

Ultrasound-guided TAP Block with or without Dexmedetomidine vs. Local Infiltration of the Wound after Open Herniorrhaphy: A Randomized Prospective Controlled Study

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Abstract

Objectives: Transversus abdominis plane (TAP) block and local anesthetic wound infiltration (LAI) can provide a variable effective pain relief at the wound site after surgery. This prospective study was designed to evaluate the postoperative analgesic efficacy of TAP with or without dexmedetomidine compared with LAI of the wound after herniorrhaphy.

Materials and methods: Sixty adult patients were divided into 3 groups of 20 patients each. Group1 (TAPD): Patients received single shot ultrasound-guided (US) TAP block using 15 mL of levobupivacaine 0.5% mixed with 0.9 µg/kg of dexmedetomidine. Group 2 (TAP): Patients received single shot US guided TAP block using 15 mL of levobupivacaine 0.5%. Group 3 (LAI): Patients received local anesthetic infiltration (LAI) patients received local infiltration using 15 mL of levobupivacaine 0.5%. The following parameters were assessed at 2, 10, 18 and 24 h postoperatively: postoperative duration of analgesia, analgesic pain scores using the visual analogue scale (VAS) for pain, amount of supplemental intravenous morphine, postoperative nausea and vomiting during 24 h.

Results: We found that a lower significant difference ($P < 0.05$) of VAS pain scores at rest and on movement between group TAPD and group TAP at time 24 h postoperatively. Also, there was a lower significant difference ($P < 0.05$) of VAS pain scores at rest and on movement between group TAPD and group LAI at 10, 18 and 24 h. Moreover, there was a lower significant difference ($P < 0.05$) between group TAP and group LAI at times 10 and 18 h. Also, supplemental morphine consumption within 24 h was a statistically higher ($P < 0.05$) in group LAI compared to groups TAPD and TAP.

Conclusion: Using dexmedetomidine as an additive to levobupivacaine in ultrasound-guided TAP block for herniorrhaphy provides prolonged duration of postoperative analgesia, and lowered VAS pain scores. Also local anesthetic infiltration can give accepted postoperative analgesia but with shorter duration than TAP block

Keywords: Dexmedetomidine; TAP block; Local anesthetic infiltration; Herniorrhaphy

Introduction

Postoperative pain considered from the leading causes of prolonged hospital stay by interference with early ambulation and hence increases the risk for deep venous thrombosis (DVT), basal lung atelectasis and collapse from limited chest expansion after abdominal incisions. All nerve block trials not to give pain-free most of the time but also all of the time. The use of ultrasound-guided sensory block of the anterior abdominal wall with local anesthetics for postoperative pain relief is a simple and safe technique [1]. The ideal analgesic regimen needs to meet the goals of providing effective analgesia with minimal side effects [2]. Patient controlled analgesia (PCA) has been widely used to relieve postoperative pain. However, the efficacy of PCA is limited by many side effects. The side effects of opioids are occurred according to the dose, therefore, alternative treatments that can decrease the use of intravenous opioids or avoid central neuraxial blockade are required to manage pain after upper abdominal wall surgeries [1] Transversus

abdominis plane (TAP) block and local anesthetic infiltration (LAI) of the surgical wound can provide effective pain relief at the wound site after surgery. However, the relative efficacy of two techniques for postoperative analgesia remains controversial [3].

Dexmedetomidine is a centrally acting selective α_2 agonist, which have increased popularity in the last 21 years as a drug for intraoperative sedation during surgery under regional anesthesia [4] and as a sedative drug in ICU settings [5]. Animal and human studies have shown safety and efficacy of adding dexmedetomidine to local anesthetics in various regional anesthetic procedures, such as subarachnoid, epidural, and caudal injections [6].

The lateral abdominal wall consists of three muscles, the external oblique, the internal oblique and the transversus abdominis, and their fascial sheaths. The nerves that supply the anterior abdominal wall course through the neurofascial plane between the internal oblique and the transversus abdominis muscles [2]. The target of the block is to inject local anesthetic into the TAP that a potential space just superficial to the transversus abdominis muscle [7].

