

# Ultrasound-guided bilateral transversus abdominis plane block *versus* spinal morphine for pain relief after caesarean section

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## Abstract

**Background:** Ultrasound-guided transversus abdominis plane block is an effective method for pain relief after caesarean delivery. The gold standard to treat pain after caesarean delivery is spinal morphine administration; at the same time TAP is considered as an effective method to treat this pain. In this study, we compared efficiency and side effects of these techniques in patients undergoing elective caesarean delivery.

**Methods:** 104 women undergoing elective caesarean delivery under spinal anesthesia were randomized to receive either TAP block with Bupivacaine 0.25% (BUPICAINE, UNIMED, TUNISIA) or spinal morphine. All patients received a standard postoperative analgesia with Paracetamol intravenously. Rescue analgesia using Nefopam and morphine intravenously was given when necessary. Patients were assessed at 2, 4, 6, 12 and 24 hours after caesarean delivery. Visual analog scale (VAS) pain scores at rest and during the palpation of the uterine globe were recorded. Analgesic consumption, time to first analgesic request, heart rate, systolic and diastolic blood pressure were noted. Patients rated the severity of opioid side effects and their satisfaction with the protocol of analgesia.

**Results:** Pain scores at rest and during the palpation of the uterine globe during the first 24 postoperative hours were similar in both groups. The number of patients who received additional analgesia was similar in both groups. The intestinal transit recovery was earlier in the TAP block group with a statistically significant difference ( $p < 10^{-3}$ ). Maternal satisfaction was similar in both groups.

**Conclusion:** TAP block and intrathecal morphine were of similar efficiency for pain relief after caesarean section. The incidence of side effects was comparable in both groups.

## Introduction

Pain after caesarean section is severe during the first 48 postoperative hours, and then it gradually decreases during the second and the third day [1]. Post caesarean section pain management is an important clinical issue due to the increase of caesarean sections, to the need for an earlier perambulation and to an early recovery of mother-child relationship.

Common analgesic strategies are based on a multimodal approach combining spinal, epidural or systemic opioids to non-opioids such as Paracetamol, anti-inflammatory drugs, Tramadol or Nefopam. However, the use of opioids is usually associated with side effects such as nausea and vomiting, sedation, itch, urinary retention, delayed recovery of intestinal transit, respiratory depression and even hyperalgesia. Trying other analgesic techniques may be useful to reduce not only postoperative pain but also opioid-related side effects, and, as a result, to promote postoperative rehabilitation in order to limit the risk of thromboembolism on per partum [2]. The infiltration of the abdominal wall with local anesthetics is more commonly used for pain management. The transversus abdominis plane (TAP) block has recently been proposed to relieve the somatic pain component [3]. It is efficient especially when performed under ultrasound guidance. The aim of our study was to compare efficiency and side effects of spinal morphine to ultrasound-guided TAP block in patients undergoing elective caesarean delivery.

## Methods

After local ethics committee agreement, we led a prospective randomized simple-blind study in the Maternity and Neonatology Center of Tunis. A clear explanation of the analgesic technique and pain assessment were given to the patients before obtaining their informed consent. Initially, we enrolled 104 ASA I or II parturients, all scheduled for elective caesarean delivery, via a Pfannenstiel incision under spinal anesthesia. Emergent cases, ASA III and IV, and non-consenting parturients were not included. Parturients in whom spinal anesthesia failed were excluded ( $n=0$ ) as well as those in whom the typical biconvex lens image was not obtained while performing the ultrasound-guided TAP block ( $n=2$ ), those who had anesthetic or surgical complications ( $n=2$ ), and those who received any other analgesics than those prescribed in our study protocol ( $n=0$ ).

