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Postoperative Analgesia for Abdominal Laparoscopic Surgery: Tap Block vs Peri-Orificial Infiltrations

Moustapha Diedhiou[1]*, Ndiamé Sarr[1], Elhadji Boubacar Ba[2], Abdourahmane Ndong[1], Fallou Galass Niang[1], Jacques Noel Tendeng[1], Ibrahima Konaté[1], Mohamed Lamine Fall[1]

[1]Health Sciences Training and Research Unit (UFRSS), Gaston Berger University, Saint Louis, Senegal
[2]Faculty of Medicine and Pharmacy, Cheikh Anti Diop University, Dakar, Senegal
Email: *moustapaha.diedhiou@ugb.edu.sn

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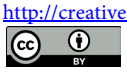

Abstract

Introduction/Purpose: The "transverse abdominal plane block" or TAP block was described by Rafi in 2001. It describes an approach to the neurofascial plane of the transverse abdominal muscle via the Jean-Louis Petit triangle and provides analgesia of the entire homolateral hemi abdomen. The aim of our study was to compare post-operative analgesia and post-operative morphine requirements between transverse abdominal plane block (TAP) and peri-orificial infiltration during laparoscopic abdominal surgery. Material and method: Prospective, randomized study conducted over a 2-year period. The study was conducted in the operating theatre of the Saint Louis Regional Hospital in Senegal. All adult patients undergoing laparoscopic abdominal surgery were included. Clinical aspects, pain scales and morphine consumption were analyzed. Results: A total of 60 patients were enrolled: 30 patients in the TAP group and 30 patients in the infiltration group. The average age was 32.9 years. The indications for laparoscopy were acute appendicitis in 50% of cases, gallbladder stones in 16% and inguinal hernia in 8%. For the TAP group, the mean numerical pain scale was 3.9 at 6 hours post-operatively and 2.1 at 24 hours post-operatively. For the infiltration group, the mean numerical pain scale was 4.3 at 6 hours post-op and 3 at 24 hours post-op. Morphine consumption at 6 hours post-op was on average 0.4 mg/patient for the TAP group and 0.9 mg/patient for the infiltration group. Discussion/conclusion: Analgesia provided by ultrasound-guided TAP block for laparoscopic abdominal surgery appears to be identical to periorificial infiltration. However, the simplicity and reproducibility of ultrasound-guided TAP block gives it a definite advantage.

Keywords

Loco-Regional Anesthesia, Post-Operative Analgesia, Infiltrations,

Laparoscopy, TAP-Block

1. Introduction

The renewed interest in pre, per and postoperative infiltration techniques as well as new echo-guided detection techniques is opening up new horizons for abdominal wall blocks. The block of the transversus abdominis plane (TAP block) and infiltration of trocar incisions are two analgesia techniques commonly used in laparoscopic abdominal surgery. A total of ten trials comparing these two techniques have described the superior efficacy of TAP block over trocar infiltrations in terms of postoperative analgesia and reduction in morphine consumption [1].

The aim of this study was to compare the two techniques in terms of postoperative analgesia.

2. Material and Method

We conducted a prospective, randomized 1:1 study. The overall objective of the study was to compare TAP block and infiltration of trocar incisions in terms of postoperative analgesia during laparoscopic surgery. The study was conducted in the operating theatre of the Saint Louis Regional Hospital in Senegal. The study period was from January 1, 2019 to December 31, 2021. We included all adult patients scheduled for laparoscopic supra- or sub mesocolic surgery.

All patients admitted for laparoscopic abdominal surgery were included in our study and randomized 1:1. Thus, 30 patients were included in the TAP group and 30 patients in the Infiltration group.

After induction, a bilateral ultrasound-guided transverse abdominal plane block was performed for the TAP group and infiltration of the trocar incisions was performed at the end of the surgical procedure for the infiltration group.

