Analgesic effect of postoperative laparoscopic-guided transversus abdominis plane (TAP) block, associated with preoperative port-sites infiltration, within an Enhanced Recovery After Surgery protocol in One-anastomosis gastric bypass: a randomized clinical trial

Running title: Laparoscopic-guided TAP block

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Abstract:

Background:The use of ultrasonography to assist needle placement during transverse abdominal plane (TAP) technique has provided direct visualization of surround anatomical musculature and facial planes. However, the increased girth in patients undergoing bariatric surgery is challenging to visualize via ultrasonography which may lead to poor postoperative analgesia.

Objective:The aim of the study is to investigate whether the addition of postoperative laparoscopic-guided TAP block as part of a multimodal analgesic regimen within the ERAS protocol compared to no block provides better postoperative analgesia in patients undergoing one-anastomosis gastric bypass surgery.

Patients and Methods: A prospective clinical trial was performed. Patients were randomized into two groups: patients undergoing postoperative laparoscopic-guided TAP (TAP-lap) and patients not receiving TAP-lap (Control). Multimodal analgesia included preoperative port-sites infiltration with Bupivacaine 0.25% in both groups and systemic Acetaminophen. Pain quantification as measured by visual analogic scale (VAS), was assessed at 6 and 24h after surgery, and 24 h postoperative opioid consumption.

Results: One hundred and forty patients were included, 70 in each group. The mean operation time was 78.5±14.4 min in TAP lap and 75.9±15.6 min in Control (NS). The mean postoperative pain, as measured by VAS, 6h after surgery was 23.1±11.3mm in TAP-lap and 41.8±16.2mm in Control (p=0.001).

24 h after surgery was 16.6±11.4mm in TAP-lap and 35.4±12.7mm in Control (p=0.001). Morphine rescues were necessary in 14.2% in Control and 2.8% in TAP-lap (p=0.035).

Conclusion: Laparoscopic-guided TAP block as part of a multimodal analgesia regimen can reduce postoperative pain and opioid consumption, without increasing operative time.

Key words:

Transversus abdominis plane block; TAP; One-Anastomosis Gastric bypass; OAGB; Enhanced Recovery After Surgery; ERAS; Multimodal analgesia; Postoperative pain

Introduction:

Bariatric surgery, usually performed laparoscopically, is an effective procedure to reduce and maintain weight loss in morbid obese patients[1]. Despite the laparoscopic approach has significantly reduced the postoperative pain, it is still present. Thus, an adequate management of postoperative pain remains a challenge, as it is closely related with a decrease in the quality of life in the immediate postoperative period[2]. Several multimodal analgesia schemes, as part of Enhanced Recovery After Surgery (ERAS) programs, have been proposed, aiming to reduce postoperative pain, reduce postoperative opioid consumption and shorten hospital stay[3-6]. Multimodal analgesia involves the use of opioids, local anesthetics, and nonsteroidal anti-inflammatory drugs, all with different pharmacological actions in order to maximize analgesic efficacy, while reducing the risk and severity of adverse events, mostly associated with systemic opioids administration[7]. During laparoscopic surgery, it is common for the surgeon to infiltrate the laparoscopic ports with local anesthetics. We previously demonstrated that the association of port-sites infiltration to intravenous analgesia achieves improved the pain control[8].

The transversus abdominal plane block is a regional anesthesia technique that consists of placing local anesthetic into the fascial planes between the transversus abdominis muscles providing analgesia to the anterior-lateral abdominal wall[9,10]. TAP blocks are routinely performed for pain control after laparoscopic surgery at many institutions[11]. The provided analgesic effect reduces the risk of postoperative cardiopulmonary complications, which are more prone to appear on morbidly obese subjects[12.13]. The ultrasound guidance allows a greater precision of needle placement in the desired tissue plane[14]. However, the increased girth in patients undergoing bariatric surgery is challenging to visualize via ultrasonography, which may lead to poor postoperative analgesia[15,16].

Morbidly obese patients particularly benefit from opioid-sparing analgesia. Therefore, the application of loco-regional techniques, such as TAP block, must be maximized. Our group developed the technique of laparoscopic-guided TAP block in patients undergoing Roux-en-Y gastric bypass (RYGB), and observed a greater analgesic effect of laparoscopic-guided TAP than port-site infiltration[17].