Randomization was performed using a computer-generated table of random numbers. Parturients were assigned to receive either

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subarachnoid morphine (SM group) or TAP block (TAP group). Patients in the SM group received spinal anesthesia with 10 mg of 0.5% hyperbaric bupivacaine (BUPI, UNIMED, TUNISIA), 5 µg of Sufentanil (SUFENTAMED, UNIMED, TUNISIA) and 100 µg of preservative-free morphine (MORPHINE CHLOHYDRATE, AGUETTANT). Patients in the TAP group received spinal anesthesia with only 10 mg of 0.5% hyperbaric bupivacaine and 5 µg of Sufentanil, they had in addition TAP block with 0.25% isobaric Bupivacaine 20 ml on each side. The TAP block was performed at the end of surgery: A linear array 5-12 MHz ultrasound probe (MySono U6® MEDISON) was used. Imaging depth was set at 4 to 6 cm. The probe was transversely oriented and placed at the midpoint between the lower costal margin and the iliac crest in the midaxillary line. The probe was angulated in order to identify the external oblique, internal oblique, and transversus abdominis muscles and their interfascial planes. A 20-gauge Quincke needle (adhe-els®) was used, after scraping the tip in order to refine the sensation of loss of resistance when crossing the fascia. The needle was introduced via in plane technique into the neurofascial plane between the internal oblique and the transversus abdominis muscle, with the tip in the midaxillary line. A 3 mL test dose of the study solution was administered to check appropriate positioning. Twenty mL of 0.25% isobaric Bupivacaine was slowly injected on each side with negative aspiration every 5 mL under real-time ultrasounds visualization. Patients in both groups were given intravenous Paracetamol 1 gram every 6 hours. The first dose was given on arrival in postoperative care unit. Postoperative pain was assessed using a visual analogue scale (VAS). Breakthrough pain was treated with Nefopam (Acupan®) 20 mg every time the VAS score was more than 4 cm. Intravenous morphine 5 mg was given every time the VAS score remained above 4 cm after Nefopam infusion [4,5].

The primary outcome of our study was pain scores at rest and during the palpation of uterine globe. Secondary outcomes were Nefopam and morphine consumption, time to first analgesic request, the occurrence of itch and postoperative nausea and vomiting, time to intestinal transit recovery and finally the maternal satisfaction. We aimed to detect a mean VAS score difference of  $1 \pm 1.5$  cm between the groups. A calculation based on  $\alpha = 0.05$  and a power of 90% yielded a sample size of 39 patients per group using a 2-tailed test. But we chose to enroll 52 parturients per group to improve the quality of our results.

Collected data were: age, weight, height, ASA status, parity, and number of deliveries, gestational age, and the indication for caesarean section. Patients were assessed for VAS scores at rest and during the palpation of uterine globe immediately after surgery then at the 2nd, 3rd, 6th, 12th and 24th hour postoperative. We also noted heart rate, systolic and diastolic blood pressure, itch, postoperative nausea and vomiting, time to first analgesic request and the total given dose of Nefopam and morphine, and finally time to intestinal transit recovery. Patients were asked to rate their satisfaction by the mean of a three-item scale (Excellent-Good-Bad).

Statistical analyses were performed using Statistical Package for the Social Sciences SPSS® version 20 software. Quantitative data were reported as mean  $\pm$  standard deviation (SD) and were analyzed using Student's *t* test. Qualitative data were reported as numbers and percentages and were analyzed using Chi2 test. Statistical significance level was fixed at 0.05.

## Results

104 patients were enrolled in the study. Four patients were excluded: Two patients had post-partum hemorrhage requiring

general anesthesia, two other patients were excluded because the typical biconvex lens image was not obtained while performing the ultrasound-guided TAP block. Consequently, only 100 patients were studied. Age, weight, height, body mass index, number of pregnancies, number of deliveries, gestational age, history of caesarean delivery, ASA status and duration of surgery were all similar in both groups (Table 1). VAS Pain scores at rest were similar in both groups during the first 24 hours postoperative (Table 2). VAS pain scores during palpation of the uterine globe were similar in both groups during the first 24 hours postoperative (Table 3). Breakthrough pain occurred in 18 patient (36%) in TAP group versus 16 patients (32%) in SM group

