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BRIEF COMMUNICATION

# Ultrasound-guided transversus abdominis plane block (US-TAPb) for robot-assisted radical prostatectomy: a novel '4-point' technique—results of a prospective, randomized study

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**Abstract**
Several works stress the importance of ultrasound-guided transversus abdominis plane block (TAPb) for post-operative analgesia and its versatility in all types of abdominal surgery, thanks to laparotomy and laparoscopy. The aim of this study was to evaluate the impact of TAPb on intra- and post-operative analgesia in the first 24 h after robot-assisted radical prostatectomy (RARP). TAPb is a new local anesthetic technique which provides analgesia after abdominal surgery. It involves injection of local anesthetic into the plane between the transversus abdominis and the internal oblique muscles. TAPb can be performed according to a landmark technique, either through the lumbar triangle or with ultrasound guidance. We evaluated the intra- and post-operative analgesic efficacy of TAPb in 100 ASA I–III patients undergoing RARP under general anesthesia without (group A, 50 patients) or with US-TAPb (group B, 50 patients), in the first 24 post-operative hours. After induction of general anesthesia, US-TAPb was performed in 50 selected patients. All patients received post-operative analgesia (Paracetamol 1 g) three times a day. Tramadol and Ketoprofen were used as rescue drugs if the Numerical Rating Scale test was $>3$. No complications were recorded during block performance. A significant reduction was seen in the need to administer intraoperative opioids, and in the occurrence of post-operative pain or post-operative drug consumption in patients receiving US-TAPb. Seven patients, all in group A, received 100 mg of Tramadol. In group B, only one patient received 100 mg Tramadol (first and second post-operative days) due to surgical complications. In conclusion, US-TAPb provided highly effective intra- and post-operative analgesia in the first 24 h after RARP. A further prospective study is necessary to assess the best protocol for all patients.

**Keywords** Robotic radical prostatectomy · Anesthesiology

## Introduction

Anterior abdominal wall incisions cause considerable post-operative pain, with a substantial effect on the stress response and outcome of surgery. The introduction of minimally invasive techniques, such as laparoscopic and more recently robotic surgery, has been demonstrated to be useful in reducing post-surgical pain, although no operation is completely painless.

Traditionally, after major pelvic surgery, pain relief is provided by IV medications such as morphine or paracetamol. However, the efficacy of these drugs is often limited by their side effects, which include suppression of gastrointestinal functions. One alternative is an epidural injection of local anesthetic and/or other pain-relieving medications, which are effective in controlling pain by numbing the nerves supplying the abdomen. Local anesthetic injected into the skin around surgical wounds is also often given [1].

In the last few years, transversus abdominis plane block (TAPb) has been shown to provide effective post-operative analgesia in both adults and children undergoing abdominal surgery [2].

To evaluate the intra-/post-operative analgesic effects of TAPb in patients undergoing robotic radical prostatectomy

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(RARP) for prostate cancer, a randomized prospective study was carried out comparing the association of general anesthesia and a four-point injection of TAPb after general anesthesia versus the general anesthesia alone. The secondary endpoint was the safety of TAPb procedure.

## Materials and methods

### Design and setting

Patients undergoing RARP were prospectively enrolled and randomized (using a computer program—Excel® program) to receive general anesthesia with (group A) or without TAPb (group B). The investigator who generated random allocation sequence, enrolled participants, and assigned participants to interventions was an anesthesiologist (LA). Research assistant collecting the data (PP) and surgeon (FDM) were all blinded to each patient's study group assignment.

We included all patients who are candidates for RARP. Exclusion criteria were American Society Anesthesiologists (ASA) IV patients, history of relevant local anesthetics allergy or opioid addiction, or if they had coagulation disorder or there was infection at the needle insertion site.

The primary outcome was the difference in intraoperative opioid administration and post-operative drug consumption needed, and the reduction of post-operative pain. To quantify pain, a Numerical Rating Scale test (NRS) was given to all patients at 6, 12, 18, and 24 h after the end of the operation. The second outcome measure was the number of patients with acute complications of TAPb.

