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Study of Dexmedetomidine versus Fentanyl as Adjuvants to Bupivacaine in Ultrasound Guided Transversus Abdominis Plane Block for Postoperative Analgesia after Cesarean Delivery

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ABSTRACT

Background: Dexmedetomidine's potential to increase blockade duration has piqued the interest of researchers as a local anaesthetic adjuvant in recent years. As an opioid analgesic, fentanyl is highly effective.

Objective: Improving postoperative analgesia after Cesarean delivery using dexmedetomidine or fentanyl as additives to bupivacaine for transversus abdominis plane block with ultrasonography guidance.

Patients and Methods: One hundred and twenty cases were randomly divided into two equal groups each included 60 cases. Group D received ultrasound guided transversus abdominis plane (TAP) block using dexmedetomidine 1 microgram/kg + 40 ml bupivacaine 0.25%, and the volume was divided equally and given bilaterally. Group F received ultrasound guided TAP block using fentanyl 1 microgram/kg + 40 ml bupivacaine 0.25%, and the volume was divided equally and given bilaterally.

Results: Group D had lower mean arterial pressure as well as heart rate than group F at 4, 8, 12, 18, and 24 hours post-operative. Group D had a significantly longer time to first analgesia compared to group F. Group D had significantly reduced total analgesic intake compared to group F over a 24-hour period. Rescue analgesics were needed by a greater percentage of patients in group F than in group D after 6, 12, and 24 hours. A statistically significant difference was seen between the two groups after 20 and 24 hours on the VAS, with group D scoring lower than group F.

Conclusion: Dexmedetomidine was more effective than fentanyl in providing postoperative analgesia with bupivacaine for transversus abdominis plane block with ultrasonography guidance following caesarean section.

Keywords: Dexmedetomidine, Fentanyl, Bupivacaine, Cesarean delivery.

INTRODUCTION

Opioid medications given via the systemic and/or neuraxial pathways are the standard of care in analgesia. Neuraxial techniques are efficient and risk-free, but they require a skilled practitioner and close observation to ensure success. Patient-controlled analgesia (PCA), such as intravenous or epidural morphine, is another method of administering opioids. Patients report higher levels of therapeutic satisfaction when they are given agency for their pain management. Opioids can have serious negative effects on a person's body, including drowsiness, vomiting, itching, or nausea as well as respiratory depression in very rare circumstances. Breast milk secretion is a further concern with this group. Paracetamol and other NSAIDs don't do the trick when they come to relieving pain by themselves [(1)].

The transversus abdominis plane (TAP) block is a targeted treatment for pain in the area where the anterior division of the thoracic spinal cord (T6) meets the lumbar spinal cord (L1). The TAP block is used to lessen pain after numerous abdominal procedures [(2)].

The TAP block, used for postoperative analgesia after a Caesarean section, is easily performed with ultrasound technology. Several adjuvants have been used to lengthen the effect and improve the quality of the local anaesthetic action, with promising results, but TAP block only lasts as long as the local anaesthetic does [(3)].

Dexmedetomidine is a highly selective alpha 2-adrenoceptor agonist that, when administered systemically has calming, pain-relieving, sympathetic-nerve-calming, and anesthetic-saving properties. Dexmedetomidine's potential to increase blockade duration as a local anaesthetic adjuvant has garnered a lot of attention as of late. After abdominal surgery, it may be best to combine a local anaesthetic with dexmedetomidine administered via TAP block, as the latter primarily affects peripheral nociceptive receptors [(4)].

With the discovery of opioid receptors in peripheral nerves, efforts have been made to improve the efficacy and safety of peripheral nerve blocks by combining local anaesthetics with opioids. There are numerous opioids that have been discovered to have local anaesthetic effects, including fentanyl and sufentanil [(5)].