For patients in the TAP group, the block consisted of placing a high-frequency ultrasound probe midway between the iliac crest and the costal margin on the middle axillary line. Under in-plane ultrasound control, a 50 mm or 80 mm needle was inserted and its tip checked. As soon as the tip of the needle was positioned between the fascia of the internal oblique and transverse muscles (**Figure 1**), a local anesthetic mixture was injected. In our study, we opted for a local anesthetic mixture of xylocaine 2% and bupivacaine 5 mg/ml. For each patient, 20 ml of the mixture was injected on each side. The block was considered effective when a hypoechoic biconvex lens image was obtained between the fascia of the transverse and medial oblique muscles (**Figure 2**). For patients in the infiltrated group, we performed infiltrations of the trocar incisions with a total of 20 ml of the same mixture.

For each patient, we recorded clinical, anesthetic and evolutionary aspects, numerical pain scales at 6 and 24 hours post-op, and morphine requirements up

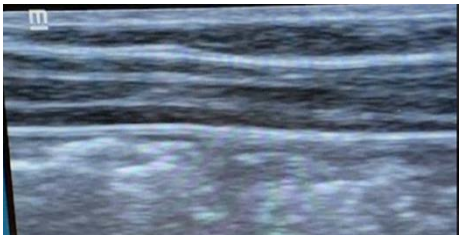

Figure 1. Cross-sectional ultrasound showing abdominal wall muscles (Saint Louis operating room image).

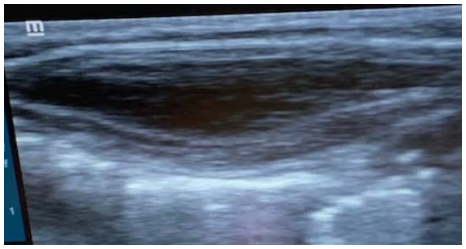

Figure 2. Cross-sectional ultrasound showing the appearance of a biconvex lens between the fascias of the oblique internal and transverse muscles. (Saint Louis operating room image).

to 6 hours post-op. The main evaluation criteria were: numerical pain scale at 06 hours, at 24 hours post-op and morphine requirements up to 6 hours post-op. We used Biostat TGV software to determine the correlational statistical tests to be performed for our study. The data collected were then analyzed using XLSSTAT software and a relationship was considered to be statistically significant when the p-value < 0.05.

After obtaining informed and signed consent, a survey form was completed for each patient. We excluded from the study any patient whose survey form had not been fully completed.

3. Results

A total of 60 patients were enrolled. The overall mean age was 32.9 years, with a maximum age of 74 years and a minimum age of 11 years. TAP block was performed in 30 patients (50%) in the first group and peri-orificial infiltrations were performed at the end of the surgical procedure in 30 patients (50%). The sex ratio was 2 men/1 woman. A total of 58 patients (96%) had an ASA 1 score and 2 patients (4%) had an ASA 2 score. The mean body mass index was 26.9 kg/m^2 with a maximum of 31 and a minimum of 18 kg/m^2. A past history of asthma was found in 3 patients (5%), arterial hypertension in 2 patients (3%) and diabetes in 3 patients (5%). The indications for laparoscopy were: acute appendicitis in 30 patients (50%), lithiasis gallbladder in 10 patients (16%), inguinal hernia in 5 patients (8%). **Figure 3** illustrates the distribution of our population according to diagnosis. Antibiotic prophylaxis or antibiotic therapy was instituted in all our patients according to the altemeier classification. A rapid sequence induction was performed in 40 patients (67%) if a full stomach was suspected, and