The TAP block can't give a full anesthesia and analgesia for the abdominal surgeries but it is considered as a part of multimodal analgesic regimen [8]. US-guided TAP block was growing rapidly, it has been shown that the TAP block provides effective analgesia after abdominal surgeries [9]. US scanning is needed to ensure that the correct positioning of the needle in the TAP [10].

Single injection of TAP block usually provides up to 24 h of effective analgesia for abdominal wall wounds. A large dose of local anesthetic is required to be injected into the plane [9,11]. Infiltration of LA into the skin and subcutaneous tissue layer at surgical incision sites can relieve pain scores at the surgical wound until 24 h postoperatively. This technique is a safe, simple and less costly. It is routinely performed by surgeon in most hospitals for postoperative analgesia. The analgesic efficacy of TAP block versus local infiltration of the surgical wound on postoperative analgesia remains controversial [3].

Aim of Our study was to compare the analgesic efficacy of TAP block either with or without dexmedetomidine with local injection of LA of the surgical wound by the surgeon at, 2, 10, 18 and 24 h postoperatively.

Materials and Methods

After obtaining approval from the Regional Ethics Committee, and written informed consent, we conducted this randomized, controlled clinical trial. Sixty patients (ASA I, II, and III), undergoing open herniorrhaphy, were randomly allocated to three groups (20 patients each). Group TAPD: the patients received single shot US guided TAP block using 15 mL of levobupivacaine 0.5% mixed with 0.9 µg/kg of dexmedetomidine. Group TAP: The patients received single shot US guided TAP block using 15 mL of levobupivacaine 0.5%. Group LAI: The patients received local anesthetic infiltration using 15 mL of levobupivacaine 0.5%. Exclusive criteria were patients with history of allergy to local anesthetics, major systemic disease, blood coagulopathy, and patients who were unable to understand the response grading of the Visual Analogue Scale (VAS). All patients were instructed one day before surgery about the study protocol and the use of VAS.

There was no deviation from the standard pre-anesthetic and anesthesia protocols and postoperative care remained unchanged. Premedication as performed with midazolam (0.03 mg/kg) intravenously upon arrival to the preoperative holding area. General anesthesia was induced with fentanyl 2 mcg/kg, 2% lidocaine (1.5 mg/kg), rocuronium (0.5 mg/kg), and 2-3 mg/kg of propofol, then endotracheal intubation was done. Anesthesia was maintained with sevoflurane and oxygen.

Anesthesia was maintained with sevoflurane 1.5-2 vol% in 50% O₂/air. Anesthetics were titrated according to hemodynamic parameters. The lungs were mechanically ventilated aiming ECO₂ between 35-40 mmHg. At the end of surgery, isoflurane was discontinued and neuromuscular reversal was provided with administration of 0.05 mg/kg of neostigmine and 0.02 mg/kg of intravenous atropine, then tracheal extubation was done once the patient fulfilled the criteria of extubation.

Dexmedetomidine hydrochloride (Precedex®, manufactured by Hospira, Inc. Lake Forest, IL, and USA) was supplied in 100 µg/mL and both levobupivacaine and dexmedetomidine were diluted in physiological saline to achieve a mean pH of 5.6. All blocks were performed by a certified anesthesiologist in regional anesthesia with

the assistance of another anesthesia technician. Another anesthesiologist (not included in this study) was involved in patient's data collection. After completion of the surgical procedure, all TAP blocks were done. A single injection and unilateral was performed using a portable ultrasound machine with multi-beam capability (Philips Healthcare®, Sqarq Release 1.0.1, USA), and A 38-mm linear 7-to 12-MHz probe was covered with Tegaderm dressing (3M, St. Paul, MN) and was used in each case.

The operator stand on the same side of the operation in a supine position and TAP was blocked from this position. Full aseptic precautions were maintained during the block. The skin was prepared with 2% chlorhexidine solution and the probe was placed transversely on the anterolateral abdominal wall between the iliac crest and the subcostal margin at the level of the umbilicus. The three muscles (external oblique, internal oblique, and transversus abdominis) of the anterior abdominal wall were identified (Figure 1).

