

## Comparative Study between Continuous Transversus Abdominis Plane Block and ON- Q Anesthetic Pump for Postoperative Analgesia Following Caesarean Section

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**Abstract: Background:** The transversus abdominis plane (TAP) block has been developed for post-operative analgesia after gynecologic and abdominal surgery. The ON-Q Pain Relief System used for continuous direct local anesthetic infusion into surgical wounds. The objective of this study is to compare the efficacy of continuous transversus abdominis plane (TAP) block and the ON -Q Pain Relief System as a part of multimodal post operative analgesia regimen after caesarean section. **Methods:** 90 ASA grade I or II patients were admitted for elective caesarean section under spinal anesthesia. Patients were randomly assigned to one of three groups comprising 30 patients each. In group (A) TAP block was given at the end of surgery on both sides. In group (B) On - Q pump infusion was applied after completion of surgery. Group (C) is the control group. In all patients, paracetamol i.v infusion and PCA morphine started one hour postoperatively and continued for the next 24 hours. Assessment of morphine consumption, sedation, nausea, vomiting, urinary retention and pruritis were done at 30 min., 2, 4, 6, 12 and 24 hours after completion of surgery. **Results:** Groups A and B had less morphine consumption, postoperative sedation, nausea, vomiting, urinary retention and pruritis than group C. **Conclusion:** Both TAP block and ON-Q Pain Relief System are effective and safe method of analgesia following caesarean section. Both decrease the requirement of opioids and thus associated side effects.

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### 1. Introduction

Post-cesarean section effective analgesia is important. Pain and subsequent anxiety impair the mother's ability to optimally care and breast feed for her infant in the immediate postpartum period. Effective pain relief aids in early mobilization and decreases risk of thromboembolic diseases which is common after cesarean delivery. Essentially, analgesic technique should be safe, effective, not affecting mother's ability to move and carries no neonatal adverse effects<sup>(1-3)</sup>.

Opioid administration either systematically as intramuscular injection, patient controlled analgesia intravenously or as a part of regional anesthesia is the most commonly used modality. Opioids are effective analgesics but they are associated with frequent side effects such as nausea/vomiting, pruritis, sedation<sup>(4)</sup>, neonatal transfer through breast milk leading to transient neurobehavioral changes<sup>(5)</sup>. Therefore a multimodal approach is recommended.

The transversus abdominis plane (TAP) block is a peripheral block involving the nerves of the neurovascular plane between the internal oblique and transversus abdominis muscles<sup>(6)</sup>. The block has been developed for post-operative analgesia after gynecologic and abdominal surgery. The initial

approach described the lumbar triangle of Petit as the landmark used to guide the deposition of local anesthetic solution in the neurovascular plane. Other techniques include ultrasound-guided access to the neurovascular plane via the mid-axillary line between the iliac crest and the costal margin, and another subcostal access termed the 'oblique subcostal' access.<sup>(7)</sup>

Infusion pump systems used for continuous direct local anesthetic infusion into surgical wounds consist of disposable, nonelectrical pumps or electromechanical pumps that deliver a continuous infusion at controlled rates for a specified duration of time<sup>(8)</sup>. The ON-Q Pain Relief System consists of an electrometric pump that holds 270 mL of local anesthetic. The pump is connected by a flow-limiting valve to a small flexible catheter that acts as a soaker hose and allows continuous infusion of the drug to nearby tissues<sup>(9)</sup>.

The objective of this study is to compare the efficacy of continuous transversus abdominis plane (TAP) block and the ON -Q Pain Relief System as a part of multimodal post operative analgesia regimen after caesarean section.

## 2. Methods

This study was done in Ain Shams University hospitals in Obstetric and Gynecology department. After approval of the institutional ethics committee; 90 ASA grade I or II patients were admitted for elective caesarean section under spinal anesthesia. Following detailed pre-anesthetic check up, written informed consent was taken from all patients. Exclusion criteria were; a history of adverse reactions to local anesthetics, local infections, obesity (BMI >30 kg m<sup>-2</sup>), chronic pain, and the inability to use a patient controlled analgesic (PCA) device. Patients with cardiovascular, pulmonary and neurological diseases were also excluded from study. The indication and timing for CS were reviewed by the obstetrician involved in the study.