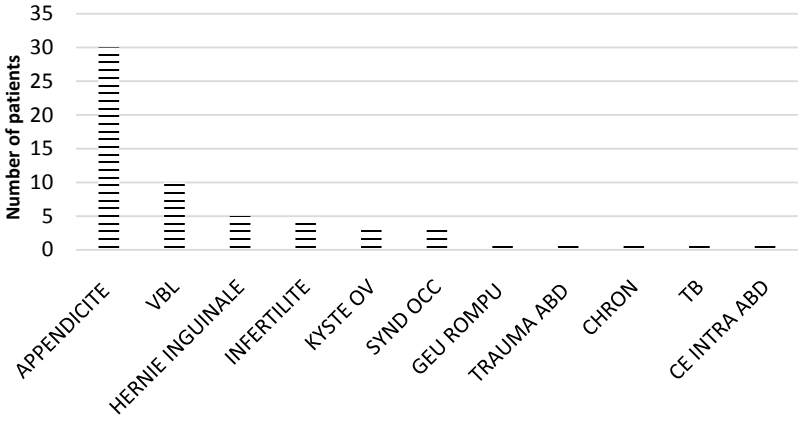

Figure 3. Distribution of the population by diagnosis.

a conventional induction was used in 20 patients (33%). All our patients underwent orotracheal intubation and mechanical ventilation in volume-controlled mode with strict control of respiratory pressures and exhaled CO_2. Monitoring was standard in all our patients and included non-invasive blood pressure, heart rate, pulsed oxygen saturation and capnography. Hemodynamic status was stable throughout the procedure in 57 patients (95%); in 3 patients arterial hypotension observed after induction was controlled by vascular filling and a bolus of ephedrine. All patients were extubated on the table after optimal recovery.

For the TAP group, pain assessment at 06 hours post-operatively using a numerical scale showed a mean numerical scale of 3.9 with a standard deviation of 1.322 and extremes of 6 and 2. Pain assessment at 24 hours post-op for the TAP group showed a mean numerical pain scale of 2.1 with a standard deviation of 1.768 and extremes of 5 and 0. For the trocar infiltration group, the mean numerical pain scale at 6 hours was 4.3 with a standard deviation of 0.952 and extremes of 6 and 2. Pain assessment at 24 hours post-op showed a mean numerical scale of 3 for the infiltrated group, with a standard deviation of 1.389 and extremes of 5 and 0.

In correlational analysis, the mean pain rating scale at 24 hours post-op was lower for the TAP group but there was no statistically significant relationship between TAP and post-op pain ($p > 0.05$). Table 1 compares the two groups in terms of pain scale at 6 hours and 24 hours post-op. Figure 4 and Figure 5 illustrate the changes in pain scales at 6 and 24 hours post-op for the two groups. Patients in the TAP group consumed a total of 12 mg of morphine at 6 hours post-op with a standard deviation of 0.770 and extremes per patient were 2 and 0. Patients in the infiltration group consumed a total of 29 mg of morphine at 6 hours post-op with a standard deviation of 1.449 and extremes of 5 and 0. In absolute terms, morphine consumption at 6 hours post-op appears to be lower for the TAP block group, however, there was no statistically significant relationship between TAP block and morphine consumption at 6 hours post-op ($p > 0.05$). Table 2 compares the two groups in terms of morphine consumption at 6 hours post-operative.

Table 1. Statistics pain scale description of both groups.

	Pain scale at 6 h post-op		Pain scale at 24 h post-op	
	TAP Group	Infiltration Group	TAP Group	Infiltration Group
Number of samples	30	30	30	30
Mean	3.9	4.3	2.1	3
Median	4	4	2.5	3
Standard deviation	1.322	0.952	1.768	1.389
Maximum	6	6	5	5
Minimum	2	2	0	0
Sum on the scale value	117	129	63	90
Confidence interval of 95%	0.493	0.355	0.660	0.518

• p value: 0.21665163081173; • Odds ratio: 1.2948 - 95% confidence interval [0.8449; 1.9905].

Table 2. Descriptive statistics of morphine use at 6 heures in both groups.

	MORPHINIC USE AT 6HR POST- OPERATION	
	Groupe TAP	Groupe infiltration
Numbers of samples	30	30
Mean	0.4	0.9
Median	0	0
Standard deviation	0.770	1.449
Maximum (mg)	2	5
Minimum (mg)	0	0
Sum (mg)	12	29
Confidence interval 95%	0.287	0.541

• p-value: 0.058181034670855 - Degrees of freedom: 43.518473207475; • 95% confidence interval [−1.1801; 0.021].