### Technique (group B)

After the general anesthesia, TAPb was administered using the BK® Ultrasonography machine with a linear array transducer probe (6–13 MHz). The procedure was performed by means of a landmark technique through the lumbar triangle. It involved identifying the lumbar triangle of Petit (bounded inferiorly by the iliac crest, posteriorly by the latissimus dorsi muscle, and anteriorly by the external oblique muscle) (Fig. 1a, b). A needle was introduced with two losses of resistance (external and internal oblique fascia, respectively) (Fig. 1c). Then a total of 200 ml of 0.25% levobupivacaine was injected, 50 ml each at the left and the right sides.

An ultrasound-guided approach (US-TAPb) was first described by Hebbard in 2007 [2]. In 2011, the technique was modified by Børglum, who introduced another site of injection: the idea was to anesthetize both the upper (Th6–Th9) and lower (Th10–Th12) portions of the abdominal wall bilaterally by means of a four-point single-shot technique to provide effective post-operative analgesia [3].

In the present study, all patients received post-operative analgesia of 1 g of Paracetamol three times a day. Ketoprofen and Tramadol were used as rescue drugs if the NRS was > 3.

Statistical analysis was carried out with MedCalc software (version 17.9). Data are presented as means ± SD or median (and interquartile range), according to the distribution. Categorical data are shown as raw data. The Mann–Whitney *U* test was used to compare the two groups if data were not normally distributed. Comparisons between the groups at each time interval were made according to Student's *t* test when data were normally distributed. Categorical data were analysed with Chi-square analysis. For the analysis of NRS values we used a Bonferroni correction for the multiple comparisons, resulting in an alpha of 0.01.

For sample size calculation, we considered that a clinically important reduction in 24-h Tramadol consumption would be 50% absolute reduction, with the significance level, $\alpha$, of 0.05 and the power of test, $1-\beta$, of 95%. We calculated that 13 patients would be required per group. To minimize any effect of data loss, we elected to recruit 50 patients per group into the study.

## Results

There were a total of 100 patients enrolled in this prospective study (group A 50; group B 50). All the patients met eligibility criteria (Fig. 2). The demographic and pathological characteristics of patients are reported in Table 1. In group A, block performance took on average 15 min (± 5). No complications were recorded during block performance. Only one patient in group A was moved to second-day surgery, due to post-operative complications.

Significant reductions were seen in the need for intraoperative opioid administration (Sufentanil 40 ± 5 and 60 ± 5 mcg in group A and B, respectively; $p < 0.0001$—95% confidence interval) and post-operative drug consumption (Tramadol: 200 and 700 mg in groups A and B, respectively; $p < 0.0001$—95% confidence interval; Ketoprofen: 100 and 300 mg in groups A and B, respectively; $p < 0.0001$—95% confidence interval) in patients treated with US-TAPb (Table 2).

Considering the mean post-operative pain, as measured by NRS, there were significant differences after 6, 12, 18 and 24 h, according to Bonferroni correction test ($p < 0.0001$—95% confidence interval).

## Discussion

In a review, Findlay et al. demonstrated that TAPb is an effective adjunct to multimodal post-operative analgesia after abdominal surgery. However, analysed studies report data only after general surgical procedures, such as open and