As an opioid analgesic, fentanyl is highly effective. It's an opioid agonist having analgesic and sedative characteristics, and it's a synthetic phenylpiperidine. Fentanyl acts on the central nervous system by binding selectively to the mu-receptor (CNS). Fentanyl exerts its analgesic effects by stimulating the opening of potassium channels and blocking the opening of N-type voltage-gated calcium channels. So, the neuronal excitability drops and hyperpolarization happens [(6)].

This study aimed to improving postoperative analgesia after Cesarean delivery using dexmedetomidine or fentanyl as additives to

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bupivacaine for transversus abdominis plane block with ultrasonography guidance.

PATIENTS AND METHODS

One hundred and twenty pregnant women who were chosen to have an elective C-section were enrolled in our randomised, prospective, controlled, double-blind clinical trial at Anesthesiology Department in collaboration with the Gynecology and Obstetrics Department, Zagazig University Hospitals, Egypt.

Patients were divided into two groups of 60 using a computer-generated randomization table before surgery.

1) **Group D:** received ultrasound guided TAP block using dexmedetomidine 1 microgram/kg added to 40 ml bupivacaine 0.25%, and the volume divided equally and given bilaterally.
2) **Group F:** received ultrasound guided TAP block using fentanyl 1 microgram/kg added to 40 ml bupivacaine 0.25%, and the volume divided equally and given bilaterally.

Inclusion criteria: Patient acceptance, 21 – 40 years old, American Society of Anesthesiologists (ASA) physical status classification system class II, elective uncomplicated Cesarean delivery under spinal anesthesia and BMI of 25 – 30 kg/m^2.

Exclusion criteria: Intolerant of local anesthesia patients, any fetal anomalies of congenital origin, drug addiction, uncooperative patient and allergic cases to any component of drugs used.

All patients underwent the following: Patients were evaluated by recording demographic information (age, gender, height, weight, BMI, and vital signs), obtaining a medical history (including a list of any current medications), conducting a physical examination of all major body systems, and requesting routine investigations (such as a complete blood count, sedimentation rate, bleeding time).

i. Preoperative management:

- Sitting patients were given spinal anaesthetic with a 25-G spinal needle and 3 ml of 0.5% hyperbaric bupivacaine.
- Pin prick feeling was used to measure the start of sensory blockage at 2-minute intervals, until the level was stable for two tests in a row.

ii. Intraoperative management:

The patient was seated in a flexed-back position. To prevent infection, we took all necessary precautions. To avoid having the gloves come into contact with the patient's unclean skin, swabs and antiseptic were used to clean the back. Paramedian approach, midway between two neighbouring vertebrae, a subcutaneous wheal was raised. To anaesthetize the back, LA was injected further into the midline and paraspinally. After deciding which interspinous space (L3/4 or L4/5) to target, a 25-gauge quincke spinal needle is placed there and guided into the ligamentum flavum. As the needle passes through the ligamentum flavum, resistance increases; once in the epidural space, resistance decreases. When the stylet is removed, the dura is pierced and cerebrospinal fluid (CSF) begins to flow out of the needle, causing a second sensation of decreased resistance. When cerebrospinal fluid (CSF) appears, 3 ml of hyperbaric at a concentration of 0.5% is injected slowly, taking great care not to move the needle. After the injection has been given, the spinal needle is removed and a bandage is placed over the puncture.

All patients were placed supine after intrathecal injection of local anaesthetic, and 5 L/min of oxygen was administered through nasal cannulas. Pin prick feeling was used to measure the start of sensory blockage at 2-minute intervals, until the level was stable for two tests in a row. The Bromage scale was used to evaluate the severity of motor block [(7)]. Surgical intervention is authorized at the T7 sensory block level and a Bromage score of 3.

a) Evaluation of intraoperative hemodynamic:

At each of the four study intervals, the participants' oxygen saturation, heart rate as well as mean arterial blood pressure, were recorded. Time points before spinal anaesthesia (t0), during the incision (t1), 15 minutes later (t2), and during skin suturing (t3) were recorded. A 15% drop in mean arterial pressure (MAP) or heart rate (HR) from baseline was considered an episode of hypotension or bradycardia. Patients were randomly assigned to one of two groups once their wounds had healed:

Group D: The patient had a TAP block utilising ultrasound guidance, with 1 microgram/kg body weight of dexmedetomidine injected with 40 milliliters of 0.25% bupivacaine and the resulting volume split in half and administered bilaterally.