The aim of this study was to determine if postoperative laparoscopic-guided TAP block adds analgesic effect to preoperative port-sites infiltration, as part of a multimodal analgesia scheme within an ERAS program, in patients undergoing One-Anastomosis gastric bypass (OAGB).

Patients and Methods:

A prospective randomized clinical trial of patients undergoing OAGB at an Internation Federation for Surgery of Obesity (IFSO) Center of Excellence, was performed between December 2018 and March 2019 Inclusions criteria consisted of adult patients who were scheduled to undergo one-anastomosis gastric bypass (OAGB) procedure with either a BMI > 40 kg/m2 or >35 kg/m2 with the presence of comorbidities associated with obesity (i.e. Type 2 Diabetes Mellitus, hypertension, dyslipemia, sleep apnea). Patients were excluded if they were scheduled for additional surgeries (band removal, cholecystectomy, hernioplasty, or hiatal hernia treatment), history of foregut surgery, bariatric-revision surgery, history of allergy to local anesthetics, coagulopathy or anticoagulation, and those patients who refused TAP block.

The sample size calculation was based on historic data of our center of postoperative pain quantification by Visual Analogic Scale (VAS) 24 hours after surgery in patients undergoing preoperative port-sites infiltration with Bupivacaine 0.25% associated with

postoperative intravenous analgesia (Control Group – 40mm) and an expected reduction to 25 mm in patients undergoing the combination of preoperative port-sites infiltration, intravenous analgesia and postoperative laparoscopic-guided TAP block with Bupivacaine (Experimental group). At 80% power and a significance level of p=0.05, it was calculated that 70 patients were required in each arm of the study.

Patients were randomized using a computerized simple randomization scheme in a 1:1 ratio into 2 groups: patients undergoing postoperative laparoscopic-guided TAP associated to postoperative intravenous analgesia and preoperative port-sites infiltration (TAP-lap Group) compared to those ones receiving only postoperative intravenous analgesia associated with preoperative port-sites infiltration (Control Group) (CONSORT flow diagram).

Surgical technique:

The laparoscopic procedure consisted of the placement of 6 ports: right and left flank (12 mm), supraumbilical (10mm), right and left hypochondrium and right iliac fossa (5 mm). A 20cm-long gastric pouch, calibrated with a 36 Fr bougie was constructed. Termino-lateral gastro-jejunal anastomosis with linear stapler (I-Drive with Tri-staple cartridges, Medtronic, USA) was performed. The holes were sutured with continuous barbed suture V-Loc 2/0 (Medtronic, USA). The total bowel length was determined; the biliopancreatic limb length represented 60% of the total bowel length and the common limb 40%. Mesenteric defects were not closed in any of the cases. The integrity of the anastomoses and staple lines were checked with intraoperative methylene blue dye.

Analgesic technique:

Preoperative port-sites infiltration was performed by the surgeon with 10 ml of Bupivacaine 0.25%, applying 1.5 ml under the aponeurotic layer in each port.

Intravenous analgesia included Acetaminophen 1g/6h.

Bupivacaine 0.25% 30ml was used for TAP-lap. The drug was injected into the plane between the internal oblique and the transversus abdominis muscles, as previously reported[13]. Local anesthetic injection was placed at the dermatome level, just lateral to the port insertion sites (Figure 1). The local anesthetic was injected sequentially with 5 mL of bupivacaine 0.25% into the fascial plane between the internal oblique and the transversus abdominis muscles at each of the three corresponding port sites on the right and left side for a total volume of 30 ml. At each port site, the laparoscopic guidance consists in the insertion of the needle until the tip protrudes on the peritoneal layer. Then the needle is retracted 3mm into the abdominal wall, which is the estimated thickness of the preperitoneal space and the transversus abdominis muscle, so that the anesthetic drug is injected into the space between the internal oblique muscle and the transversus abdominis muscle, forming a bulge protruding on to the peritoneum (Figure 2).

Patients who reported postoperative pain greater than a VAS score of 50 mm received subcutaneous morphine 5 mg until discharged from the hospital.

