Comparison of Postoperative Analgesic Efficacy of Wound Site Infiltration and Ultrasound-guided Transversus Abdominis Plane Block with 0.5% Ropivacaine in Lower Abdominal Surgeries under Spinal Anesthesia

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Abstract

Context: Optimization and providing excellent quality of postoperative analgesia after total abdominal hysterectomy is a determinant factor of better clinical outcome, increases patient satisfaction, and allows early mobilization of the patient. Aims: The aim of this study is to compare the postoperative analgesic efficacy of wound site infiltration (WSI) and ultrasound-guided transversus abdominis plane block (TAPB) with 0.5% ropivacaine in lower abdominal surgeries under spinal anesthesia. Settings and Design: This was a randomized controlled study. Subjects and Methods: One hundred and ten patients undergoing lower abdominal surgeries were randomly allocated to two groups (WSI and TAP) of 55 patients in each. At the end of the surgical procedure, 2.5 mg/kg of the drug ropivacaine 0.5% was administered by an anesthesiologist through either of the routes of study. Visual analog score (VAS) assessment was done at every 30 min, for 1½ h, every 2 for 24 h postoperatively. Injection diclofenac sodium 75 mg intramuscularly was given whenever VAS was >3 as rescue analgesic. Statistical Analysis Used: Epi Info 7.0 version software for Windows was used. All analyses were performed using Kolmogorov–Smirnov test. Mann–Whitney test was applied to detect the difference between the two groups. P < 0.05 was considered statistically significant. Results: Postoperative VAS scores in Group TAP were significantly reduced at 30 min, 1st h, 1 h 30 min, 2, 4, 6, 8, 10, 12, 18, and 24 h (P < 0.001). The total doses of rescue analgesics administered were also low in the Group TAP (1.41 ± 0.538) with P < 0.0001 in comparison to Group WSI (2.24 ± 0.637) with P < 0.001. Conclusions: The quality of analgesia along with lesser rescue analgesic requirement and their side effects makes the TAPB, a good and safer option for lower abdominal gynecological surgeries. Both WSI and USG TAPB are effective in providing postoperative analgesia as a part of multimodal analgesia in lower abdominal surgeries. However, in our study the quality of analgesia along with lesser rescue analgesic requirement and their side effects makes the TAPB, a good and safer option for lower abdominal gynecological surgeries.

Keywords: 0.5% Ropivacaine, ultrasound-guided transversus abdominis plane block, wound site infiltration

INTRODUCTION

Optimization and providing excellent quality of postoperative analgesia after total abdominal hysterectomy is a determinant factor of better clinical outcome, increases patient satisfaction, and allows early mobilization of the patient. Various modes of postoperative pain relief have been introduced in a stepwise fashion depending on the intensity of pain and achieve the same goals, but the relative efficacy is unknown.[1,2] As a part of multimodal analgesia in our institution, wound site infiltration (WSI) is done by the gynecologist for lower abdominal surgeries.

Infiltration of local anesthetic (LA) into the transversus abdominis plane (TAP) as described first by Rafi and few other authors acts by blocking the thoracolumbar nerves (T6–L1) which supplies the anterior abdominal wall.[3] A cadaver dissection study confirms the presence of the T10 to L1 thoracolumbar nerves intricately in the fascial layer between

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the internal oblique and transversus abdominis muscles contribute to the main sensory supply of the skin, muscles, and parietal peritoneum of the anterior abdominal wall, thus making it useful for lower abdominal surgeries. Shibata et al. also reported TAP block (TAPB) use in gynecological procedures with sensory block up to T10 and recommended its use only in lower abdominal surgery.[7]

We aimed to compare the postoperative analgesic efficacy of WSI and ultrasound-guided (USG) transversus abdominal plane block with 0.5% ropivacaine in lower abdominal surgeries under spinal anesthesia as both techniques are used to manage somatic pain, and we hypothesized that transversus abdominis block acts on the nerves supplying the abdominal muscles (thoracolumbar nerves ranging from T6 to L1), so TAPB can be used effectively for postoperative analgesia with less postoperative nausea vomiting and better patient satisfaction.

**Subjects and Methods**

The approval of the Institutional Ethics Committee (IEC/PP/2017/04) for a prospective randomized controlled trial was obtained. Written informed consent from 110 American Society of Anesthesiologists physical status I and II patients who fulfilled the inclusion criteria undergoing lower abdominal surgeries were randomly allocated (computer-generated random numbers) to two groups (WSI and TAP) of 55 patients each. At the end of the surgical procedure (skin closure), 2.5 mg/kg of the drug ropivacaine 0.5% was administered by an anesthesiologist through either of the routes of study. Patients in Group WSI will receive 2.5 mg/kg of 0.5% ropivacaine which was given subcutaneously at the surgical incision site, and in Group TAP, under sterile precautions, the linear ultrasound probe (high frequency 9–12 Hz Sonosite M-Turbo®) was placed subcostally between the costal margin and the iliac crest in the lateral abdominal wall, the external oblique, internal oblique, and transversus abdominis were identified. In the, in-plane technique, a 23 g quincke needle was advanced and LA was administered over the transversus abdominis muscle. 2.5 mg/kg of 0.5% ropivacaine (total volume split and given bilaterally) was given in Group TAP. The patient was shifted to postoperative ward where they were monitored for postoperative pain and complications at 30 min, 1 h, 1 h 30 min, 2, 4, 6, 8, 10, 12, 16, 20, and 24 h. After confirming the regression of spinal anesthesia below the level of L2 dermatome, the sensory assessment was done.