**Table 1.** Patients characteristics in both groups.

Group	TAP group (N=50)	SM group (N = 50)	P
Age (year)	32.3 $\pm$ 4.3	32.3 $\pm$ 4.3	0.55
Weight (Kg)	80.9 $\pm$ 13.8	78.1 $\pm$ 11.7	0.26
Height (cm)	162.9 $\pm$ 5.6	162 $\pm$ 6.2	0.43
BMI (kg/m <sup>2</sup> )	30.5 $\pm$ 4.9	29.7 $\pm$	0.38
Number of pregnancies	2 $\pm$ 1.2	2 $\pm$ 1.4	0.87
Number of deliveries	2.2 $\pm$ 1	2 $\pm$ 1	0.52
Gestational age (Week)	38.7 $\pm$ 1.1	39.1 $\pm$ 1.2	0.08
History of caesarean delivery (%)	72 %	62 %	0.39
ASA 1 (%)	78 %	88 %	0.28
ASA 2 (%)	22 %	12 %	
Duration of surgery (min)	36.5 $\pm$ 8.7	35.9 $\pm$ 6.6	0.75

Data are expressed as mean  $\pm$  SD or percentages

**Table 2.** VAS pain scores scale at rest.

VAS (cm)	TAP group (N=50)	SM group (N=50)	P
H2	1.0 $\pm$ 1.5	0.7 $\pm$ 1.1	0.19
H4	2.1 $\pm$ 2.1	1.9 $\pm$ 1.9	0.6
H6	2.8 $\pm$ 2	2.2 $\pm$ 2.2	0.12
H12	2.4 $\pm$ 2.0	2.3 $\pm$ 1.8	0.81
H24	2.1 $\pm$ 1.4	2.6 $\pm$ 1.7	0.1

Data are expressed as mean  $\pm$  SD

**Table 3.** VAS pain scores during palpation of the uterine globe.

VAS (cm)	TAP (N=50)	MIT (N=50)	P
H2	2.3 $\pm$ 1.9	2.3 $\pm$ 2.1	0.92
H4	3.7 $\pm$ 2.4	3.6 $\pm$ 2.5	0.92
H6	4.2 $\pm$ 2.2	4.0 $\pm$ 2.6	0.77
H12	4.4 $\pm$ 2.4	4.0 $\pm$ 2.3	0.43
H24	4.1 $\pm$ 1.9	4.5 $\pm$ 2.1	0.31

Data are expressed as mean  $\pm$  SD

**Table 4.** Evolution of systolic blood pressure and heart rate.

		TAP n=50	MIT n=50	P
H2	BP	112 $\pm$ 11	113 $\pm$ 13	0.65
	HR	79 $\pm$ 11	77 $\pm$ 9	0.08
H4	BP	112 $\pm$ 10	115 $\pm$ 11	0.15
	HR	80 $\pm$ 10	79 $\pm$ 10	0.3
H6	BP	114 $\pm$ 9	113 $\pm$ 11	0.72
	HR	81 $\pm$ 9	80 $\pm$ 11	0.8
H12	BP	110 $\pm$ 8	113 $\pm$ 8	0.17
	HR	79 $\pm$ 9	78 $\pm$ 14	0.7
H24	BP	112 $\pm$ 10	114 $\pm$ 7	0.2
	HR	78 $\pm$ 8	79 $\pm$ 8	0.75

BP: Systolic blood pressure (mmHg); HR: Heart rate (bpm); Data are expressed as mean  $\pm$  SD.

( $p=0.19$ ) and was handled by Nefopam infusion. There was no need for Morphine injection in any patient. The average cumulative dose of Nefopam was similar in both groups ( $26 \pm 10$  mg in TAP group vs.  $32 \pm 20$  mg in SM group;  $p=0.4$ ). No difference was noted regarding time to first analgesic request in both groups (7 hours in TAP group vs. 9 hours in SM group;  $p=0.12$ ). Systolic blood pressure and heart rate were similar in both groups (Table 4). The incidence of itch was similar in both groups (76% in TAP group vs. 78% in SM group;  $p=0.81$ ) as well as postoperative nausea and vomiting (18% in TAP group vs. 28% in SM group;  $p=0.23$ ). 45 patients (90%) in the TAP group restored their transit in the first 24 hours postoperative versus only 29 patients (58%) in the SM group ( $p<10^3$ ). Maternal satisfaction was similar for all items (excellent, good and bad) in both groups ( $p=0.94$ ). In fact, satisfaction was excellent in 58% of cases in TAP group vs. 60% in SM group.