Group F: Patient underwent ultrasound-guided TAP block with 1 microgram/kg fentanyl combined with 40 milliliters of 0.25% bupivacaine and administered bilaterally.

b) Ultrasound guided performance of the block:

In a fully germ-free setting, a high-frequency linear ultrasound probe was used. The patient was lying on their back with the transducer placed in the middle of the body, between the iliac crest and the lower costal boundary. After visually checking the surrounding area of the abdominal wall with a mirror, a 22-gauge needle was inserted into a plane between the internal oblique and transversus abdominus muscles. The test solution was administered into each group after they performed a plane dissection and negative aspiration. This was also written on the reverse side.

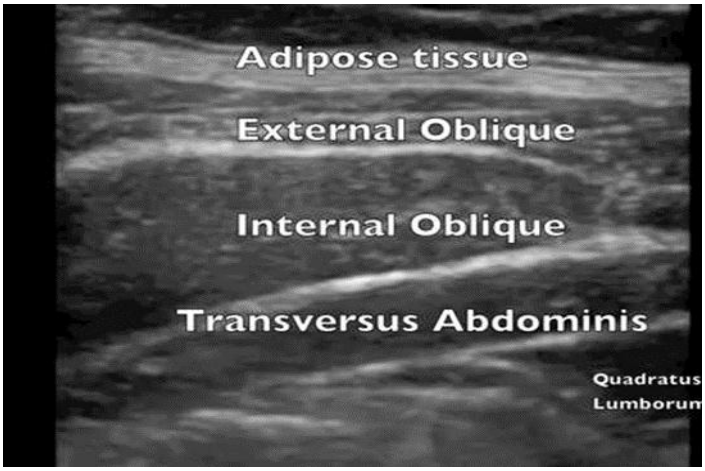

Figure (1): Separating the internal oblique muscle from the transversus abdominis muscle is the transversus abdominis plane.

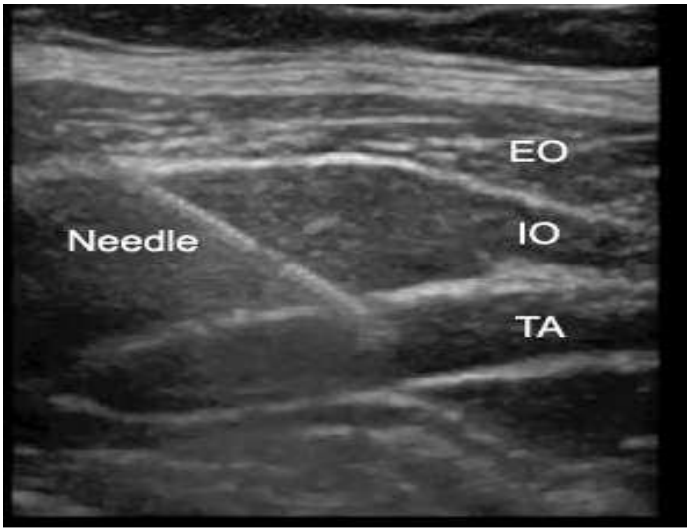

Figure (2): The point of the needle shows up between the internal oblique and the transversus abdominis muscles in the plane of the torso (In- plane approach of the needle).