Patients were randomly assigned by a computer generated random tables to one of three groups comprising 30 patients each. In group (A) TAP block was given at the end of surgery on both sides. In group (B) On - Q pump infusion was applied after completion of surgery. Group (C) is the control group. In all patients, paracetamol i.v infusion (1000 mg / 8 hours) and PCA morphine started one hour postoperatively and continued for the next 24 hours.

After operating room admission, monitoring for electrocardiography, pulse oximetry and non-invasive blood pressure were started and continued till patient was out. All patients were pre-loaded with 10 ml/kg body weight Ringer lactate before start of surgery, then spinal anesthesia with 2.5 - 3 ml of 0.5% heavy bupivacaine was performed. Surgery was conducted by a lower segment cesarian section via a pfenstiel incision by the obstetrician involved in the study after adequate sensory level was achieved. Surgical steps and surgical sutures (vicryl and prolene) were the same in all patients.

After completion of surgery patients were randomly allocated into three groups by a computer based program:

### Group (A):

Ultrasound guided Tap block was applied. The research team used the posterior approach<sup>(10)</sup>. Using strict aseptic technique, the investigator scrubbed and gowned and the ultrasound probe was covered by a sterile plastic cover and placed in the midaxillary line just superior to the iliac crest [Figure 1].

After identifying the abdominal layers, the transversus abdominal plane was reached by using an 18-G Touhy's needle. Correct placement of the needle tip was confirmed by injecting 15 ml of normal saline through the catheter on each side [Figure 2]. The epidural catheter was then advanced superiorly up to the 10 cm skin mark. The needle was removed and catheter connected to a bacterial filter,

then catheters and the catheter introducer sites were covered with transparent 'op-site' dressings. After one hour of completion of surgery, an infusion of a 0.125% bupivacaine infusion at 10 ml/ hr was continued for 48 hours on each side.

### Group (B):

The elastomeric pump (ON-Q Pain Buster<sup>®</sup>, I-Flow Corp., Lake Forest, CA, USA) were applied at the end of the surgical procedure [Figure 3]. The surgeon inserted 20 gauge multiholed Soaker catheter through an introducer needle, 2 cm from the lateral end of the incision along the full length of the wound in the subcutaneous space, then, the s.c. space and skin were separately closed with running sutures, then catheter and the catheter introducer site were covered with transparent 'op-site' dressings with the tubing coiled and sewn to the skin to prevent accidental removal or kinking. After one hour of completion of surgery, the catheter was attached to the pump and left in place for approximately 48 hours with the infusion of a 0.125 % bupivacaine at a rate of 10 ml/ hr.

### Group (C):

Neither TAP block nor the ON-Q pump were applied. One hour postoperatively, in all patients (the three groups) paracetamol i.v infusion (1000 mg / 8 hours) and PCA morphine started.

Morphine was administered with i.v. boluses of 2.5 mg at 5 min intervals, up to a total of 5 mg in all patients and PCA devices were set to deliver an i.v. infusion of 1 mg dose with a 15 min lockout time.

Assessment of morphine consumption, sedation, nausea, vomiting, urinary retention and pruritis were done by a nurse blinded to both technique and patient at 30 min., 2, 4, 6, 12 and 24 hours after completion of surgery.

At any point of time if VAS was >3, additional bolus injection of 2.5 mg of morphine was injected to control pain.