After identification of the neuro-fascial plane between the internal oblique and the transversus abdominis muscle, a 20G 10 cm Tuohy needle (Prefix, tuohy, B.Braun, Melsungen AG-Germany) was introduced anteriorly in the plane of the ultrasound beam. The needle was directed to approach the TAP and on entering the fascial plane, 5 mL of normal saline to open the neurofascial plane and the injectate (15 mL of levobupivacaine 0.5%) was injected after negative aspiration. The injectate was seen spreading in the TAP as a dark oval shape.

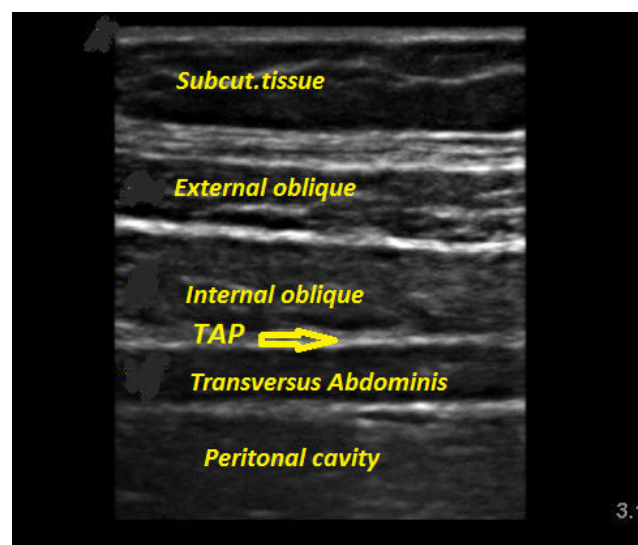


Figure 1: Ultrasound scanning of the lower abdominal wall at the level of umbilicus.

For group LAI, a single injection of 15 mL of levobupivacaine 0.5% into skin and subcutaneous tissue layer at surgical incision sites, this technique was done by the surgeon postoperatively. After emergence from anesthesia, the patients were transferred to the post-anesthesia care unit (PACU) for 1 h, and remained monitored using ECG, noninvasive blood pressure, and pulse oximetry until meeting the PACU discharge criteria. Patients were asked to mark their pain scores on a visual analogue scale (VAS) (0-10 cm, with unmarked line in which 0 cm=no pain and 10 cm=worst pain imaginable).

An investigator collected the VAS pain scores at rest and on movement at, 2, 10, 18 and 24 h postoperatively. Patient-controlled analgesia (PCA) set to give 1mg bolus of morphine with 10 min lockout and time to first analgesic request was recorded.

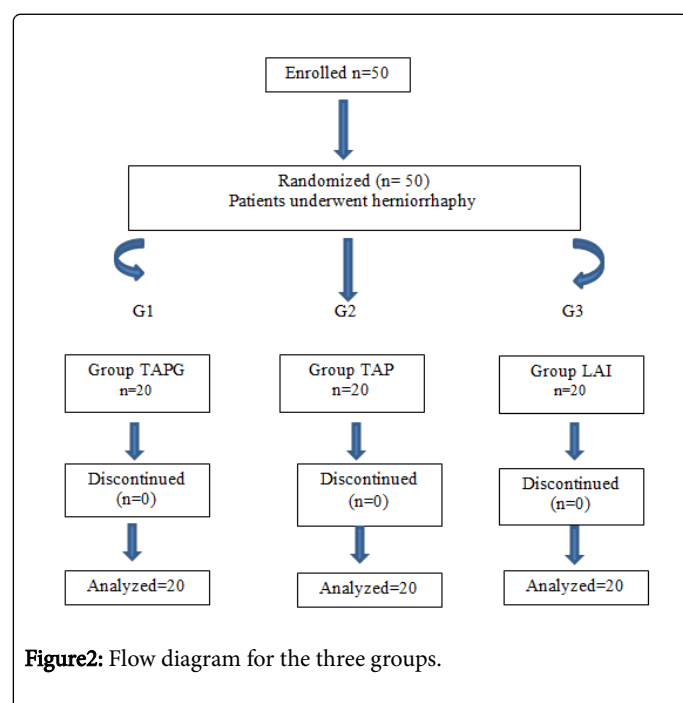
The total consumption of morphine was measure in this study within the first 24 postoperatively. Also we noted the side effects associated with morphine consumption like nausea, vomiting. In cases of postoperative nausea and vomiting, patients received 4 mg IV ondansetron.

