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Ultrasound transversus abdominis plane (TAP) block versus local infiltration analgesia for acute and chronic postoperative pain control after laparoscopic bilateral hernia repair : a single-center randomized controlled trial

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Abstract : *Background* : we compared the efficacy of transversus abdominis plane (TAP) block versus local infiltration on acute and chronic pain after a first laparoscopic surgical treatment of bilateral inguinal hernia performed in a day hospital.
Methods : In this randomized, prospective, double-blind study, we studied 52 patients scheduled for lapa-roscopic bilateral hernia repair. The patients were randomly allocated to receive local infiltration (group 1) or a TAP block (group 2). The surgeon locally injected the patients in group 1 with a solution of 20 mL of 0.5 levo-bupivacaine. An ultrasound-guided injection of 40 mL 0.25 levobupivacaine was administered to the patients in group 2 by the anesthesiologist. The pain score was assessed using a numeric rating scale at the arrival in the recovery room, one hour after surgery and 6 hours (H+6) after arrival at the recovery room. Subsequently, the pain was assessed 24 hours (H+24), 3 weeks (D21) and 3 months (M3) after surgery.
Results : We observed significant differences in terms of pain at H+6 and at H+24 in favor of the TAP block group. However, there was no significant difference between both groups in postoperative pain after 3 weeks (D21) or after 3 months (M3).
Conclusions : In our study, we observed a significant difference in terms of pain in favor of TAP block versus local infiltration, during the first 24 hours after a first laparoscopic treatment of inguinal hernia. We did not find any significant difference on chronic pain.

Keywords : Pain ; postoperative ; anesthesia ; local ; levobupivacaine.

Introduction

The surgical treatment of inguinal hernia is one of the most common surgical procedures. At least 24 998 cases were treated in Belgium in 2017 (1). Approximately 180-200 inguinal hernia surgeries are performed every year as first treatment in our institution. It is a well-established fact that surgical trauma can lead to chronic pain (2). This pain is mainly caused by nerve lesions in the inguinal canal, due to scar tissue remodeling secondary to the presence of the prosthesis, due to the way the prosthesis is fixed (staples, sutures) or due to recurring of the hernia. The pain can also be visceral, especially in the vas deferens. Chronic pain can affect the patient's daily routine and professional activities, which may have both social and financial impact.

The multimodal approach to postoperative pain treatment, including loco-regional anesthesia, has proven advantages both in terms of pain intensity and sooner recovery (3). The aim of this study is to compare the efficacy of transversus abdominis plane (TAP) block versus local infiltration on acute and chronic pain, after a first laparoscopic surgical treatment of bilateral inguinal hernia performed in a day hospital.

Methods

Study patients

Following approval by the Ethics Committee of the Centre Hospitalier Chrétien (CHC), 58 patients were recruited between November 2017 and October 2018 to participate in this prospective,

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randomized, double-blind study conducted in our institution (Hôpital Saint-Joseph, CHC Liège, Belgium) (see Figure 1). Each patient's consent was obtained before surgery. In order to eliminate the bias coming from the surgeon's influence on postoperative pain, only one surgeon participated in our study. All patients scheduled for surgical treatment of bilateral inguinal hernia were eligible for our study. Patients hospitalized for reasons other than surgery, as well as those with high pain scores at the initial evaluation before surgery, were excluded.

Study design and treatment protocol

Randomization was performed with consecutively numbered, opaque, sealed envelopes opened sequentially to determine the patient's treatment assignment. The patients were divided into two groups. The first group (Group 1) underwent local infiltration, while the second group (Group 2) was treated by TAP block. The local anesthetics were administered in both groups just after induction of anesthesia and before any surgical stimulation. The patients in Group 1 (local infiltration) received an injection of 20 mL of 0.5 levobupivacaine, performed by the surgeon at the site of trocar and camera insertion, with a 21G needle (BD Microlance® 0.8 x 50 mm). Only one surgeon participated in this study. The prosthesis (3D Max® Light Mesh, BARD®) was not fixed. The patients in Group 2 (TAP block) received an ultrasound-guided injection (General Electric Device, LOGIC® P9, linear probe 4-12Hz). The ultrasound probe was oriented transversely to the anterolateral abdominal wall where the three muscle layers (external oblique, internal oblique, and transverse abdominal muscle) were most visible. Then, the probe was moved more posterior and lateral until the emergence of transverse abdominal muscle was clearly visible. The needle (Pajunk® SonoTAP, 21G x 110 mm) was introduced in-plane, and 20 mL of 0.25 levobupivacaine were injected on each side into the plane between the internal oblique and transverse abdominal muscles. The optimal position was confirmed by the hydrodissection of the transverse abdominal muscle plane. Only two anesthetists, with more than 10 years of experience, performed the TAP blocks.