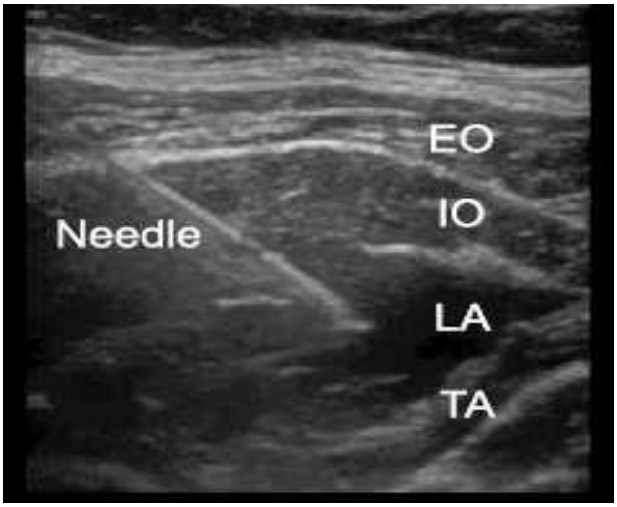

Figure (3): The injection site, visible between the internal oblique and transversus abdominis muscles, lies in the transversus abdominis plane.

iii. Postoperative management:

At 2, 4, 8, 12, 18, and 24 hours postoperatively, hemodynamic parameters were measured and compared to preoperative values. A visual analogue scale (VAS) was used to record the level of pain experienced. Rescue analgesia in the form of intravenous morphine sulphate 0.03 mg/kg was administered when the patient's VAS score was higher than 4. It was noted how long it took before rescue analgesia was needed (from when the local anaesthetic stopped working to when the VAS reached 4). Number of patients who required intravenous morphine sulphate, total daily doses administered, and total daily doses administered were recorded. Failure of the block, intramuscular hematoma, abscess and visceral or peritoneal penetration, or perforation have all been documented as possible complications of TAP. Nausea, vomiting, itchiness, and respiratory depression are just some of the side effects that have been linked to intravenous opioids.

Ethical approval: This experiment was ethically approved by Zagazig University's Ethical Board. After being fully informed, all participants provided written consents. The study was conducted out in line with the Helsinki Declaration.

Statistical analysis

Statistical Package for the Social Sciences, version 20, was utilised to do the computational analysis of the collected data (SPSS). Tables and graphs were used to show the results. Mean, median, standard deviation, and confidence intervals were displayed with the numerical data. Quantitative data like frequency and percentage were used to illustrate the data. When dealing with quantitative independent variables, the student's t test (T) is employed to evaluate the data. Quantitatively distinct data were evaluated using Pearson Chi-Square and Chi-Square for Linear Trend (X^2). Significant results were considered to exist when the p-value ≤ 0.05.

RESULTS

A total sample of 120 patients who had mean age of 32.8 ± 5.8 years among group D and 33.4 ± 5.4 years among group F did not vary significantly. The mean weight was 88.3± 15.0 Kg and 87.2 ± 16.2 kg. The mean height was 1.7 ± 0.1 m and 1.6 ± 0.1 m in D and F groups respectively with non-statistically significant difference. The mean BMI was 31.7± 5.8 Kg/m^2 and 32.3 ± 6.0 Kg/m^2 for D and F groups respectively with no significant difference (Table 1).

Table (1): Participant characteristics

Variable		Group D n= 60	Group F n= 60	P value
Age (years)	Mean ± SD	32.8± 5.8	33.4± 5.4	0.617
Weight (kg)	Mean ± SD	88.3± 15.0	87.2± 16.2	0.981
Height (m)	Mean ± SD	1.7± 0.1	1.6± 0.1	0.295
BMI (kg/m^2)	Mean ± SD	31.7± 5.8	32.3± 6.0	0.628

Mann Whitney U test; Student t test; *p is significant at <0.05

The average heart rates of the two groups did not differ significantly at the start of the study. At 4, 8, 12, 18, and 24 hours post-operative, group D had a significantly lower mean heart rate than group F (Table 2).