Prophylaxis of nauseas and vomiting (PONV):

The prophylaxis regimen used was according to the Spanish National Enhanced Recovery After Surgery (ERAS) protocol for bariatric surgery[18], and specifically following the Apfel scale[19]. Given that most patients were women (females are more prone to present

PONV, following Apfel scale criteria), without history of smoking at the time of surgery (stop of tobacco habit was mandatory at least 8 weeks prior to surgery), and undergoing a surgery involving the stomach, all the patients were considered as high risk patients for postoperative nausea or vomiting (PONV).

Thus, all the patients received pharmacologic prophylaxis with triple therapy, including Dexametasone during the anaesthetic induction, and Droperidol and Ondansetron at the end of the surgery.

Variables:

Primary outcome of this study was pain quantification as measured by Visual Analogic Scale (VAS), ranging from 0mm (absence of pain) to 100mm (unbearable pain) at 24 hours after surgery. Secondary outcomes include pain quantification at 6 hours after surgery, surgical durantion, opioid consumption during the first 24 hours, PONV, complications and hospital stay. Pain quantification during the first 24 hours was evaluated by a nurse blinded to the treatment applied.

Statistics:

Statistical analysis was performed with the statistical software SPSS 22.0 for Windows. Quantitative variables that followed a normal distribution were defined by the mean and standard deviation. For non-Gaussian variables, the median and range were used. Qualitative variables were defined by number and percentage of cases.

Comparison of variables was performed with Student t-test (Mann-Whitney test in non-Gaussian variables). Comparison of qualitative variables was performed with the Chi-square test; in those cases with fewer than 5 observations in the cell the Fisher exact

probability method was used. P< 0.05 was regarded as significant. An intent-to -treat analysis was performed.

The study was approved by the local ethics committee and informed consent was obtained from all the patients.

Results:

A total of one hundred and forty obese patients were included in the study; no patients were excluded. The two groups were comparable with respect to age, gender, comorbidities, weight and BMI (Table 1).

Mean operation time was 78.5 ± 14 min in TAP lap Group and 75.9 ± 12.6 min in Control Group (Non significant-NS). Postoperative complications appeared in 1 patient in each group (1.4%): one abdominal wall hematoma in the right iliac fossa, adjacent to the placement of the 5-mm port in TAP-lap Group, and one subcutaneous emphysema secondary to the pneumoperitoneum in the Control Group. Both complications were conservatively managed and recovered uneventfully. There were no mortality or readmission in any of the groups.

When analyzing the postoperative pain, patients presenting complications were not excluded, as this is an intention-to-treat analysis. The mean postoperative pain, as measured by VAS, 6 hours after surgery was 23.1±11.3mm in TAP-lap Group and 41.8±16.2mm in Control Group (p=0.001). 24 hours after surgery, postoperative pain was 16.6±11.4mm in TAP lap Group and 35.4±12.7mm in Control Group (p=0.001).

Morphine rescues were necessary in 2 patients (2.8%) in TAP-lap Group and in 10 patients (14.2%) in the Control Group (OR 4.47, CI95%(1.7 -11.2); p=0.035) All the patients with morphine rescue needs required only a single administration of 5mg

subcutaneous morphine chloride during the first 24 hours postoperatively. Later morphine rescues were not necessary in any cases. During hospital stay, PONV appeared in 1 patient (1.4%) in TAP-lap group and 8 patients (11.4%) in Control Group (OR 4.27, CI95% (1.8-10.6); p=0.039). All the patients with PONV received morphine rescues. Median hospital stay was 1 day (range 1-2 days) in both groups (NS). Hospital discharge during the first 24 hours in 95.7% of the patients in TAP-lap Group and in 87.1% of the cases in Control Group (p=0.07).

Discussion:

Port-sites infiltration with local anesthetic drugs is a usual procedure employed for multimodal analgesia. However, its analgesic efficacy remains unclear. Several series report excellent postoperative analgesia[20,21], whereas other studies could not demonstrate this efficacy[22]. A previous study of our group showed that port-sites infiltration with Bupivacaine achieved similar analgesic efficacy than epidural analgesia in patients undergoing bariatric surgery [8].