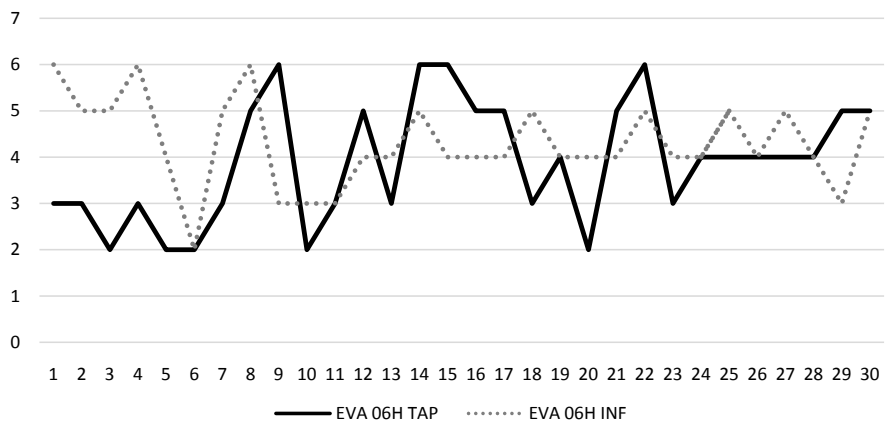

Figure 4. Pain scale curve at 6 h for TAP and infiltrated group.

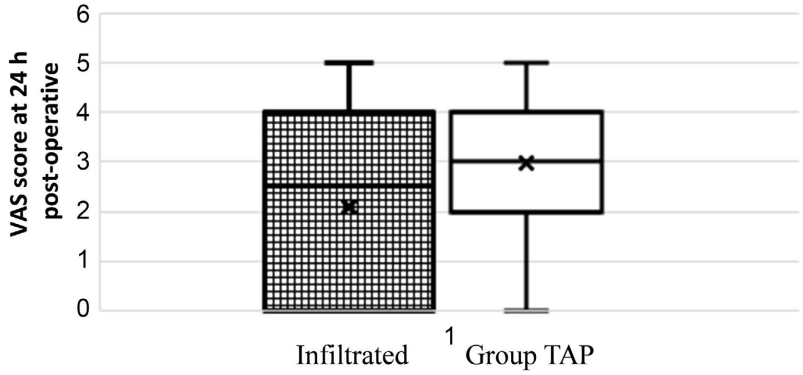

Figure 5. Distribution of 24-hour pain scales for both groups.

4. Discussion

Laparoscopic techniques have revolutionized abdominal surgery and led to an adaptation of anesthetic management. Although laparoscopic surgery is associated with less surgical trauma, postoperative pain is common [2]. Optimal pain management in this context of minimally invasive surgery is vital and must be integrated into the anesthetic strategy. Good pain management helps to meet the need for rapid recovery, which is why this surgical technique was chosen. Intravenous analgesia alone is certainly important, but with the use of morphine analgesics in relatively high doses, certain complications, particularly digestive (postoperative ileus, urine retention, respiratory insufficiency) may hinder postoperative recovery. Non-steroidal anti-inflammatory drugs (NSAIDs) are recommended in the context of gastrointestinal surgery as they promote 30% of morphine sparing and reduce the side effects of morphine [3]. However, retrospective and a cohort studies [4] [5] have found that non-steroidal anti-inflammatory drugs and COX-2 inhibitors are risk factors for digestive fistulas. They are currently used as part of multimodal analgesia, which combines a loco-regional analgesia strategy [3].