Table (2): Heart rate baseline and perioperative among the studied groups

Variable	Group D n= 60	Group F n= 60	P value
HR t0	80.5 ± 8.45	79.63 ± 8.54	0.577
HR t1	81.73 ± 8.47	80.25 ± 9.21	0.36
HR t2	80.3 ± 8.61	82.72 ± 9.17	0.140
HR t3	79.2 ± 9.28	80.53 ± 9.07	0.427
HR 2 hours	78.25 ± 9.65	78.32 ± 8.78	0.968
HR 4 hours	78.83 ± 9.46	83.2 ± 8.65	**0.009***
HR 8 hours	74.5 ± 9.86	84.08 ± 9.53	**<0.001***
HR 12 hours	73.48 ± 7.76	86.2 ± 8.97	**<0.001***
HR 18 hours	66.37 ± 9.01	86.42 ± 9.27	**<0.001***
HR 24 hours	66.65 ± 8.31	84 ± 9.51	**<0.001***

No statistically significant difference in mean SpO_2 was observed between the groups. At the outset, the groups did not differ significantly in terms of mean arterial pressure. Group D had significantly lower mean arterial pressure at 2, 4, 8, 12, 18, and 24 hours post-op compared to group F (Table 3 & figure 4).

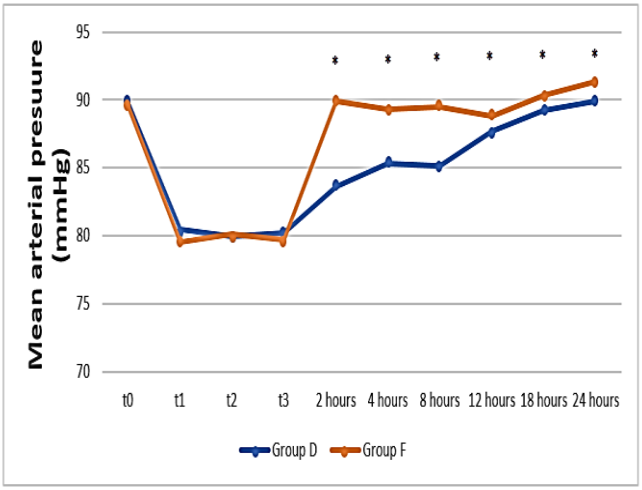

Table (3): SpO_2 baseline and perioperative among the studied groups

Variable	Group D n= 60	Group F n= 60	P value
SPO_2 t0	98.1± 1.5	97.8± 1.4	0.446
SPO_2 t1	98.1± 1.5	98.2± 1.5	0.952
SPO_2 t2	98.4± 1.4	98.2± 1.4	0.438
SPO_2 t3	97.9± 1.5	97.7± 1.3	0.248
SPO_2 2 hours	97.9± 1.5	97.9± 1.4	0.847
SPO_2 4 hours	97.8± 1.3	98.2± 1.4	0.072
SPO_2 8 hours	98.2± 1.4	97.8± 1.4	0.111
SPO_2 12 hours	97.9± 1.4	97.9± 1.4	0.999
SPO_2 18 hours	97.9± 1.2	98.1± 1.4	0.276
SPO_2 24 hours	98.4± 1.2	98.2± 1.5	0.415

Figure (4): During and after surgery, changes in mean arterial pressure

In group D, the time to first analgesia was much longer than in group F. Group D had significantly reduced overall analgesic intake compared to group F throughout the course of 24 hours. Those in Group D were more likely to request rescue analgesics at 6, 12, and 24 hours compared to patients in group F.

Table (4): Postoperative analgesia requirements among the participants

Variable		Group D n= 60	Group F n= 60	P value
Time to first analgesia (hours)	Mean ± SD	10.66 ± 0.55	8.38 ± 0.5	**<0.001***
Number of cases demanded rescue analgesic after 6 hours	n (%)	6 (10)	15 (25)	**0.031***
Number of patients requested for rescue analgesic after 12 hours	n (%)	9 (15)	20 (33.3)	**0.019***
Number of patients requested for rescue analgesic after 24 hours	n (%)	19 (31.7)	30 (50)	**0.041***
Total analgesic consumption /24 h (mg)	Mean ± SD	1.44 ± 0.55	5.3 ± 1.22	**<0.001***

Student t test, Chi square test.