Moncada et al reported that the port-sites infiltration achieves a significant pain reduction only during the first 4 postoperative hours, but no longer. They performed preoperative infiltration with bupivacaine, which is a drug with a half-life significantly shorter than the time frame examined[23]. Actually, there is a great controversy about the optimal time of infiltration with local anesthetic drugs. Some groups defend the preoperative application in order to reduce unpleasant sensations and autonomic reactions to injury, as nociceptors are activated by inflammation and injury, giving rise to painful and non-painful sensations that influence feeding and illness behavior[24,25]. Local anesthetics have shown to present an anti-inflammatory effect, which modulates the immune response to surgical

intervention[24,25]. However, other authors defend a postoperative infiltration to prolong the duration of the anesthetic after surgery[26,27]. Moon et al have solved this dilema, using liposomal bupivacaine, a long-acting local anesthetic with half-life of 96 hours. They performed a TAP block preoperatively and observed a significant reduction of postoperative morphine needs during all the hospital stay[28]. However, liposomal bupivacaine is expensive and not available at all institutions and further studies should confirm the initial results obtained.

In our Control Group, only with preoperative port-sites infiltration, the postoperative pain assessment revealed a mild pain relief, with mean VAS measurements of 41.8mm at 6 hours after surgery and 35.4mm at 24 hours, and requiring a morphine rescue in 14.2% of the patients. Considering that the half-life of Bupivacaine is 8 hours, even the pain determination 6 hours after surgery showed a loss of analgesic effect.

Andersen et al[29] conducted a systematic review on different analgesic treatment options in laparoscopic gastric bypass surgery. They conclude that port-sites infiltration and TAP block are effective analgesic methods, but there are no studies comparing both approaches. Many anesthesiologists defend TAP block as superior to port-sites infiltration and prefer to carry out a TAP block, once they decide to perform an ultrasound-guided infiltration. In order to reduce the difficulties in the identification of the transversus abdominis plane when performing ultrasound-guided TAP blocks in bariatric patients, we developed the laparoscopic guidance[17]. The laparoscopic TAP block technique provides direct visualization of the target area. However it is not as precise in as ultrasonography delineating the interfacial planes and surrounding musculature. Therefore, we suggest using ultrasonographic confirmation of local anesthetic spread, at least during the learning curve.

In the present study we aimed to evaluate the addition of postoperative laparoscopic TAP

block to preoperative port-sites infiltration with isolated preoperative port-sites infiltration, and observed a significantly better pain relief and lower morphine rescue needs in the TAP-lap Group. In our opinion, a synergistic effect of the multimodal regimen probably accounts for the success of the postoperative analgesia seen in our study. The port infiltration with local anesthetic reduces the pain generation, whereas the laparoscopic TAP block prolongs the analgesic effect.

A limitation for the external validation of this technique is that the TAP-lap was performed by trained surgeons in this approach. In our previous study evaluating the initial implementation of this procedure in RYGB[17], the first 10 cases of TAP-lap block were validated with ultrasonographic confirmation of the anesthetic infiltration in the correct plane, considering it as the learning curve. Anyway, further prospective randomized studies should be conducted to confirm a similar efficacy in laparoscopic-guided and ultrasound-guided TAP block.

Conclusion:

Laparoscopic-guided TAP block, associated to preoperative port-sites infiltration, as part of a multimodal analgesia scheme, can reduce postoperative pain and opioid rescue needs, without increasing operative time.

Clinicaltrials.gov registration: NCT03775018

Conflict of interests statement:

Jaime Ruiz-Tovar, MD, PhD; Gilberto Gonzalez, MD; Andrei Sarmiento, MD; Miguel A. Carbajo, MD, PhD; Javier Ortiz-de-Solorzano, MD; Maria Jose Castro, MD, PhD; Jose Maria Jimenez, PhD and Lorea Zubiaga, MD, PhD have no conflicts of interest or financial ties to disclose.

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Financial disclosure:

Jaime Ruiz-Tovar, MD, PhD; Gilberto Gonzalez, MD; Andrei Sarmiento, MD; Miguel A. Carbajo, MD, PhD; Javier Ortiz-de-Solorzano, MD; Maria Jose Castro, MD, PhD; Jose Maria Jimenez, PhD and Lorea Zubiaga, MD, PhD have nothing to disclose.

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Figure 1: Port sites. Injection point for the TAP is indicated by the red points and syringes (laterally to the ports placement)