

## EXPERTS' OPINION

## The TAP block in obese patients: pros and cons

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## ABSTRACT

The growing number of laparoscopic surgical procedures performed in obese patients has increased the need to explore suitable analgesic techniques for a prone population to postoperative complications. The morbidly obese population may particularly benefit from the opioid-sparing or the opioid-free anesthesia/analgesia, which maximize the use of locoregional techniques. Transversus abdominal plane (TAP) block has been widely used as part of multimodal analgesia for abdominal and gynecological surgeries, but evidence in obese patients is still poor. The efficacy of TAP block in morbidly obese patients undergoing laparoscopic bariatric surgery is still under discussion, because ultrasound visualization of the abdominal wall muscles can be challenging due to the excessive subcutaneous fat. Inadequate needle positioning, failed regional analgesia, and possible related risks must be counterbalanced by adequate evidence of effectiveness. The present article will discuss the pros and cons of TAP block in the treatment of obese patients.

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The transversus abdominis plane (TAP) block, introduced by Rafi in 2001, is a peripheral nerve block to the anterolateral abdominal wall.<sup>1</sup> The TAP is a space between the internal oblique muscle and the transversus abdominis muscle, where the thoracolumbar nerves originating from the T6 to L1 roots run to supply the anterolateral abdominal wall. There are at least four different approaches, which correspond to different involved spinal nerves (Table I): subcostal (T6-T9); lateral (T10-T12); posterior (T9-T12); and oblique subcostal (T6-L1). A posterior TAP block offers a longer analgesia compared with a lateral TAP block for the infraumbilical abdominal wall. Subcostal or dual (subcostal + lateral/

posterior) blocks are required for analgesia of the supraumbilical wall.<sup>2</sup> Ultrasound guidance is the gold standard for identifying the TAP during the block, because, when compared with landmark-based techniques, it increased the success rate and the safety of this procedure.<sup>3</sup> The TAP block is technically simple in expert hands, provides excellent analgesia for a variety of abdominal procedures, reduces postoperative opioid consumption, and has a relatively long duration of action. However, there are some limitations, such as the need for bilateral block for midline incisions and the lack of effectiveness for visceral pain.<sup>4</sup>

In the last years, the laparoscopic approach

TABLE I.—*The four main approaches for the ultrasound-guided TAP block.*

Approach	T-L nerves	Injection site	Supplied area	Technique
Subcostal	T6-T9	Near the xiphoid, between the transversus abdominis and the rectus abdominis	Upper abdomen (below the xiphoid and parallel to the costal margin)	Bilateral dual TAP or four-quadrant
Lateral	T10-T12	On the midaxillary line, between the costal margin and the iliac crest	Anterior abdominal wall at the infraumbilical area (from midline to midclavicular line)	Bilateral dual TAP or four-quadrant
Posterior	T9-T12	In the area of the lumbar triangle of Petit, between external oblique muscle and latissimus dorsi muscle (superficial to the aponeurosis near quadratus lumborum)	Anterior and lateral abdominal wall (from the costal margin to the iliac crest)	Bilateral dual TAP or four-quadrant
Oblique subcostal	T6-L1	On the oblique subcostal line	Upper and lower abdomen (from the xiphoid toward the anterior part of the iliac crest); similar to dual TAP	

T-L: thoracolumbar.

has been widely developed and, nowadays, most abdominal surgeries can be laparoscopically performed. Laparoscopic techniques are associated with many advantages, including reduced postoperative pain, lower complications rates, shorter hospital stay and earlier reincorporation to normal activities, than open procedures.<sup>5</sup> TAP block has been widely used for laparoscopic surgery in abdominal<sup>6, 7</sup> and gynecological surgeries.<sup>8</sup>

Worldwide the prevalence of obesity is rising. Obese patients may undergo laparoscopic abdominal surgeries for a variety of pathologies, including specific bariatric procedures. The number of worldwide bariatric surgeries is growing constantly.<sup>9</sup> Obesity is associated with increased postoperative complications and regional anesthesia is recommended where possible.<sup>10</sup> Obesity is the most common cause of obstructive sleep apnea (OSA),<sup>11</sup> therefore patients undergoing bariatric surgery are considered at high risk of respiratory side effects when they are exposed to opioid analgesics. The morbidly obese population may particularly benefit from the opioid-sparing or the opioid-free anesthesia/analgesia, which are techniques that minimize or avoid the use of opioids in the perioperative period and maximize the use of loco-regional techniques.<sup>12, 13</sup> The TAP block has been used as analgesic technique in obese patients to reduce perioperative opioid consumption, not only for bariatric surgery,<sup>14</sup> but also for Caesarean section.<sup>15</sup>

However, the performance of the TAP block may be challenging in this population, where the

excessive subcutaneous adipose tissue may reduce the ultrasound visibility of the target structures, inducing many authors to use the surgical block in laparoscopic procedures.<sup>16</sup> Moreover, the literature still shows some controversy on the real effectiveness of the TAP block, particularly in this population. In the present article, Professor Ruiz-Tovar discussed the pros of using the TAP block in obese patients, while Professor Albrecht drew cons.

