

# Intraoperative Ultrasound-guided Transversus Abdominis Plane Block in Lower Abdominal Surgery

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## ABSTRACT

**Background:** Ultrasound-guided transversus abdominis plane (TAP) block has been used for analgesia in lower abdominal surgery. In the literature, there are inconsistent reports regarding the efficacy of TAP block in different open abdominal procedures. Therefore, we conducted this prospective randomised double-blind study to evaluate the pattern of perioperative analgesia and to validate the efficacy of TAP block in patients undergoing lower abdominal surgery.

**Methods:** Thirty-two patients scheduled to undergo lower abdominal surgery (open appendectomy or inguinal hernia repair) under general anaesthesia (GA) were randomly allocated into two groups (each 16 patients) according to pain relief modality used intraoperatively. Group I patients received GA and group II received GA followed by ultrasound-guided TAP block after induction of anaesthesia. Unilateral ultrasound-guided TAP block was achieved with 12 ml of 0.5% bupivacaine. Haemodynamic changes and total dosages of intraoperative analgesics used were recorded intraoperatively. Postoperative pain was assessed using numeric rating score. The total dosages of postoperative analgesics were recorded. Paired student t-test was used to analyze heart rate and blood pressure variations, and Mann-Whitney U test was used to compare analgesic requirement and pain score.  $P < 0.05$  was considered significant.

**Results:** Group II required significantly less amount of fentanyl intraoperatively compared with group I [mean (SD)—75 (12.9) vs 193 (28.1)  $\mu\text{g}$ ;  $P > 0.0001$ ]. Postoperative use of meperidine was significantly reduced in group II compared to group I [mean; 7.5 (13.4) vs 46.2 (8) mg;  $P > 0.0001$ ]. The numeric rating score was significantly lower in group II compared with group I [mean (SD)—0.75 (1.4) vs 5 (1.4)— $P > 0.0001$ ].

**Conclusion:** Ultrasound-guided TAP block is an effective method of providing analgesia during the intraoperative and immediate postoperative period for patients undergoing lower abdominal surgery.

**Keywords:** Anaesthetic techniques, Postoperative, Pain, Regional, Abdominal Surgery, Ultrasound.

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## INTRODUCTION

The use of ultrasound-guided TAP block is a promising technique in providing analgesia in abdominal surgery. Ultrasound-guided transversus abdominis plane (TAP)

block provides excellent pain relief, especially in lower abdominal surgery as proved by Tran et al.<sup>1</sup> The higher success rate of this technique has been attributed to the accurate identification of the layers of the abdominal wall and the exact placement of the needle tip.<sup>2</sup>

Narcotics are the main mode of analgesia during lower abdominal surgical procedures where regional blocks, like epidural or spinal, are not used as part of the anaesthetic management. Niraj et al evaluated the analgesic efficacy of unilateral ultrasound-guided TAP block in attenuating morphine consumption during the first postoperative day following open appendectomy. They concluded that ultrasound-guided TAP block provided excellent postoperative analgesia for patients who underwent open appendectomy. However, their study was limited to pain assessment in the postoperative period only.<sup>3</sup>

The literature is full of conflicting results on the efficacy of ultrasound-guided TAP block in lower abdominal surgery. In a recent report, Griffiths et al failed to show any significant additional benefit from TAP blockade in a heterogeneous patient population who received multimodal analgesia for midline laparotomy unlike other published data.<sup>4</sup>

We believed that because the TAP block is given before the start of surgery, it would be appropriate to evaluate the pattern of its analgesic efficacy in the intraoperative and immediate postoperative period. Therefore, we designed a prospective randomised double-blinded study, to evaluate the efficacy of ultrasound-guided unilateral TAP block in providing perioperative analgesia compared with the conventional analgesia (intraoperative fentanyl and postoperatively meperidine) in patients undergoing open lower abdominal surgery (open appendectomy or inguinal hernia repair).