Randomization

Patients were randomized to one of the three study groups by drawing sequentially numbered, coded, sealed, and opaque envelopes with a computer-generated allocation number. The sealed envelopes for the randomization were prepared by a research assistant who took no further part in the study (Figure 2).

Statistical analysis

Data management and all statistical analysis were performed using SPSS version 20.0 (SPSS Inc., Chicago, IL, USA). One-way ANOVA was used for continuous variables, while the Kruskal-Wallis test was used for categorical variables to analyze the differences among groups. For non-parametric data, the Mann-Whitney rank sum test was used. A p value less than 0.05 was considered to indicate significance. Continuous, parametric data are reported as mean \pm SD. standard deviation (SD) measured the central tendency of data and the distribution of data around their mean value.



Results

Ultrasound-guided single shot TAP block was performed easily done without complications. The demographic data of patients of the three studied groups was comparable, and duration of surgery ($P>0.05$) as shown in Table 1).

| Variable | Group TAPD (n=20) | Group TAP (n=20) | Group LAI (n=20) | P value |
|---------------------------|----------------------|---------------------|---------------------|---------|
| Age (years) | 32.33 \pm 9.58 | 33 \pm 14.2 | 35.16 \pm 10.98 | 0.9 |
| Weight (kg) | 67.83 \pm 13.46 | 64.83 \pm 17 | 65.33 \pm 7.28 | 0.92 |
| | 16/4 | 17/3 | 17/3 | 0.9 |
| ASA (I/II/III) | 8/10/2 | 7/10/3 | 10/7/3 | 0.94 |
| Duration of surgery (min) | 45.5 \pm 9.85 | 43.33 \pm 13.5 | 48.8 \pm 10.4 | 0.7 |

Table 1: Patient's characteristics and clinical data; Data are expressed as mean \pm SD.

There was a statistical increase in VAS pain score at rest and with movement in group LAI at 10, 18, and 24 h postoperatively compared to group TAPD. While there was a statistical increase in VAS pain score at rest and with movement in group LAI at 10, and 18 h postoperatively compared to group TAP.

Moreover, there was a statistical increase in VAS pain score at rest and with movement in group TAP at time 24 h postoperatively compared to group TAPD (Tables 2 and 3).

| Variable | Group TAPD (n=20) | Group TAP (n=20) | Group LAI (n=20) | P value |
|-------------|----------------------|---------------------|---------------------|---------|
| VAS at 2 h | 1.33 \pm 0.51 | 1.5 \pm 0.54 | 1.83 \pm 0.98 | 0.48 |
| VAS at 10 h | 1.66 \pm 0.81 | 2.16 \pm 1.16 | 3.83 \pm 1.47* | 0.016 |
| VAS at 18 h | 1.83 \pm 0.75 | 2.5 \pm 1.05 | 4.5 \pm 1.04* | <0.001 |
| VAS at 24 h | 2.5 \pm 0.54 | 4 \pm 0.63* | 4.8 \pm 0.98* | <0.001 |

Data are expressed as mean \pm SD; *Significant compared to other groups.

Table 2: Postoperative Visual Analogue Scale (VAS) at rest.

| Variable | Group TAPD (n=20) | Group TAP (n=20) | Group LAI (n=20) | P value |
|-------------|----------------------|---------------------|---------------------|---------|
| VAS at 2 h | 1.76 \pm 0.75 | 1.83 \pm 0.75 | 1.9 \pm 0.92 | 0.95 |
| VAS at 10 h | 2.33 \pm 0.51 | 2.8 \pm 0.75 | 4.8 \pm 0.85* | <0.001 |
| VAS at 18 h | 2.33 \pm 0.51 | 2.8 \pm 0.75 | 5.16 \pm 0.75* | <0.001 |
| VAS at 24 h | 2.66 \pm 0.81 | 4 \pm 1.41* | 5.5 \pm 1.04* | 0.002 |

Data are expressed as mean \pm SD; *Significant compared to other groups.

Table 3: Postoperative Visual Analogue Scale (VAS) with movement.