TAP block provides excellent analgesia following abdominal surgery, with the best benefit/risk ratio [2]. When performed correctly, it provides analgesia of the anterior abdominal wall from T12 to L1 [6]. Several studies have compared the efficacy of TAP block and wound infiltration in different surgical procedures with mixed results [7]. Our results are consistent with a study of laparoscopic colorectal surgery that suggested the ability of TAP block to effectively control postoperative pain and reduce analgesic consumption [8]. Hosgood, *et al.* [9] showed that TAP block effectively reduced postoperative pain and the need for analgesics when they compared TAP block to placebo in live donor nephrectomy. It should also be pointed out that these studies did not take into account the different types of trans-abdominal-pelvic block that could be performed. Indeed, even if the diffusion space for TAP is the same, there are differences in terms of dermatomes affected between lateral, posterior and subcostal TAP block.

The TAP block technique initially described by Rafi consists of approaching the plane of the transverse muscle by an injection at the level of the triangle of

Jean-Louis Petit [10]. The Jean-Louis Petit lumbar triangle is an anatomical space bounded at the bottom by a fixed landmark, the iliac crest, at the front by the posterior edge of the external oblique muscle and at the back by the anterior edge of the large dorsal muscle. The bottom of the triangle is formed by the body of the internal oblique muscle, below which the TAP is located. This triangle usually lies posterior to the top of the iliac crest [6]. This technique was validated by Mc Donnell *et al.* in an anatomical study on 3 cadavers in which the dye injected by this route was found at the level of the TAP; the same study confirmed in 3 healthy volunteers, after injection of 20 ml of radiopaque solution, showed impregnation of the TAP persisting for more than four hours and a sensory block from L1 to T7 [11]. Clinical studies have confirmed the performance and efficacý of this block by this route under ultrasound guidance. Nevertheless, in several other studies authors were surprised not to find a block as extensive as that initially described by Mac Donnell *et al.* [11]. For example, Shibata *et al.* [12] and Hebard *et al.* [13] only found a maximum extension of the block from L1 to T10 after ultrasound TAP block. This was confirmed by Tran *et al.* who, after dissecting 16 hemicadavers that had received 20 ml of dye at the level of the TAP under ultrasound, only found impregnation of the T10, T11, T12 and L1 nerves in 50%, 100%, 100% and 93% of cases respectively [14]. In order to gain overlying metamers, Hebard proposed to reach the plane of the TAP no longer at the mid-axillary line but more superiorly towards the cephalic region under the costal rim; he thus averagely attended T8 and T9. This approach has been termed "SUB-TAP" [13] or subcostal block TAP. Posterior TAP block, which is easily performed when the patient is in the lateral position, provides much broader analgesia with a visceral component. **Figure 6** illustrates the different types of TAP block depending on the injection site [15].