VAS score was statistically significantly lower among group D than group F at 20 and 24 hours among the two studied groups (Figure 5).

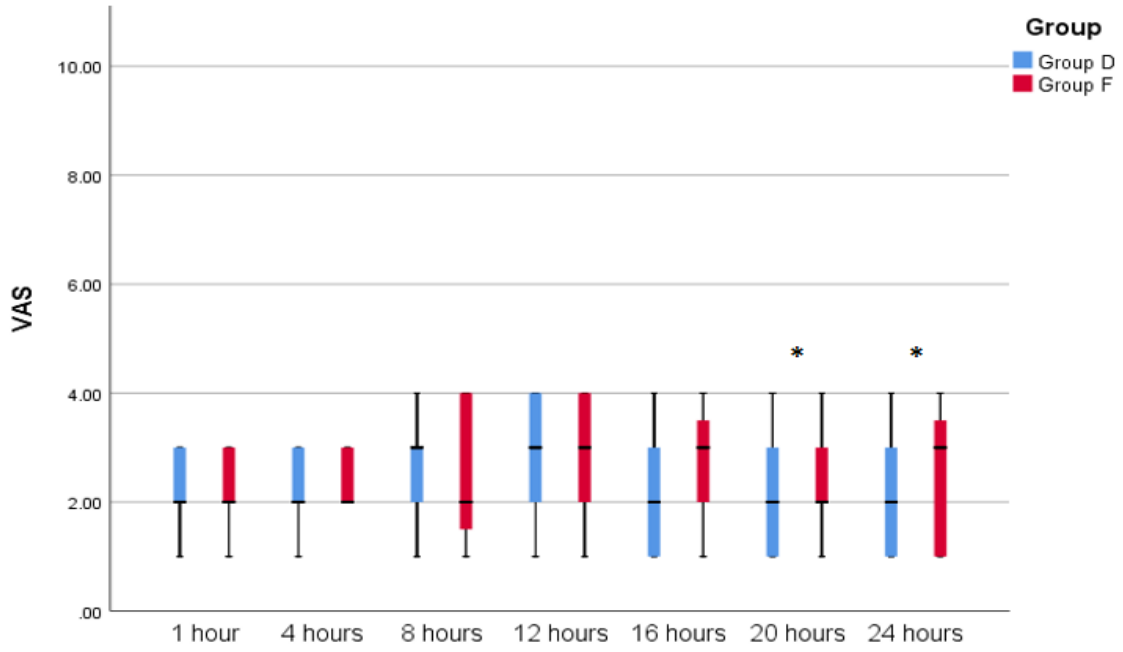

Figure (5): VAS at different time points among the two studied groups

Good and outstanding satisfaction were higher in group D, suggesting a statistically significant difference between the two groups tested (Table 5).

Table (5): Comparison of patient satisfaction between the two groups

Variable		Group D n (%)	Group F n (%)	P value
Patients' satisfaction	Poor	3 (5)	7 (11.7)	**0.005***
	Fair	7 (11.7)	20 (33.3)	
	Good	30 (50)	24 (40)	
	Excellent	20 (33.3)	9 (15)	

DISCUSSION

With the use of modern ultrasound technology, patients undergoing Caesarean sections may be given a TAP block for postoperative analgesia. Because TAP block only lasts as long as the effect of the injected local anaesthetic, several adjuvants have been used with promising results to increase the duration and quality of the local anaesthetic activity [8].

In our study we aimed to know which is more effective; dexmedetomidine or fentanyl as adjuvants to bupivacaine in ultrasound guided TAP block to provide post-operative analgesia after Cesarean delivery to improve postoperative analgesia. Our investigation involved 120 patients randomly assigned into two groups each of whom numbered 60 using a computer-generated randomization table. Patients in group D had a TAP block under ultrasound guidance, with 1 microgram of dexmedetomidine/kg body weight added to 40 ml of 0.25% bupivacaine, with the resulting volume being administered bilaterally. Patients in group F got a TAP block under ultrasound guidance with a fentanyl 1 microgram/kg and bupivacaine 40 ml 0.25% administered bilaterally.