The TAP block in obese patients: pros

Laparoscopic surgery is part of Enhanced Recovery After Surgery (ERAS) protocols, aiming to reduce the impact of the surgical damage and improving the postoperative quality of life and reincorporation to usual activities.<sup>17</sup> Despite laparoscopic techniques are also associated with lower postoperative pain than open approaches, the adequate management of postoperative pain remains a major challenge in obese patients, as it might condition the appearance of major morbidity, mainly pulmonary complications, leading to a decrease in the health-related quality of life in the immediate postsurgical period.<sup>18</sup> Therefore, in order to reduce the incidence and severity of postoperative pain, multimodal analgesia, as part of ERAS programs, has been defended by many authors. Multimodal analgesia involves the use of two or more drugs with different mechanisms of action to maximize analgesic efficacy, while reducing the risk and severity of adverse

events.<sup>19</sup> These protocols applied to laparoscopic surgery mostly include the association of intravenous analgesia with the port-sites infiltration with local anesthetic drugs.<sup>20</sup> However, the Clinical Guidelines for Enhanced Recovery after abdominal surgery, published by the Spanish Health Ministry, conclude that there is no sufficient evidence to support the use of port-site infiltration with local anesthetic drugs, and defend the use of epidural analgesia in open techniques and TAP blocks in laparoscopic approaches, as better alternatives.<sup>21</sup>

The resulting analgesia after TAP blocks may be especially beneficial in obese patients after abdominal surgery due to their higher risk for postoperative pulmonary complications.<sup>22, 23</sup> Several studies have demonstrated that the TAP block decreases peri- and postoperative pain and reduces the use of opioids.<sup>24</sup>

The introduction of ultrasound guidance has allowed greater precision of needle placement in the desired tissue plane.<sup>25</sup> However, some authors defend that the visualization of the abdominal wall muscles can be hindered by obesity and could lead to failed regional anesthesia.<sup>26</sup> Theoretically, the deep anatomic location of structures and nerves implies that the ultrasound beam travels a greater distance, leading to beam attenuation. Moreover, the quality of the imaging through fat may be poorer as the adipose tissue has a nonlinear relationship to frequency, whereas most biological tissues have linear relationship. In addition, the irregularly shaped adipose layers lead to uneven speed of sound causing phase aberration of the sound field. So that above the focus of the transducer, there is differing speeds of sound, leading to mismatch of acoustic impedance at the fat/muscle interfaces. In obese patients, there is an increase in the number of reflective interfaces not only leading to more echoes, but also decreasing the incident of sound available to penetrate deeper tissues, such as nerves, vessels, or other targeted structures.<sup>27-29</sup>

However, these theoretical problems that may arise in the obese patients, are not clinically reflected in many studies. Andersen *et al.* performed a recent systematic review of randomized trials involving the analgesic treatment in

morbidly obese patients undergoing laparoscopic gastric bypass surgery. They conclude that TAP block may improve analgesia compared to placebo.<sup>30</sup> Many studies defend TAP block as superior to port-site infiltration and, if ultrasound-guidance is feasible, many anesthesiologists prefer to carry out a TAP block rather than a port site infiltration. Other studies have shown similar benefits in obese and lean patients undergoing laparoscopic colorectal surgery and Caesarean delivery.<sup>31, 32</sup> Several authors defend that the ultrasound guidance allows the identification of the layers of the abdominal wall even in obese patients, where landmarks are often obscured by the body habitus.<sup>33, 34</sup>