## PATIENTS AND METHODS

After obtaining hospital ethics committee approval, a written informed consent was also obtained from all 32 patients included in this prospective study. The patients were randomly divided by the sealed envelope technique into two groups. Group I (GA) received conventional anaesthesia care. Group II (GA + TAP) received ultrasound-guided unilateral TAP block following induction of general anaesthesia. All patients were in the age group 18 to 55 years with ASA status of I and II. Patients with a history

of allergy to local anaesthetics, bleeding disorders and unwilling patients were excluded from the study. In both the groups, GA was induced using fentanyl ( $1 \mu\text{g.kg}^{-1}$ ), propofol ( $2 \text{mg.kg}^{-1}$ ) and rocuronium ( $0.7 \text{mg.kg}^{-1}$ ) to facilitate tracheal intubation. Maintenance of anaesthesia was achieved with desflurane (MAC 0.8-1) and rocuronium as required. In group II (GA + TAP), the TAP block was performed by an anaesthetist blinded to the study, under aseptic precautions, using Sonosite M-turbo (Bothell, WA, USA), 13-6 high frequency linear probe. The ultrasound probe was placed in the anterior axillary line at the umbilical level and block was performed using 100 mm insulated needle (Stimuplex, B Braun, Germany). The target area was scanned, the layers of abdominal wall (fat, external oblique, internal oblique, transversus abdominis) were identified and the needle was inserted using in-plane needling technique under real time ultrasound guidance. The needle was guided to the fascial plane of the transversus abdominis muscle. A negative aspiration for blood was confirmed and 12 ml of 0.5% bupivacaine was injected and the spread of the local anaesthetic was observed using ultrasound. The surgery commenced under the supervision of an anaesthetist blinded to the mode of analgesia. The patients were observed for their heart rate, blood pressure at induction, skin incision and then at 15, 30 minutes and 1 hour during the procedure. The observing anaesthetist was advised to use fentanyl ( $1-2 \mu\text{g.kg}^{-1}$ ) for analgesia, if the heart rate, blood pressure or both increased more than 20% of baseline. The patients were also assessed in the immediate postoperative period for pain using numeric rating score (NRS). The PACU team who was also blinded to the mode of analgesia assessed the demand for meperidine in the postoperative period. From a preliminary analysis of a pilot study, a mean difference of 30  $\mu\text{g}$  of perioperative analgesic (fentanyl) was considered to be required by the two groups: GA (mean dosage: 75; sd = 27) and GA + TAP (mean dosage: 45; sd = 25). Fixing the level of significance, as  $\alpha = 0.05$  and with  $\beta = 0.10$  (a power of 90%), the study required 15.77 (i.e. 16 patients) in each group, i.e. 32 patients in total. Paired student t-test was used to analyze the heart rate and blood pressure variations, and Mann-Whitney U test was used to compare analgesic requirement and pain score.

## RESULTS

The two study groups were comparable in terms of age, gender and duration of surgery. There were 27 male patients and five female patients (Table 1). There was significant difference in the heart rate and systolic blood pressure on incision in both the groups ( $P < 0.0001$ ). There was no significant difference in heart rate ( $P = 0.441$ ) at 15 minutes and beyond, although a significant difference in systolic blood pressure ( $P = 0.17$ ) at 15 minutes was recorded. There

was no significant difference in blood pressure beyond 15 minutes in both groups (Tables 2 and 3). Also, in the TAP group, there were significantly lower amounts of fentanyl used in the intraoperative period [193(28) vs 75 (12.9),  $P < 0.001$ ]. The TAP group required significantly (lower) lesser amount of meperidine in the postoperative period [46.2(8) vs 7.5 (13.4),  $P < 0.001$ ] as the group had significantly lower pain scores compared with GA group [5(1.4) vs 0.75 (1.4),  $P < 0.001$ ] (Table 4).

## DISCUSSION

A change in the practice of opioid use in lower abdominal surgery has been noticed with the introduction of ultrasound-guided TAP blocks. A previous study by El-Dawlatly et al described the success of TAP block in reducing morphine consumption in the postoperative period in patients undergoing laparoscopic surgery.<sup>5</sup> The present study aimed to evaluate the efficacy of the block, both in intraoperative and postoperative period by studying the opioid requirements in patients undergoing lower abdominal surgery. Also, we compared the fentanyl requirements in the intraoperative period and meperidine used in the postanesthesia care unit (PACU) in both groups. Our findings confirmed that the narcotics requirement was reduced with simultaneous use of ultrasound-guided TAP block. The study was limited to intraoperative and early postoperative periods and did not extend into the late postoperative period. This study also emphasises the fact that 12 ml of 0.5% bupivacaine is sufficient to produce clinical analgesia, whereas other authors have used 20 ml of the same drug for similar effects. Effectiveness of the reduced volume of anaesthetic may be related to the appropriate deposition of the injected local anaesthetics under ultrasound guidance.<sup>6,7</sup> The study demonstrated that significantly lower requirements of fentanyl and meperidine were used in the TAP block group. In the series, we