**Postoperative analgesia**

Postoperative pain was assessed using visual analog score (VAS 0–10) as VAS 0 – no pain and VAS 10 – maximal pain. VAS assessment was done at 30 min, 1 h, 1 h 30 min, 2, 4, 6, 8, 10, 12, 16, 20, and 24 h postoperatively. Injection diclofenac sodium 75 mg intramuscularly was given whenever VAS was >3 as rescue analgesic.

If the patients experienced pain early, they were instructed to request pain medication and were advised not to wait until the next VAS score assessment schedule.

The duration of analgesia was defined from the administration of infiltration or TAPB to the time of request to the first rescue analgesic administration.

Total rescue analgesic consumption is defined as the total number of doses administered in the first 24 h postoperatively. Adverse effects such as bradycardia, hypotension, nausea, and vomiting was tabulated and treated according to standard guidelines.

**Sample size**

As per OpenEpi software (Open-source.org, version 3.03a, Emory University, Atlanta, Georgia, USA), considering two-sided significance level as 95%, power of the study as 80% and ratio of sample size unexposed/exposed as 1, and referring the percent of unexposed with outcome as 42% and that of exposed with outcome as 70% as per the master article taken as reference,[6] the sample size is estimated as 55 in exposed and 55 in unexposed group in this study.

**Statistical analysis**

Data were entered in an excel sheet and analysis was done using the Epi Info 7.0 software (developed by CDC, Atlanta, Georgia, USA) for Windows. Values were expressed as mean ± standard deviation. Distribution of the variables was assessed using Kolmogorov–Smirnov test. Test of significance was applied based on distribution of variables. Mann–Whitney test was applied to detect the difference between the two groups. $P < 0.05$ was considered statistically significant.

**Results**

Both the groups were comparable in with respect to operative procedures. Patients who underwent TAPB took significantly longer time (6 h) to request for the first rescue analgesic ($P = 0.001$), with reduced VAS at the time of rescue analgesic (2.64 ± 0.969) when compared to patients who received WSI (3.04 ± 1.105). Postoperative VAS scores in Group TAP were significantly reduced at 30 min, 1 h, 1 h 30 min, 2, 4, 6, 8, 10, 12, 18, and 24 h ($P < 0.001$). The VAS scores in the WSI group was high from the beginning of 30 min to 24 h when compared to the TAP group, but no statistical difference was observed after 8 h in both the groups [Table 1].

The total doses of rescue analgesics administered were also low in the TAP group (1.41 ± 0.538) with $P < 0.0001$ in comparison to WSI group (2.24 ± 0.637) with $P < 0.001$ [Table 2 and Figure 1].

The incidence of postoperative nausea and vomiting (PONV) was high (55.17%) in Group WSI compared to Group TAP (44.82%). However, the difference was not statistically significant ($P = 0.516$) [Table 3].

**Discussion**

The objective of the present study was designed to compare the postoperative analgesia using 0.5% ropivacaine through two different routes (WSI vs. TAPB) to assess the efficacy of...
placement of LA at the TAP which improves safety and efficacy as well. This has been well supported by the works of McDonnell et al. who evidenced the possibility of liver injury and intraperitoneal injection following landmark-guided TAPBs.[14-18] Till date, only one case has been reported by Lancaster and Chadwick about a liver laceration after ultrasound-guided TAPB, which was likely because of failure to adequately visualize the needle during the procedure.[19] A careful aspiration and then injecting the drug will prevent complications from intravascular injections.

Ultrasound-guided TAPB provided good quality as well as longer duration of analgesia when compared to WSI of LA with reduced request of rescue analgesics.

Even though wound infiltration and TAP help to alleviate somatic component of postoperative pain, only very few authors have compared the postoperative analgesic efficacy of WSI and ultrasound-guided transversus abdominal plane block with 0.5% ropivacaine in lower abdominal surgeries under spinal anesthesia.[10] However, many authors and meta-analysis compared TAP with placebo.[11-16] The few available literatures compared analgesic efficacy of WSI and TAPB using bupivacaine or levobupivacaine in varying concentrations, doses, with additives, with ultrasound-guided technique, in other surgeries, and comparing pain on movement.[17-19]

Mankikar et al. in their analysis compared USG-guided TAPB using 0.5% ropivacaine and placebo and assessed the efficacy of TAPB with ropivacaine for a period of 24 h postoperatively in patients undergoing cesarean section (CS). They put forth the results which showed that TAPB with ropivacaine compared with normal saline not only reduced postoperative VAS at 24 h but also prolonged the time for rescue analgesia with reduction in mean requirement of tramadol in the study group.[20] Our study correlated well with the above study

ultrasound-guided TAP over WSI using 0.5% ropivacaine (as assessed by VAS score and requirement of rescue analgesics) and duration of postoperative analgesia in patients undergoing lower abdominal surgeries under spinal anesthesia and to assess the incidence of postoperative complications such as PONV, hypotension, and bradycardia.