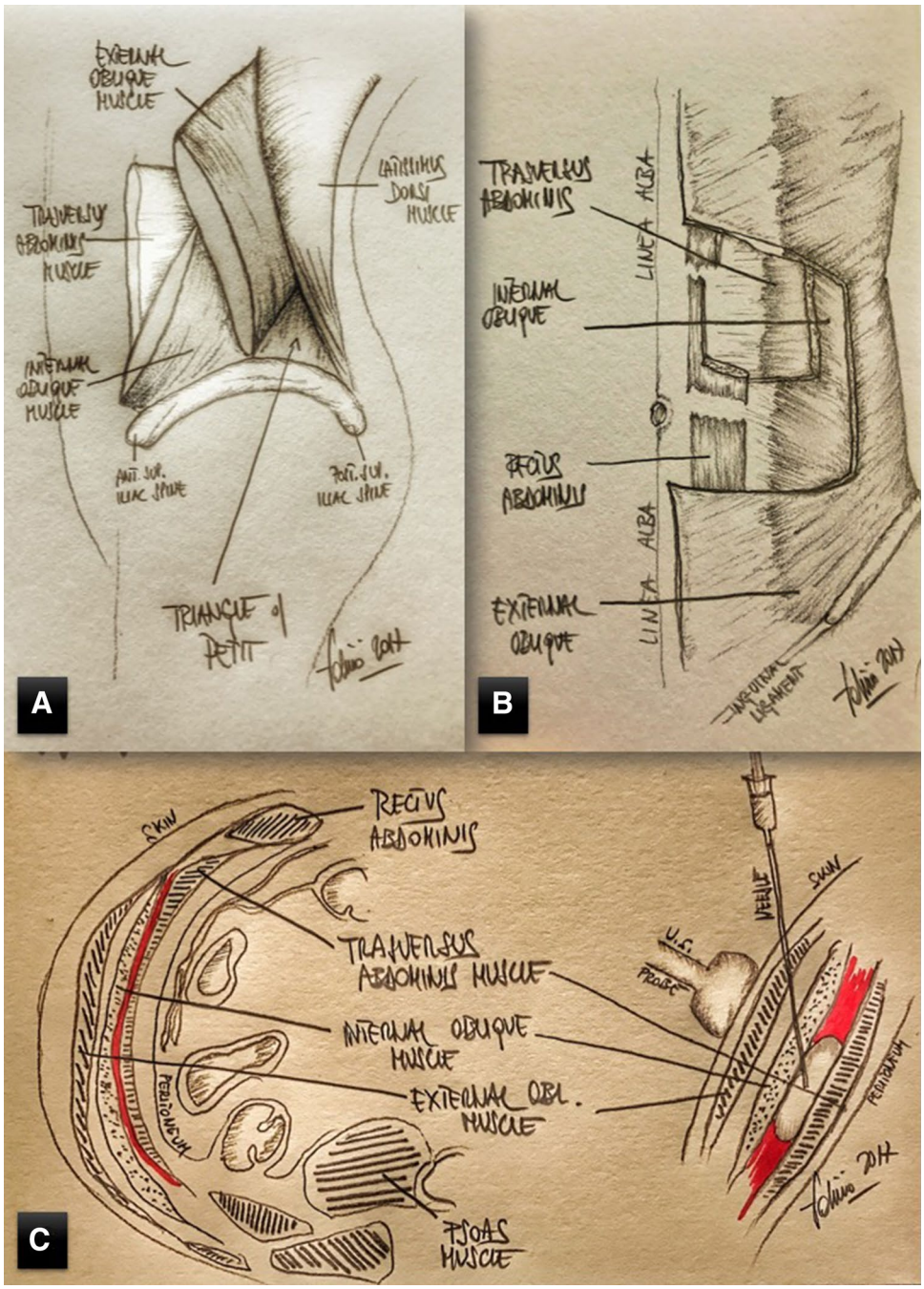


**Fig. 1** **a** Scheme showing the triangle of Petit. **b** Scheme showing the different layers of the abdominal wall. **c** Scheme of the procedure. The red line identifies the space between the internal oblique and the transversus abdominis muscles

laparoscopic colorectal resection, open appendectomy and laparoscopic cholecystectomy (although—unusually—all with sub-umbilical ports), obstetric and gynecological procedures, such as mixed laparotomies, total abdominal hysterectomy and Caesarian section, and esthetic abdominoplasty with post-bariatric abdominoplasty [4].