All the patients included received premedication one hour before surgery. This consisted of one tablet of etoricoxib 120 mg and one tablet of alprazolam 0.25 or 0.5 mg. The induction of general anesthesia consisted of one intravenous injection combining propofol (2 mg/kg), sufentanil (0.15 µg/kg) and rocuronium (0.6 mg/kg). All patients received orotracheal intubation. An inhalational anesthetic (sevoflurane) in a 50 oxygen/air mixture was used for maintenance. A drip of one litre NaCl 0.9% was administered peroperatively. All patients received systemic analgesia of 2 g paracetamol and 2 mg/kg tramadol 30 minutes before waking up. The patients were extubated as soon as surgery was complete, and transferred directly to the recovery room, where they were monitored for one hour on average. Postoperative analgesia included administration of paracetamol 1 g four hours after the first injection and every 6 hours afterwards. Etoricoxib 120 mg was given for 5 days starting from the morning after surgery, and tradonal odis 50 mg/8 hours if necessary.

Outcome measures and baseline data collection

Each patient's body mass index (BMI) and classification according to the American Society of Anesthesiology were noted. A Kalkman-score[10] was calculated during the preoperative anesthesia consultation, in order to evaluate the risk for postoperative chronic pain occurrence. We excluded from the study all patients with a Kalkman score of >7/15, patients under anticoagulant therapy or platelet aggregation inhibitors with the exception of acetylsalicylic acid, as well as the patients with a history of allergy to local anesthetics. During the preoperative visit, pain at rest was measured using a visual analogue scale (VAS). Pain score at rest was assessed using a numeric rating scale ranging from 0 (no pain) to 10 (unbearable pain). This was recorded as soon as the patient arrived at the recovery room, then again one hour after the surgery and once more after a 6 hours stay in the recovery ward. When pain scores exceeded 4 on the numeric rating scale, the patients were further treated with titrated doses of piritramide. The pain was also assessed 24 hours after surgery, at the ward, and recorded after a phone call to the day hospital nurse. Finally, the VAS was also measured during the postoperative surgery consultation three weeks and three months after surgery. The nurses and the surgeon performing the pain assessments were unaware of the analgesic technique used in the patient. The difficulty of dissection was evaluated in a subjective way by the surgeon and qualified as easy, normal or difficult. The average duration of surgery, as well as the possible postoperative complications (bleeding, vesical globe, etc.) were also recorded.

Statistical analysis

Quantitative variables were expressed as mean ± standard. Qualitative variables were expressed as frequencies and percentages. Continuous variables were compared using t-test if the variable was normally distributed, or Wilcoxon test if not. The chi-square statistic was used for categorical variables. All statistical testing was two-sided and differences were considered significant when the p value was less than 0.05.

Results

One patient was excluded from the study one hour after waking up, because he developed a hematoma at the surgical site. Five other patients were also excluded, because they underwent inguinal hernia treatment using a different method or with combined surgery such as umbilical hernia or scar revision, see Fig. 1.

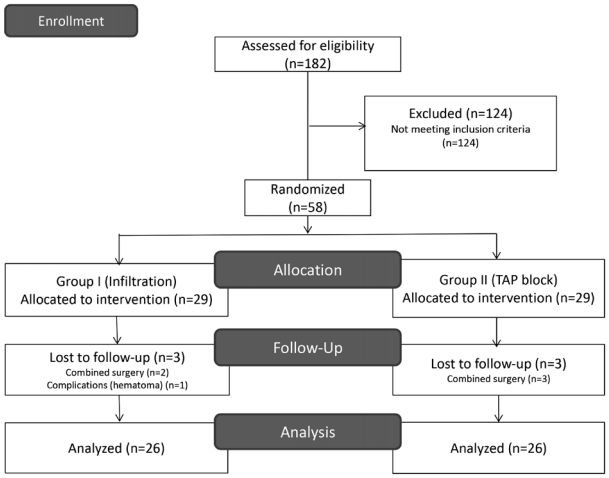

Fig.1. — Randomization flow diagram.

The characteristics of the patients included in the study are shown in Table 1. The average age was 54.1 ± 13.2 years in Group 1 vs. 58.4 ± 14.9 years in Group 2 (p = 0.283). The ratio of male patients was 88.5 in Group 1 vs. 96.2 in Group 2 (p = 0.298). The BMI was 25.1 ± 2.9 kg/m^2 in Group 1 vs. 24.2 ± 2.7 kg/m^2 in Group 2 (p = 0.251). The ratio of ASA I, II and III patients was 57.7, 42.3 and 0 in Group 1 and 38.5, 53.8 and 7.7 in Group 2 respectively (p = 0.186).

Surgery details are given in Table 2. The average duration of surgery from the time of the incision until the last stitch was 37.2 ± 10.7 min. in Group 1 vs. 41.2 ± 9.9 min. in Group 2 (p = 0.114). Surgery was qualified as easy (E), normal (N) or difficult (D) for 76.9 %, 15.5 % and 7.7 % of patients in Group 1 vs. 69.2%, 15.4% and 15.4% of patients in Group 2 respectively (p = 0.680).