## Discussion

Ultrasound-guided blockade of the abdominal wall was found to be efficient for pain relief after cesarean delivery [6,7]. It is associated with a decrease of other analgesic consumption such as Tramadol [7,8] or morphine [9], and with a longer time to first analgesic request [9].

Studies have compared the analgesic efficacy of spinal morphine administration to TAP block after cesarean section. Our study found that spinal morphine and TAP block provided a similar analgesic efficiency. Kanazi *et al.* [8] however, did not find a difference in VAS pain scores with 0.2 mg of spinal morphine. But, using an increasing dose of spinal morphine ( $> 0.1$  mg) makes no analgesic benefit but many side effects [10-12]. Actually, the optimal dose of spinal morphine is thought to be of only 75  $\mu$ g [13]. As found in our study, Loane *et al.* [14] reported no difference in pain scores while comparing 100  $\mu$ g of spinal morphine to ultrasound-guided TAP block with 100 mg of Ropivacaine in patients undergoing elective cesarean section. Several combinations of spinal morphine to TAP block were reported [15-18], they used either Bupivacaine or Ropivacaine and globally found that the association of spinal morphine with TAP block may improve analgesia and even delay the first analgesic request but it is associated with an increasing incidence of side effects. Spinal morphine, but not TAP block, is thought to improve pain scores and morphine consumption [18]. The association of TAP block with spinal morphine may not give additional analgesic gain [18]. This fact may be due to the absence of ultrasound guidance when performing the TAP block. Indeed, ultrasound-guided nerve blocks offers the advantage of real time imaging of the needle trajectory and local anesthetics spread, which may improve both safety and block effectiveness [19].

In our study, total doses of rescue analgesia were comparable in both groups. Kanazi *et al.* [8] showed reduced total tramadol doses during the first 12 hours in the spinal morphine group; however, they used higher doses (0.2 mg) of spinal morphine.

In our study, the time to first analgesic request was similar in both groups. Kanazi *et al.* [8] reported a longer time to first analgesic request in the spinal morphine administration group (8 hours vs 4 hours).

The mean heart rate and blood pressure were similar in both groups. We did not find studies that use these data for assessment of pain relief.

Spinal morphine used to be the « gold standard » technique for post cesarean pain relief [20-22]. The recommended dose of 100  $\mu$ g, is in fact a good compromise between efficiency and side effects (respiratory depression, itch, nausea, vomiting and delay recovery of transit) [23]. The incidence of itch, nausea and vomiting was

comparable in both groups in our study. The restoration of transit was significantly delayed in the spinal morphine group compared to the TAP block group. Nausea and vomiting are the commonest side effects of spinal morphine; it is seen in more than 30% of cases [9-14,18-24]. A meta-analysis [15] including nine studies found that incidence of nausea is reduced during the first 12 postoperative hours with TAP block analgesia. However, none of these studies mentioned the effect of the analgesic protocols on the recovery time of transit.

Our study as well as, Kanazi's study [8], found that spinal morphine and TAP block provided equivalent maternal satisfaction. The conjunction of spinal morphine administration with the TAP block also improved maternal satisfaction [17].

Because of its analgesic benefit, the TAP block may be useful as rescue analgesia rather than a routine technique [25]. Ultrasound-guided TAP block seems to be safe but cases of visceral injury were reported [14,26-28]. Injection of high local anesthetics volumes may increase the risk of systemic toxicity [29]. On the other side, the optimal dose of local anesthesia as well as the duration of analgesia remains poorly estimated. Carney *et al.* [30] founded TAP block to be efficient for up to 48 hours.

Despite their well-established efficiency, Non-steroidal anti-inflammatory drugs [31] were not used in our study in order to bring out the role of local anesthetics. In our study, we did not assess the success rate of sensory distribution of the block, because residual sensory block related to spinal anesthesia may remain in the early postoperative period. We did not measure the Bupivacaine blood rates in the TAP group.

## Conclusion

TAP block and spinal morphine have similar efficiency for pain relief after cesarean section. No difference was noted regarding the VAS pain scores, the total cumulative dose, the time to first analgesic request, the systolic blood pressure and heart rate. The restoration of transit was significantly delayed in the spinal morphine group compared to the TAP block group. The incidence of itch, postoperative nausea, vomiting and maternal satisfaction was comparable in both groups.

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