In our experience, some inexperienced anesthesiologists certainly refer difficulties in the identification of the transversus abdominis plane when performing ultrasound-guided TAP blocks in obese patients, because of the thickness of the subcutaneous adipose tissue. In these cases, we decide to perform this procedure with laparoscopic guidance. It is true that laparoscopic guidance is not as exact as ultrasound one, as the muscular layers cannot be identified. We just identify the tip of the needle when protruding on the peritoneum and we retract it 3mm, based on the estimated thickness of the transversus abdominis muscle and the pre-peritoneal space. Moreover, the bulge obtained must suggest that the infiltration is not performed in the pre-peritoneal layer, that will provoke a greater bulge, nor in the space between both oblique muscles, that will not perform any bulge as the internal oblique muscle has greater thickness than the transversus abdominis. We perform the laparoscopic-guided TAP block laterally to the port sites, but not far away from them, trying to coincide the infiltration dermatome with the dermatome of the port site. To validate the efficacy of our technique, we performed a prospective randomized clinical trial comparing laparoscopic-guided TAP block with port-site infiltration after laparoscopic Roux-en-Y gastric bypass. We observed a significant reduction in postoperative pain, morphine needs, and hospital stay in the TAP block group.<sup>14</sup>

In the same way, Said *et al.* have recently published a novel method of continuous TAP blocks *via* laparoscopically-placed catheters for

bariatric surgery. They performed a laparoscopic dissection of the space between transversus abdominis and internal oblique muscles, placing there a catheter for continuous infusion of local anesthetics, and obtained a significant reduction of postoperative pain and opioid needs. In the performance of this approach, these authors confirm that the transversus abdominis muscle has a width of 2-3mm, as we hypothesized in our technique, and the infusion tests they performed with normal saline, obtained similar bulging images to that we observed in our patients.<sup>35</sup>

We can conclude that TAP blockade is a useful tool for multimodal analgesia, even in obese patients. It is true that the ultrasound guidance is operator-dependent and requires a certain learning curve, especially in obese subjects, but in those cases whose anatomic landmarks are difficult to identify, laparoscopic-guided TAP block is an easy and effective alternative.

### The TAP block in obese patients: cons

Regional analgesia is a key factor in reducing intra- and postoperative opioid consumption in patients requiring general anesthesia.<sup>36, 37</sup> Regional techniques however are more challenging in obese patients.<sup>38, 39</sup> Furthermore, given there are inherent risks of regional techniques,<sup>40, 41</sup> it is important that there is evidence of benefit.

In the original TAP block publication in 2001, Dr Rafi described a landmark guided, “single-pop” injection of local anesthetic in the fascial plane between the internal oblique and transversus abdominis muscles in the lumbar triangle of Petit.<sup>1</sup> Modifications such as the “double-pop” technique followed,<sup>42, 43</sup> all aiming to block the lower intercostal nerves from T7 to T12, the ilio-hypogastric nerve, and the ilioinguinal nerve. Early randomized controlled trials using the same landmark technique were consistently positive,<sup>42-46</sup> leading to widespread dissemination of the block. Reports subsequently emerged of paravertebral local anesthetic spread suggesting the possibility of visceral as well as somatic analgesia.<sup>47</sup>

It has since been demonstrated that the needle tip in the landmark technique may only be within the correct inter-muscular fascial plane in less

than 25% of cases. In their excellent study, McDermott *et al.* performed a landmark guided TAP block after induction of general anesthesia and a blinded colleague subsequently used ultrasound to verify the needle position.<sup>48</sup> The trial was terminated early due to an unacceptably high rate (18%) of peritoneal puncture, with the needle tip in other cases being either in the abdominal muscles (50%), another fascial plane or the subcutaneous tissue. As the literature already contained several reports of liver,<sup>49</sup> small bowel,<sup>50</sup> or colonic puncture<sup>51</sup> following landmark-based abdominal wall blocks, this study strengthened the evidence that landmark techniques should arguably be abandoned in all patients, and not just obese patients where it is likely the risk of inaccurate placement and peritoneal puncture is higher.

Ultrasound has been shown to increase the success of fascial plane blocks and the first ultrasound-guided TAP block was reported in 2007 by Hebbard *et al.*<sup>52</sup> A variety of heterogeneous approaches with varying needle insertion points and endpoints have since been described including the subcostal, lateral and posterior TAP blocks.<sup>53, 54</sup> Results from trials utilizing ultrasound interestingly have not always been as impressive as the initial landmark guided technique trials,<sup>42-46</sup> sometimes even with conflicting conclusions.<sup>39, 55-59</sup> Recently a number of systematic reviews and meta-analyses have examined TAP blocks and efficacy of postoperative analgesia. Baeriswyl *et al.* analyzed 31 randomized controlled trials including 1611 adult patients and concluded that ultrasound-guided TAP block provided only marginal benefit after laparotomy, laparoscopy or Caesarean delivery.<sup>54</sup> The mean difference in rest pain 24 hours postoperatively of -0.4 out of 10 in the ultrasound guided TAP block group was statistically but not clinically significant. Furthermore, these marginal benefits disappeared if patients received spinal anesthesia and intrathecal long- acting opioid.<sup>54, 60</sup> Importantly, Baeriswyl *et al.* also demonstrated a publication bias, meaning that a small number of trials with negative conclusions were missing, likely weakening these already limited benefits.<sup>54</sup> Furthermore, many studies exclude patients with a high body mass index and it is possible that these