Table 1

Characteristics of the two groups after inclusion

	All	Infiltration	TAP block	p
	(n = 52)	(n = 26)	(n = 26)	
Age (years)	56.2 ± 14.1	54.1 ± 13.2	58.4 ± 14.9	0.283
Male (n) (%)	48 (92.3)	23 (88.5)	25 (96.2)	0.298
Average BMI (kg/m^2)	24.6 ± 2.8	25.1 ± 2.9	24.2 ± 2.7	0.251
ASA (n)				0.186
I	25 (48.1)	15 (57.7)	10 (38.5)	
II	25 (48.1)	11 (42.3)	14 (53.8)	
III	2 (3.8)	0 (0)	2 (7.7)	

Table 2

Surgery details

	All	Infiltration	TAP block	p
	(n = 52)	(n = 26)	(n = 26)	
Average duration of surgery (min)	36.2 ± 10.4	37.2 ± 10.7	41.2 ± 9.9	0.114
Dissection (n)(%)				0.680
E	38 (73.1)	20 (76.9)	18 (69.2)	
N	8 (15.4)	4 (15.4)	4 (15.4)	
D	6 (11.5)	2(7.7)	4 (15.4)	

Table 3

Pain scores at rest

	All	Infiltration	TAP block	p
	(n = 52)	(n = 26)	(n = 26)	
Hour +1	1.79 + 1.55	2.15 + 1.57	1.42 + 1.47	0.071
Hour +6	1.85 + 1.46	2.35 + 1.6	1.35 + 1.13	0.031
Hour +24	1.96 + 1.41	2.54 + 1.48	1.38 + 1.10	0.006
Day +21	0.65 + 0.56	0.77 + 0.59	0.5 + 0.51	0.163
Month +3	0.15 + 0.36	0.23 + 0.43	0.08 + 0.27	0.128

In both groups, the same amount of postoperative opioids were used : 4 patients (15.4%) in Group 1 vs. 3 patients (11.5%) in Group 2 received a piritramide injection in the postanesthesia care unit (p = 0.685). The average injected dose was 4 ± 1.63 mg vs. 2.67 ± 1.15 mg (p=0.4). One patient (3.85%) in Group 1 experienced nausea and vomiting in the recovery room. Two patients (7.7%) in Group 2 experienced nausea without vomiting.

No major incident occurred during the surgical procedure in patients of either group. No signs of cardiovascular toxicity or neurotoxicity were observed in the patients. Nor were there allergic reactions, urinary signs or behavioral problems. All patients were able to leave the day hospital on the same day.

The postoperative pain (VAS) scores are shown in Table 3.

Discussion

Chronic pain after inguinal surgery is described as a kind of pain that is present for at least three months after surgery (13). According to studies, its incidence varies from 0.7 to 43.38 (8). The risk of the pain becoming chronic is higher for patients with high scores of early pain in comparison to those having low scores (9 vs. 3, $p < 0.05$), after one week (4). The relevant literature offers contradictory results regarding the superiority of TAP block versus infiltration in terms of acute and chronic pain following this type of surgery. This may be partially due to the different techniques and adjuvant treatments used for analgesia.

Petersen et al. did not observe a decrease in postoperative pain or in the consumption of morphine between TAP block and ilio-inguinal injection in patients treated for inguinal hernia[5]. Other studies have shown identical efficacy with TAP block vs. local infiltration in cases of acute pain. Still, TAP block is more efficient in cases of long-lasting pain for lower abdominal surgery, especially at 24 hours after surgery (6).

Talib et al. showed the superiority of TAP block over local infiltration in terms of nausea and vomiting, as well as of rescue analgesia (7). S. Arora et al. showed that TAP block significantly decreases VAS at rest for more than 24 hours in comparison with local anesthetic infiltration in patients treated for inguinal hernia via laparoscopy (9).

In our study, we observed significant difference in terms of pain at H+6 and H+24, and a non-significant tendency at H+1. However, there was no significant difference in pain on D21 and in M3 postoperatively. In both groups, we injected the same quantity of local anesthetic. The total volume injected was higher in the TAP block group because it is a field block, hence local anesthetic volumes required are high.

There was no difference in the morphine consumption in the recovery room. The fact that the surgeon who performed pain assessment was the surgeon who had performed the procedure could be considered among the limitations of this study. However, this bias may be regarded as one of little importance as, at three weeks and then at three months after the procedure, the surgeon could not truly have remembered the analgesic technique he used on the day of surgery.

Blanco et al. showed that quadratus lumborum (QL) block has a more prolonged effect than TAP block in reducing morphine consumption and demands after Cesarean section (11). In our series, the effect of TAP block lasted at least 24 hours and this may be due to the very posterior approach of our puncture that can be apparented to a QL block which is probably a better option than TAP block in terms of quality and duration of analgesia with a potential visceral effect (12).

Conclusion

In our study, we observed that there is only a significant difference in terms of postoperative pain in favor of a TAP block versus local infiltration, during the first 24 hours following a first laparoscopic treatment of inguinal hernia. We did not find any difference on chronic pain.

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