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wherein we too observed that patients who underwent TAPB took significantly longer time to request for the first rescue analgesic \( (P = 0.001) \), with reduced VAS at the time of rescue analgesic \( (2.47 \pm 0.813) \) when compared to patients who received WSI \( (3.04 \pm 1.105) \). In our study, there was effective analgesia for the first 6 h (early postoperative period) \( (P = 0.001) \), with reduced VAS at the time of rescue analgesic \( (2.64 \pm 0.969) \) when compared to patients who received WSI \( (3.04 \pm 1.105) \), thus proving better analgesic efficacy of the TAPB than WSI in the early postoperative period. Similar findings were described by Kang et al. in their questionnaire study in which they reported that nearly 70% of patients had pain mainly in the early postoperative period, and hence, pain control should be targeted more on the initial postoperative stage than at later periods.\(^{[21]}\)

A review by Guo et al. compared the analgesic efficacy of TAPB versus WSI reported that TAPB performed at the end of surgery had marginally significant lower pain scores than that performed before incision at 24 h postoperatively \( (P = 0.05) \). They also concluded that TAPB had lower VAS pain scores at rest and on movement at 8 and 24 h postoperatively.\(^{[23]}\) Our study was analogous to the above-said literature as we also performed TAPB and WSI at the end of surgery and hence provided significant pain reduction and better analgesia than LA wound infiltration in the postoperative period along with multimodal analgesic regimen.

Atim et al. in their prospective research which was like our study evaluated the efficacy of ultrasound-guided TAPB and bupivacaine infiltration of the skin and subcutaneous tissue of the wound in patients undergoing hysterectomy.\(^{[11]}\) They recorded that pain scores of the group with TAPB were found to be lower than those of the infiltration group in the 6 and 24th h and suggested that TAPB was more effective than surface WSI in postoperative pain management.

Further, a review of infiltration of LA subcutaneously at the surgical incision site in patients undergoing abdominal surgeries such as CS, abdominal hysterectomy, and open cholecystectomy showed that this method is not very effective in reducing postoperative pain.\(^{[22]}\)

There are some contrasting reports, especially regarding dermatomal spread of LA in TAP as there is variation in anatomical plane depending on the approach used for administering the block.\(^{[4,7,21-28]}\) There is reliable block spread between L1 and T10 dermatomes. Previous publications found that a block height from L1 to T7 could be attained, and hence, the block was appropriate for use in midline laparotomy.\(^{[11,13]}\) Other investigators have found that the block does not reliably rise above the umbilicus and is, therefore, better suited to lower abdominal surgery only.\(^{[8,14]}\) It may be that a different distribution of anesthetic (and hence sensory blockade) occurs with the landmark technique compared to ultrasound-guided technique.

The relative decrease in morphine-sparing effect of ultrasound-guided TAPB compared to landmark technique\(^{[7]}\) can be explained by these differences in LA spread due to the different approaches used by investigators and the visceral pain involvement due to tissue manipulation.\(^{[11]}\) Studies are going on in various centers to get a better idea of dermatomal distribution of LA and effect of surgical manipulation.

We used posterior approach of ultrasound-guided TAPB, which is close to petit triangle and gives a better LA spread than anterior approach; hence, rescue analgesia requirement will be less in posterior approach group compared to anterior approach for ultrasound-guided TAPB.\(^{[9]}\) Wound infiltration with LAs after CS has also been shown to reduce postoperative morphine consumption.\(^{[7,8,20,21]}\) We could not assess the effect of ultrasound-guided TAPB on opioid sparing as we are not routinely using opioid for rescue analgesia.

The incidence of PONV was high in Group WSI compared to Group TAP; however, the difference was not statistically significant. Our findings are supported by the study done by Petersen et al. and Skjelsager et al. who also reported that there was no statistically significant difference in the mean rate of PONV at 24 h between the TAP group and Local anaesthetic infiltration (LAI) group.\(^{[29,30]}\)

Our study is not without any limitations. We did not analyze the pain on movement. Pain following lower abdominal surgeries arises from two components, namely somatic and visceral. Somatic pain which arises from the anterior abdominal wall due to surgical incision was the main target of block in both our groups. Pain on movement as influenced by the visceral component interferes with the duration of analgesia and therefore may confound the results. We need to compare both anterior and posterior ultrasound-guided TAPB to find the efficacy of both techniques.

**Conclusion**

The simplicity of the technique, along with direct accurate visualization of the needle, and careful placement of local anaesthetic at the transversus Abdominis Plane has enhanced safety and efficacy as well. Both WSI and USG TAPB are effective in providing postoperative analgesia as a part of multimodal analgesia in lower abdominal surgeries. However, in our study the quality of analgesia along with, lesser rescue analgesic requirement and their side-effects makes the TAP block a good and safer option for lower abdominal gynecological surgeries.

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**Conflicts of interest**

There are no conflicts of interest.
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