Nausea and vomiting was assessed on a three point score:

0. No nausea/vomiting in past time interval.
1. Nausea in the past interval.
2. Vomiting in the past interval.

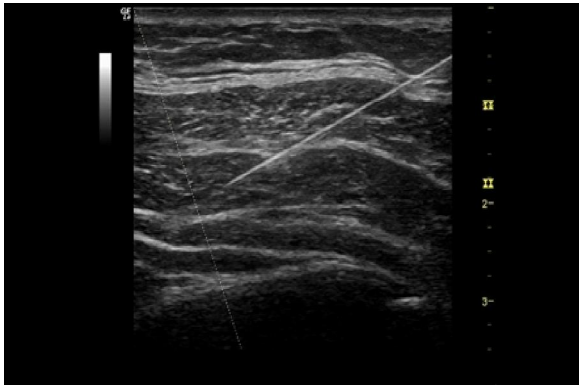
Sedation was assessed on a score of 0 to 2:

0. Awake and alert patient.
1. A quietly awake patient.
2. A sleep but easily arousable patient.

Data analysis was made by using SPSS 18.0 for Windows. Comparison between the three study groups was made by using Chi-square test for comparing means and standard deviation. However, comparing each study group with the other two groups was made by Fisher's exact test and Tukey's test. Significant results were defined when the p value was less than 0.05.



**Figure (1):** Using strict aseptic technique, the ultrasound probe was covered by a sterile plastic cover and placed in the midaxillary line just superior to the iliac crest.



**Figure (2):** Sonographic image of the abdominal muscles layers with normal saline spread in TAP.



**Figure (3):** ON-Q Pain Buster®

### 3. Results:

There were no significant differences between groups with respect to ASA classification, age, weight, duration of surgery (Table 1). No patient was excluded after inclusion to study. All patients were able to complete the entire study and their data were included in the final analysis.

There was statistically significant difference between the three groups as regards morphine consumption ( $P$  value  $< 0.001$ ). In between groups there was also statistically significant difference, where Group A had less morphine consumption than Group B and Group C. Also Group B had lower consumption than Group C (Table 2).

As regards postoperative sedation, there was statistically significant difference between groups ( $P$  value  $< 0.001$ ). Also in between groups (A and B), (A and C) and (B and C) there was statistically significant difference ( $P$  value  $< 0.001$ ) (Table 3).

There was statistically significant difference between the three groups as regards incidence of postoperative nausea and vomiting ( $P < 0.001$ ). In between groups Group (A and B), (B and C) there was no statistically significant difference between them ( $P$  value  $> 0.05$ ), while there was statistically significant difference between group (A and C) ( $P$  value  $< 0.001$ ) (Table 4).

In incidence of postoperative pruritis and urinary retention, there was statistically significant difference between the three groups ( $P < 0.001$ ). In between groups Group (A and B) there was no statistically significant difference between them ( $P$  value  $> 0.05$ ), while there was statistically significant difference between group (A and C) and group (B and C) ( $P$  value  $< 0.001$ ) (Table 5).

Those results show that morphine consumption, nausea, vomiting, sedation and pruritis were significantly reduced with the use of TAP block or ON-Q pump as a part of multimodal analgesia after cesarean section.

**Table (1):** Patients characteristics and operative data

Variable	Group A n=30	Group B n=30	Group C n=30
ASA(I/II)	25/5	26/4	24/6
Wt.(Kg)	71.6 ± 5.3	68.4±6.4	65.9±3.7
Age(years)	25.7±2.3	23.9±4.6	27.8±3.9
Duration of surgery(min)	70.9 ±10.2	65.5±12.4	73.2±5.9

**Table (2): Postoperative morphine consumption:**

Dose	Groups		
	Group A	Group B	Group C
Range	(7-12)	(10-20)	(23-35)
Mean±SD	9.54±2.044	17.84±3.11	29.45±5.422
F	12.587		
P-value	<0.001*		
Tukey's test (P-value)	A&B	A&C	B&C
	<0.001*	<0.001*	<0.001*

**Table (3): Incidence of postoperative sedation in the three studied groups:**

Sedation		Groups			Chi-square				
		Group A	Group B	Group C	X <sup>2</sup>	P-value	A&B	A&C	B&C
0	N	27	19	3	41.874	<0.001*	0.05*	<0.001*	<0.001*
	%	90.00	63.33	10.00					
1	N	2	8	14					
	%	6.67	26.67	46.67					
2	N	1	3	13					
	%	3.33	10.00	43.33					