There are only a few studies evaluating the effects of TAPb on open radical prostatectomy, with controversial results. In a prospective randomized study, Elkassabany et al. reported that the TAPb group had lower pain scores and required lower doses of total opioids in the first 24 h after surgery, confirming the early benefits of anesthesia after this kind of open surgery [5].

On the contrary, in another randomized study on patients undergoing open radical prostatectomy, Skjelsage's group demonstrated that neither TAPb nor wound infiltration with Ropivacaine improved a basic multimodal analgesic regimen with post-operative paracetamol, ibuprofen and gabapentin [6].

To our knowledge, this study is the first prospective randomized study of the analgesic effects of TAPb in RARP. The four-point technique introduced by Børglum et al. and

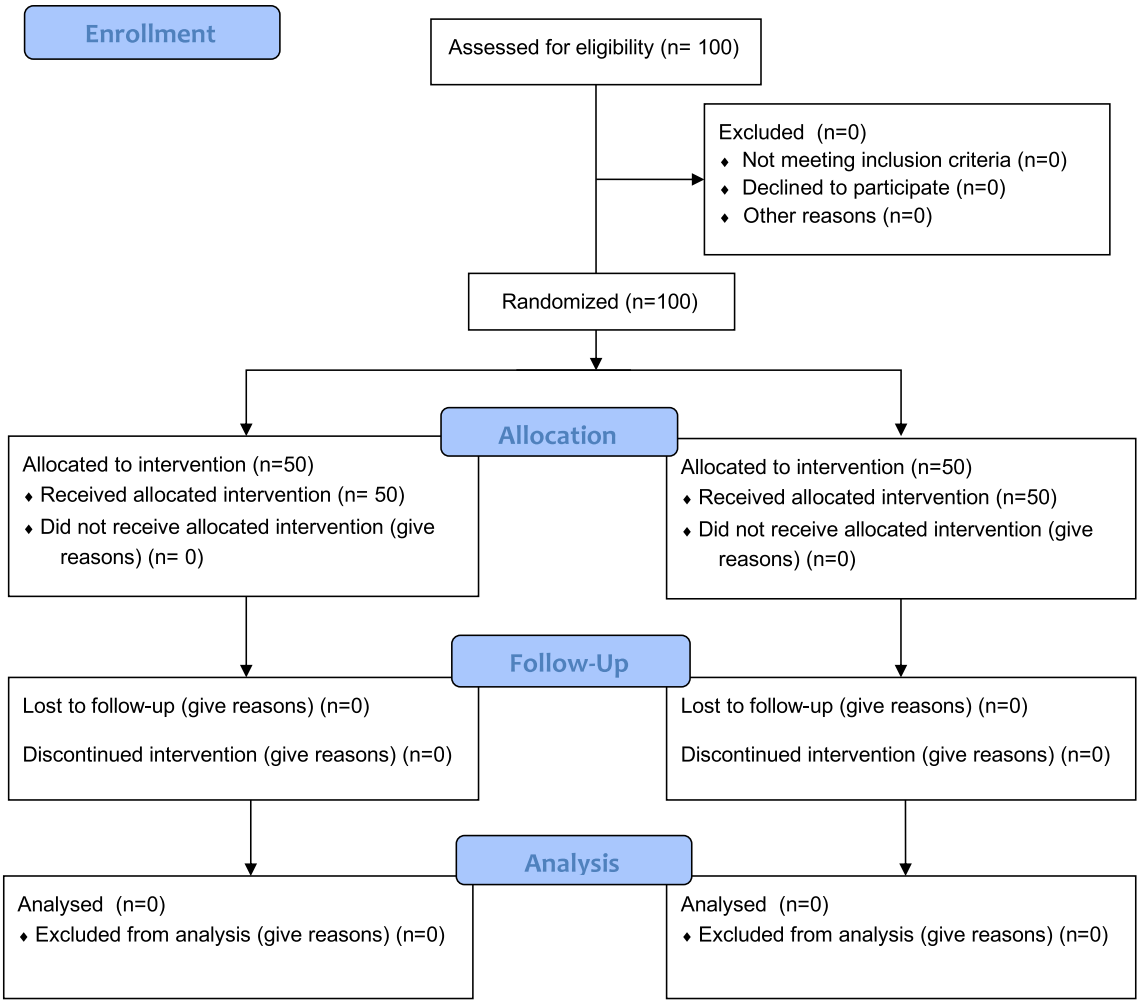


**Fig. 2** CONSORT flow diagram

**Table 1** Demographic and pathological characteristics of patients

| | Group A | Group B | *p* |
|---|---|---|---|
| Characteristics | | | |
| Age (years)—mean (SD) | 64.5 (6.25) | 64.1 (6.8) | 0.7592 |
| Weight (kg)—mean (SD) | 77.9 (11.4) | 78.6 (9.85) | 0.7432 |
| Height (cm)—mean (SD) | 171. 9 (4.9) | 173.9 (6.3) | 0.0804 |
| Surgical time—mean (SD) | 183.5 (67.6) | 184.5 (59.8) | 0.9378 |
| Pathological staging | | | |
| pT2 | 34 | 38 | |
| pT3 | 16 | 12 | |
| pN+ | 2 | 1 | |

usually performed in major gynecological operations was used. In the original paper, 15 ml of Bupivacaine 2.5 mg/ml was injected at each of the four sites. In our procedure, Levobupivacaine at a total dose of 200 mg was subdivided over the four sites. We preferred to use Levobupivacaine, a pure *S*-enantiomer of Bupivacaine, because it has fewer cardiovascular side effects and is less toxic to the central nervous system [7].