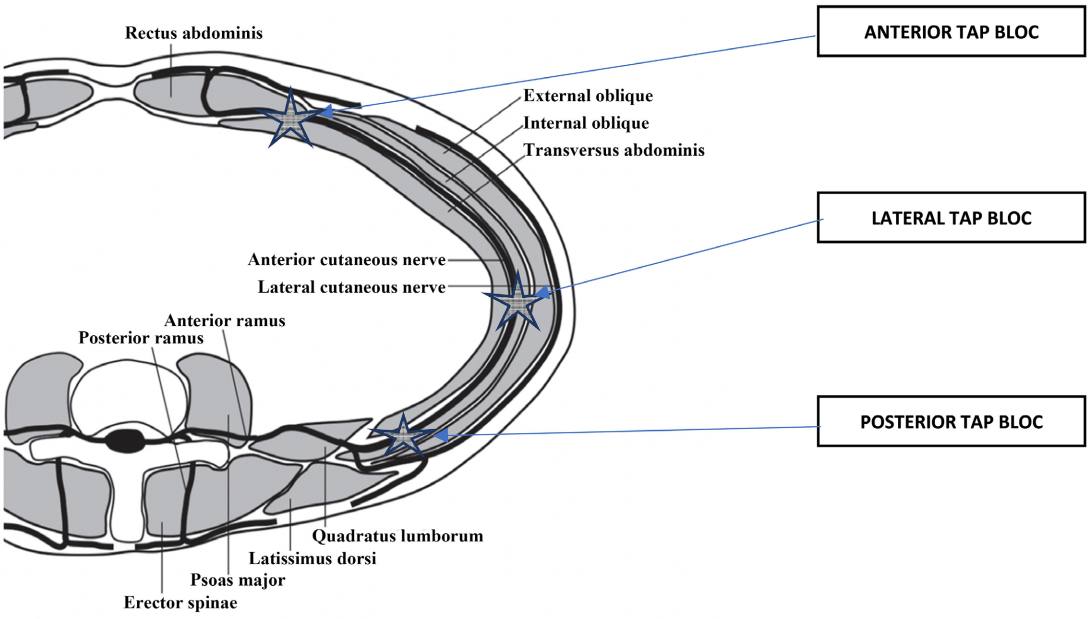

Figure 6. Cross-section of the lower abdominal wall (at T12) showing the path of a thoracic-lumbar nerve. [15]

In our series, the ultrasound-guided lateral TAP block was performed in all our patients for reasons of compliance and reproducibility. However, in our study, the diversity of surgical indications and the absence of visceral analgesia in lateral TAP explain the differences in pain assessment scores.

Similar to our study, Petersen *et al.* did not observe any reduction in post-operative pain or morphine consumption between TAP block and ilio-inguinal infiltration in patients treated for inguinal hernia [16]. Other studies have shown that TAP block is just as effective as local infiltration in cases of acute pain. For some authors, TAP block is more effective in cases of persistent pain for lower abdominal surgery, particularly 24 hours after surgery [17]. S. Arora *et al.* have shown that TAP block significantly reduces resting VAS for more than 24 hours compared with local anesthetic infiltration in patients treated for laparoscopic inguinal hernia [18]. In our study, the same observation is noted in relation to the data in the literature. Although the pain assessment scales were lower in the TAP group at H6 and H24 post-op, the difference was not statistically significant.

Morphine use in the postoperative period depends on the values of the pain assessment scales, which is why morphine requirements were lower in the TAP group than in the infiltration group in our study. In the study by Taha *et al.* [7], there was no difference in morphine consumption in the recovery room because the surgeon who carried out the pain assessment was the same surgeon who had performed the operation and could be considered to be one of the limitations of this study. Finally, thoracic epidural analgesia is considered to be the gold standard for the management of postoperative pain in abdominal surgery. However, in the guidelines published in the journal of the French Society of Anesthesia and Intensive Care (SFAR), P. Alfonsi *et al.* remind us that, subject to a weak agreement, thoracic epidural analgesia is probably not recommended after laparoscopic surgery [3].

All in all, like some of the studies mentioned above, our study has a number of limitations, in particular the need to perform a lateral TAP block for all our patients with different operative indications (supra- and submesocolic surgery). Another limitation to our study is that, the diffusion of the product is not identical at the level of all the metamers, which may influence the pain assessment scales.

In the end, the results of our study certainly did not show a clear superiority of TAP block over periorificial infiltrations in terms of post-operative pain and post-operative morphine requirements. However, the ease with which block TAP can be performed with ultrasound, its reproducibility, and the appropriation of analgesic practices by the anesthetist thanks to TAP, make it the technique of choice for laparoscopic abdominal surgery. The different techniques for performing TAP (lateral, posterior and subcostal) will need to be evaluated depending on the surgery and/or the need to control visceral pain, in order to further verify the supremacy of TAP block over periorificial infiltrations.

5. Conclusion

The analgesia provided by the ultrasound-guided transverse abdominal plane block during laparoscopic abdominal surgery seems identical to periorificial infiltrations. However, the simplicity of realization with ultrasound, reproducibility and appropriation of the practice of analgesia by the anesthetist physician thanks to the TAP make this block a technique of choice for laparoscopic abdominal surgery.

Conflicts of Interest

The authors declare no conflicts of interest.

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