**Table (4): Incidence of postoperative nausea and vomiting in the three studied groups:**

		Groups			Chi-square		Fisher's exact test (P-value)		
		Group A	Group B	Group C	X <sup>2</sup>	P-value	A&B	A&C	B&C
Nausea	N	2	5	10	7.107	0.028*	0.424	0.021*	0.232
	%	6.67	16.67	33.33					
Vomiting	N	1	3	8	7.500	0.023*	0.612	0.026*	0.181
	%	3.33	10.00	26.67					

**Table (5): Incidence of postoperative pruritis and urinary retention in the three studied groups:**

		Groups			Chi-square		Fisher's exact test (P-value)		
		Group A	Group B	Group C	X <sup>2</sup>	P-value	A&B	A&C	B&C
Pruritis	N	1	3	12	15.659	<0.001*	0.611	0.001*	0.015*
	%	3.33	10.00	40.00					
Urinary retention	N	1	2	10	13.127	<0.001*	1.000	0.006*	0.021*
	%	3.33	6.67	33.33					

#### 4. Discussion

Pain is inadequately treated in about 75% of all surgical patients, which can result in increased morbidity, length of stay, and patient dissatisfaction. Multimodal analgesia is a rational approach to treat various components of postoperative pain (tissue injury and nociceptive stimulation and subsequently 'central way' activation). The combined use of different analgesic techniques that span different phases of analgesia leads to further reduction of pain, utilizing lower dosages, thus avoiding or reducing the risk of adverse drug effects<sup>(12)</sup>.

Post-caesarean pain has two divisions, somatic and visceral. Somatic division has two components,

cutaneous and deep. Cutaneous component originates from nociceptors within the abdominal wall; it is transmitted within the anterior divisions of spinal segmental nerves, usually T10-L1, which runs laterally in the abdominal wall between the layers of transversus abdominis and internal oblique muscles. Visceral uterine nociceptive stimuli return via afferent nerve stimuli that ascend through the inferior hypogastric plexus and enter spinal cord via the T10-L1 spinal nerves<sup>(13)</sup>.

TAP block is a regional anesthesia technique which targets nerves of anterolateral abdominal wall. The posterior approach used in this study mainly blocks T9-L1, which supplies lower abdominal wall,

therefore this technique is suitable for surgeries below umbilicus. So, TAP block affects only somatic component of post-caesarean pain, therefore it can be used as a part of multimodal analgesia. There is lack of studies comparing TAP block with other analgesics such as epidural analgesia or local anesthetic infiltration into the abdominal wound. There is only limited evidence to suggest that use of perioperative TAP block reduces opioid consumption and pain scores after abdominal surgery when compared with no intervention or placebo<sup>(14)</sup>. Only few case studies and case reports described the use of continuous TAP block, mostly in intensive care unit as a rescue analgesic modality<sup>(15)</sup>.

Using the ON-Q Pain Relief System for continuous infusion of subcutaneous local anesthetics has the potential to provide postoperative analgesia by providing pain relief at the source of injury.

One advantage for the use of ON- Q Pump is that the placement of the catheters at the end of the operation is uncomplicated, and its only contraindication is allergy to the local anesthetic. After the operation, the elastomeric pump does not require any adjustment or care by physicians or the nursing staff. Unlike continuous epidurals, which require maintenance, titration, and management of complications, the use of the ON-Q device might lead to a decrease in complications, interventions, and resources needed to treat the patient.

Somatic component of post cesarean pain may be relieved by both TAP block and subcutaneous infusion by ON- Q pump but visceral pain may be more difficult to treat, so, multimodal analgesia program should be employed. Paracetamol is effective for relieving pain related to menstrual cramping and, as a result, it is used as a part of the multimodal program<sup>(16)</sup>.

In this study we compared TAP block and ON-Q Pain Relief System in combination with paracetamol in post-operative period so as to cover both somatic and visceral pain of caesarean section.

### Conclusion

Both TAP block and ON-Q Pain Relief System are effective and safe method of analgesia following caesarean section. Both decrease the requirement of opioids and thus associated side effects. However TAP block appears to be more effective analgesic modality.

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