	Group E (n=12)	Kruskal Wallis Test			
					P	P1	P2	P3
Total Amount of Rescue Analgesia (mg) in 1st 24 hours	**Mean±SD**	279.17± 45.02	158.33± 19.46	50±0.0	**<0.001**	**0.001**	**<0.001**	**0.034**
	Range	200-350	150-200	50-50				

Analysis done by One way ANOVA Test. P<0.05: (S), P<0.001 (HS), SD: standard deviation. P: p value for Independent-Samples Kruskal-Wallis Test for comparing between the studied groups (P1, P2 and P3).

There was statistically significant variation between the three groups regarding patients satisfaction (P<0.001) as group E showed the best satisfaction level then group T and finally group C (**Figure 6**).

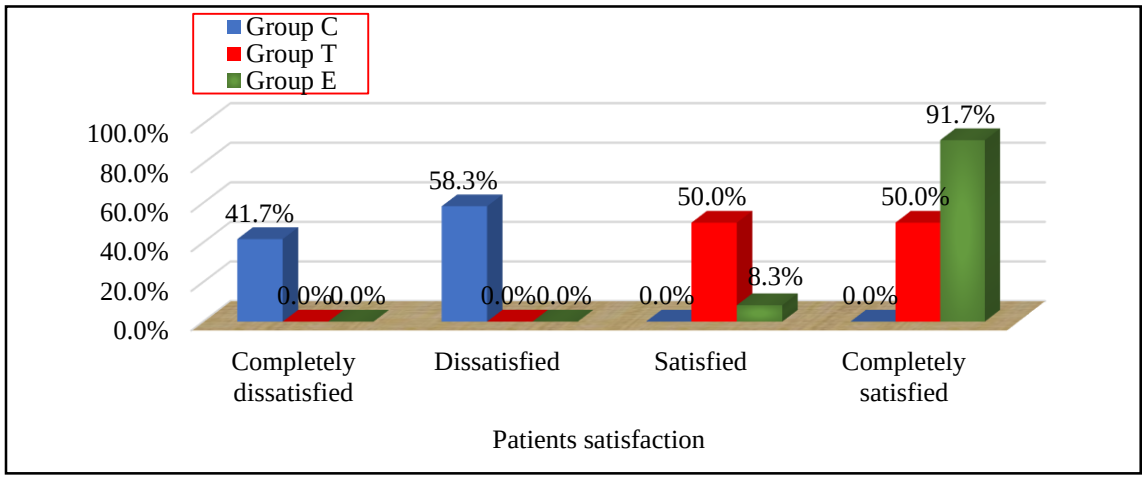

Figure (6): Comparison between the three studied groups as regards patient's satisfaction.

DISCUSSION

The goal of the current study was to determine whether ESP block was the most effective and safe method of post-cesarean delivery pain management or TAP block under spinal anesthesia.

In current study, we found that both ESP and TAP blocks are effective and safe than group C in post-cesarean delivery pain management. ESP blocks was superior than TAP blocks in the quality in the form of prolonged analgesia duration, lower VAS scores for pain both at rest and during activity, longer intervals between the first and second analgesic requests, fewer problems, and higher patient satisfaction.

As there was no statistically significant difference between the analyzed groups in terms of baseline parameters including age, weight, height, and BMI, the current study included three evenly matched groups (**P>0.05**).

As VAS pain scores reduced in group T compared to group C at 4, 8, and 12 hours, the current study demonstrated that there were statistically significant differences between the three study groups with regard to VAS pain scores both at rest and during movement. Furthermore, they were lower in group E compared to group C at 4, 8, 12, 16, 20 and at 24 hours. At 16, 20 and 24 hours. They were lower in group E compared to group T. Other than that, there were no notable variations between the three groups examined in terms of postoperative movement (P>0.05).

In agreement with the current study **Malawat *et al.*** [9] considering VAS pain scores at rest and with movement at all times following cesarean delivery, it was found that the ESP group experienced considerably lower VAS pain scores than the TAP group.

It was found that the time to the first analgesic request had decreased substantially statistically significantly in group C compared to group T (P=0.001) and group E (P<0.001). Additionally, it decreased considerably in group T compared to group E (P=0.028).

Moreover, in line with this study **Ghulam *et al.*** [10] revealed showed when ESP block is applied rather than TAP block, caesarean delivery women experience longer periods of analgesia and the first dose at which they request analgesia.

According to the current study, group C received considerably more rescue analgesia overall than group T (P=0.001) and group E (P<0.001). Also, it was significantly higher in group T when compared to group E (P=0.034).

The present study was in agreement with **Boules *et al.*** [11] who used tramadol with a 20mg dose, 10min lockout interval, and 1hr limit of 50mg, without a background dose. In comparison to the TAP group, which utilized a median of 125 mg of pethidine, the total amount of analgesics used in the ESP group was significantly lower (P<0.001).

There was a statistically significant decrease in complications in the current study, which is relevant to problems (P<0.05*) in E & T group when compared to C group (E & T groups < C group), with no statistically significant difference (P>0.05) between E and T groups.

However, **Malawat *et al.*** [9], **Boules *et al.*** [11] and **Ghulam *et al.*** [10] **revealed** showed that neither TAP nor ESP block groups demonstrated any side effects or problems.

While, **Dostbil *et al.*** [12] revealed that there was no significant variation between the ESP and control groups regarding complications and side effects such as nausea, vomiting, and itching before and after surgery.

In terms of patient satisfaction, it was found that there was statistically significant variation across the 3 groups (P<0.001), with group E showing the highest degree of satisfaction followed by groups T and C.

However, **Boules *et al.* (11)** found that there was no significant difference in maternal satisfaction between the TAP and ESP blocks groups. This is likely because, despite being an important factor, pain reduction is not the sole factor influencing satisfaction in cesarean delivery women.

Limitations: The current study had some limitations as little sample size and being a one center study. Also, this study is category iv cesarean delivery with spinal anesthesia only. Another limitation is that in present study we performed the ESP block after closure and cover surgical incision to compare with TAP blocks at time of first rescue analgesia, as result of that we encountered a problem in repositioning of the patient from supine to lateral.

CONCLUSION

ESP block, when compared to TAP block, can provide extended analgesia with a significantly lower analgesic requirement, lessen postoperative VAS at rest and activity, lower complications, and improve patient satisfaction in ESP block.

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Conflicts of interest: There are no conflicts of interest, according to the authors.

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