TAPb is generally safe, but complications such as intestinal lesions or liver trauma in those with hepatomegaly may occur. For this reason, and due to possible anatomical variability of the triangle of Petit and the body mass index, ultrasound has been advocated. In our study, the ultrasound-guided procedure was quick and easy to perform.

An evolution of this type of block is to use continuous infusion catheters, which allow longer and more effective control of post-operative pain after abdominal surgery, with fewer respiratory and cardiovascular complications, a more comfortable recovery for the patient, and a consequent reduction in the length of hospital stays and costs, in line with enhanced recovery after surgery (ERAS) pathways.

**Table 2** Intra- and post-operative administration of drugs and post-operative NRS according to the use of TAPb (group A) or not (group B)

| | Group A | Group B | *p* |
|---|---|---|---|
| Intraoperative opioid administration* | | | |
| Sufentanil mcg—mean (SD) | 40 (5) | 60 (5) | *< 0.0001* |
| NRS—mean (SD)** | | | |
| 0 h | 0.98 (0.3) | 0.99 (0.3) | 0.86 |
| 6 h | 1.98 (0.81) | 3.88 (0.3) | *< 0.0001* |
| 12 h | 1.88 (0.79) | 3.82 (0.48) | *< 0.0001* |
| 18 h | 1.84 (0.88) | 4.09 (0.3) | *< 0.0001* |
| 24 h | 1.8 (0.82) | 3.57 (0.64) | *< 0.0001* |
| Post-operative drug administration* | | | |
| Acetaminophen | 3 g/die | 3 g/die | n.s |
| Tramadol (mg)—mean (SD) | 200 (60) | 700 (60) | *< 0.0001* |
| Ketoprofen (mg)—mean (SD) | 100 (29) | 301 (68) | *< 0.0001* |

*NRS* Numerical Rating Scale test

**t* test

**Bonferroni correction test

## Compliance with ethical standards

**Conflict of interest** Fabrizio Dal Moro, Luca Aiello, Paola Pavarin and Fabio Zattoni declare that they have no conflict of interest.

**Ethical approval** All procedures performed in the present study involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its last amendments or comparable ethical standards.

**Informed consent** Informed consent was obtained from all individual participants included in this study.

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