**Table 1:** Patient characteristics

	Group I (GA)	Group II (GA+TAP)
Age (years)	23.1 $\pm$ 5.0	26.6 $\pm$ 8.5
Gender (M/F)	14/2	13/3
Duration of surgery (minutes)	90.0 $\pm$ 17.32	97.8 $\pm$ 23.8

**Table 2:** Intraoperative heart rate

Time	Group I (GA) mean $\pm$ SD	Group II (GA+TAP) mean $\pm$ SD	P-value
Induction	85.375 $\pm$ 10.19	80.438 $\pm$ 11.44	0.207
Incision	96.56 $\pm$ 11.82	80.0 $\pm$ 11.43	<0.0001
15 minutes	84.375 $\pm$ 10.98	81.06 $\pm$ 12.93	0.441
30 minutes	82.5 $\pm$ 11.83	78.75 $\pm$ 13.31	0.406
1 hour	79.63 $\pm$ 09.28	76.94 $\pm$ 11.63	0.476

**Table 3:** Intraoperative systolic blood pressure

Time		Group I (GA) mean $\pm$ SD	Group II (GA+TAP) mean $\pm$ SD	P-value
Induction		116.31 $\pm$ 5.80	110.5 $\pm$ 7.155	0.017
Incision		124.06 $\pm$ 8.61	110.13 $\pm$ 8.197	$P < 0.0001$
15 minutes	Mean $\pm$ SD	115.06 $\pm$ 6.75	109.13 $\pm$ 8.23	0.017*
	Median (min – max)	111 (108 – 132)	110 (97 – 130)	
30 minutes		112.19 $\pm$ 6.61	108.81 $\pm$ 8.63	0.224
1 hour		113.25 $\pm$ 5.84	109.81 $\pm$ 7.54	0.160

\*Mann-Whitney U test, because the data did not had normal distribution

**Table 4:** Analgesic dosages and pain score

		Median	(Min – max)	Mean	SD	P-value
Fentanyl (mg)	Group I (GA)	200	(150 – 250)	193.7	28.136	<0.0001
	Group II (GA + TAP)	75	(50 – 100)	75	12.91	
Meperidine (mg)	Group I (GA)	50	(30 – 50)	46.25	8.062	<0.0001
	Group II (GA + TAP)	0	(0 – 30)	7.5	13.42	
Pain score (1-10)	Group I (GA)	5.0	(3 – 8)	5.0	1.46	<0.0001
	Group II (GA + TAP)	0	(0 – 3)	0.75	1.48	

encountered two cases of retrocaecal appendix which required mesenteric traction and patients were given extra dose of analgesic to reduce the haemodynamic response to the traction. We believe that a careful handling of the appendix and the surrounding tissues by the surgeon along with minimal traction and mesenteric manipulation are necessary to achieve good clinical analgesia with TAP block. There are options to use bupivacaine in graded doses and strength and also as a mixture with lidocaine, but we thought that 0.5% bupivacaine would give a dense and long-lasting block. Moreover, the dose of 12 ml of 0.5% bupivacaine was mainly supported by clinical acumen and is not guided by a response to different doses.<sup>8</sup> The cadaveric study performed by Tran et al has demonstrated the need to cover T9 –L1 in TAP and has warranted the need to study the exact location of injection site, as this may reduce the volume requirement in this block.<sup>1</sup> Jankovic et al have demonstrated the exact location of nerves needed to be blocked in petite triangle (inferior lumbar triangle) to get good block.<sup>9</sup> The current study was lacking a few aspects like we did not determine the duration of the TAP block and the exact volume needed on body weight basis. Also, we did not assess postoperative nausea and vomiting in the PACU.

In conclusion, the ultrasound-guided TAP block is an efficient mode of analgesia in the intraoperative and immediate postoperative period for patients undergoing lower abdominal surgery (open appendectomy or inguinal hernia repair).

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