Regarding the demographic data in our study, there was no significant difference between our studied groups regarding age, weight, height, BMI, heart rate or hemoglobin. In line with our findings, **Abdelraouf *et al.*** [9] revealed that the demographics of patients undergoing ultrasound-guided transversus abdominis plane blocks with or without dexmedetomidine or fentanyl for postoperative pain management following elective Caesarean section were not significantly different (age, weight, height, and American Society of Anesthesiologists status).

Our research showed that in group D, the time to initial analgesia was significantly longer than in group F. Group D had significantly reduced overall analgesic intake compared to group F throughout the course of 24 hours. After 6, 12, and 24 hours, more patients in group F required rescue analgesics than in group D. TAP blocks with and without levobupivacaine for Caesarean birth under ultrasound guidance were studied by **Varshney *et al.*** [10] who showed that adding dexmedetomidine to the TAP block extended the duration of analgesia and improved patient outcome, as was seen in the current trial.

Abdelaal *et al.* [11] also studied the efficacy of TAP block for post-abdominoplasty pain management using dexmedetomidine in addition to levobupivacaine. Dexmedetomidine and levobupivacaine recipients had significantly less discomfort than the placebo group (out of a total of 69 participants). After 24 hours, the total amount of meperidine taken in by the dexmedetomidine group was lower than by the other group. Following these findings, dexmedetomidine was studied by **Bansal and Sood** [12] they analysed data from a randomised controlled trial involving 40 women undergoing Caesarean section to determine whether adding dexmedetomidine to ropivacaine in an ultrasound-guided TAP block after Caesarean section would have any effect on postoperative pain**.** However, **Ding *et al.*** [13] found that TAP block quality and duration were not significantly improved by the addition of dexmedetomidine**.**

Our research showed that at 8, 12, 16, 20, and 24 hours, group D had a considerably lower VAS score than group F. Additionally, group D was happier overall than group F. There was no statistically significant difference between the TAP-D group and the TAP-F group, which received fentanyl as adjuvant in TAP block, in terms of time to first postoperative dosage of analgesic, number of patients asking rescue analgesic, or VAS scores., according to research by **Abdelraouf *et al.*** [9] according to our findings, dexmedetomidine is preferable to fentanyl**.** Results were consistent with those reported by **John *et al.*** [14] who also showed that adding fentanyl to bupivacaine did not improve analgesia quality or duration**.**

However, **Joseph *et al.*** [15] discovered that fentanyl and dexmedetomidine, when used in ultrasound-guided TAP block, had comparable effects on analgesia maintenance and opioid consumption reduction. We agree with the findings of **Qian *et al.*** [16] who discovered that increasing the dose of ropivacaine in a TAP block from 0.3% to 0.5% by adding dexmedetomidine increased pain-free time, decreased VAS pain scores 6 and 8 hours after surgery, patient satisfaction increased, the period until the first request for analgesia was lengthened, and the number of patients requiring rescue analgesic dropped, all without major adverse effects. The addition of dexmedetomidine to bupivacaine in TAP block significantly decreased the overall dose of opioid necessary in the first 24 hours following C-section, as was previously reported by **Ramya *et al.*** [17].

CONCLUSION

Based on the result of our study, dexmedetomidine is more effective than fentanyl in providing postoperative analgesia if added to bupivacaine using ultrasound guided TAP block after cesarean delivery. Because obstetric patients have unique post-operative analgesia requirements, including breastfeeding and newborn care, TAP block is frequently used to alleviate pain after delivery. The availability of ultrasound machines, TAP block can be easily performed after a Cesarean section for postoperative analgesia. We recommend adding dexmedetomidine to bupivacaine in TAP block after cesarean delivery.

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Competing interests: Nil.

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