The time to first request for analgesia postoperatively was significantly longer in group TAPD compared to groups TAP and LAI. However there was significant increase in morphine consumption through 24 h postoperative in group LAI compared to groups TAPD and TAP (Table 4).

| Variable | Group TAPD (n=20) | Group TAP (n=20) | Group LAI (n=20) | P value |
|-----------------------------------------------------------------------------------------------------------|-------------------|------------------|------------------|---------|
| First request (min) | 907 ± 240 | 604 ± 24* | 313 ± 180* | <0.001 |
| Total Morphine Consumption | 3.66 ± 2.1 | 4.5 ± 2.42 | 11.2 ± 3.55* | 0.01 |
| PCA (mg/24 h) | | | | |
| Data are expressed as mean ± SD; *Significant compared to other groups; PCA=Patient Controlled Analgesia. | | | | |

Table 4: First analgesic request and Total consumption of PCA morphine postoperatively.

Discussion

In the current study, we found that the VAS scores at rest and movement were significantly lower in group TABD compared to groups TAP and LAI. TAP block with dexmedetomidine had lower VAS pain scores at rest and on movement at 10, 18, and 24 h postoperatively, compared with LA infiltration group. Also TAP block without dexmedetomidine had lower VAS pain scores at rest and on movement at 10 and 18 only compared with group LAI. Also we reported that the postoperative first request of morphine was delayed and total morphine consumption by PCA through 24 h was reduced in TABD and TAP groups compared with LAI group.

The LA infiltration to the surgical wound provided brief pain relief for less than 10 h after surgery. Similarly, several previous trials have shown that LA infiltration only decrease immediate postoperative pain scores within several h postoperatively compared with placebo or no intervention in inguinal herniorrhaphy [12], breast surgery [13], hip arthroplasty [14], and caesarean section [15].

Until now no suitable doses of dexmedetomidine for TAP blocks. Zhang et al. [16] reported that 100 µg dexmedetomidine prolonged the sensory and motor duration of axillary brachial block in combination with ropivacaine. Also, Esmaoglu et al. [17] reported that 80 µg dexmedetomidine prolonged the sensory duration of axillary brachial block in combination with levobupivacaine, while 50 µg dexmedetomidine had no effect on block duration. However, Bharti et al. [18] reported that patients receiving 1.5 µg/kg of dexmedetomidine combined with ropivacaine 2% in caudal anesthesia were more long duration compared with the placebo group, 0.5 µg/kg, and 1.0 µg/kg groups. In the present study, the patients administered 0.9 µg/kg dexmedetomidine combined with levobupivacaine 5% for patients in group TAPD. McDonnell et al. [2] stated that the analgesia that caused by TAP block completely finished after 24 h of the surgery. Almarakbi et al. [19] reported that adding dexmedetomidine to bupivacaine in a TAP block reduced morphine consumption and improved VAS scores after abdominal hysterectomy. Moreover, two meta-analysis studies have reported that infiltration of the wound by LA also decreased PONV [20] and postoperative morphine requirements compared with placebo [21].

On the other hand, there are three studies reported that no significant difference in mean morphine requirements during 24 h postoperatively between patients received TAP block and those with local anesthetic infiltration of the surgical wound [22-24].

In the current study, we didn't find a significant difference between the three groups as regard PONV. In a systemic review and meta-

analysis that was done by Gue et al. they found that the PONV incidence and sedation scores were not significant difference between TAP block and wound infiltration in most included studies [3]

No complication was reported in our study, however, TAP block has some complications including vascular, abdominal viscera and nerve injuries and block failure [25]. There are some limitations to our study. First, we did not assess symptoms of neurotoxicity, second, we were unable to evaluate parameters at the onset of anesthesia because patients received general anesthesia. Also, there is a clinical question regarding time and cost, moreover, ultrasound-guided TAP block is operator-dependent and time-consuming; thus, future researches are required to evaluate the time requirements and cost efficiency of these two methods.

Conclusion

Using dexmedetomidine as an additive to levobupivacaine in ultrasound-guided TAP block after repair of hernia provides: prolonged duration of postoperative analgesia, lowered VAS pain scores, and reduces PCA opioid requirements. The analgesic efficacy by using of dexmedetomidine as an adjunct mixed with local anesthetics for TAP block as multimodal postoperative analgesia might be an option to facilitate postoperative early ambulation.

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