marginal benefits could be even less in obese patients where blocks can be more challenging and arguably more likely to fail.<sup>38, 39</sup> Identifying the three different muscle layers in an obese patient can be more difficult due to the thicker layer of subcutaneous tissue and if the muscle layers are hypotrophic.

Indications for surgery in the obese are expanding and close to 200,000 bariatric surgeries are performed each year in the USA.<sup>61</sup> Postoperatively patients can suffer from moderate to severe pain,<sup>62</sup> and to date five prospective trials have explored the question of whether an ultrasound guided TAP block is beneficial.<sup>14, 33, 34, 39, 63</sup> The results of these trials are conflicting. Albrecht *et al.* undertook a randomized double-blind controlled trial including 70 patients scheduled for laparoscopic bariatric surgery and concluded that ultrasound-guided TAP blocks performed prior to surgery does not provide any additional analgesic benefit to trocar insertion site local anesthetic infiltration and systemic analgesia.<sup>39</sup> Twenty-four hour intravenous opioid consumption, pain scores at rest and on movement both in the post-anesthetic care unit and 24 hours postoperatively, and the hospital length of stay were all equivalent in the two groups. The authors suggested that these findings may be due to a more technically difficult block increasing the risk of failure and the fact that a TAP block provides only somatic and not visceral pain relief.<sup>39</sup> Other trials have also confirmed that TAP block does not confer any additional analgesia when combined with trocar site infiltration for patients sustaining a laparoscopic appendectomy<sup>58</sup> or laparoscopic cholecystectomy.<sup>59</sup> Surgical infiltration clearly requires less expertise and is quick and safe.

One final concern is local anesthetic toxicity. Toxic plasma concentrations of local anesthetics after bilateral TAP blocks at appropriate doses have been reported.<sup>64, 65</sup> Lean body weight should be used for local anesthetic dosing and not doing so increases the risk of local anesthetic toxicity.<sup>10</sup> It may even be that local anesthetic absorption is partly responsible for some of the TAP block effect. Sensory block of dermatomal levels is demonstrable after TAP blocks, therefore suggesting that local anesthetic in the correct plane

does indeed spread to nerves in the fascial plane. However, whilst work directly comparing TAP blocks and intravenous lidocaine is required, in separate meta-analyses the reduction in 24 hour morphine consumption in abdominal surgery using TAP blocks<sup>54</sup> is only slightly greater than simply administering an IV lidocaine infusion which requires less expertise and removes the risk of failure and needle-related trauma.<sup>66</sup>

This body of evidence seems to support the concept that TAP blocks be of marginal benefit in abdominal surgery and, specifically, offer no benefit in bariatric laparoscopic surgical procedures compared to port site infiltration and multimodal analgesia. Personally, we would not undertake a landmark-guided TAP block in any patient due to the proven risk of needle malposition. Ultrasound however does not eliminate this risk and careful consideration of the limited, if any, clinical benefits is therefore required before performing a TAP block in obese patients.

## Conclusions

In conclusion, TAP block seems to be a promising regional technique as part of a multimodal post-operative analgesic approach, to reduce opioid requirement and improve pain scores. TAP block can be an interesting alternative, particularly, in patients where epidural and spinal analgesia can be technically difficult or pose a risk.<sup>67</sup> However, it is still unclear if there is a real advantage in terms of analgesia when compared with local infiltration in abdominal and gynecological surgeries.<sup>68, 69</sup> Obese patients are a subpopulation that may particularly benefit from regional analgesic modalities with opioid-sparing effect, however different critical issues emerged when using ultrasound-guided TAP block for bariatric surgery, such as correct identification of the plane, needle positioning, and local anesthetic volume. The ultrasound guidance, that should represent the gold standard, can be challenging in obese, may increase procedural time, and requires a certain learning curve.<sup>70</sup> The laparoscopic-guided approaches to the abdominal wall can be considered as alternative option, when subcutaneous fat hinders ultrasound imaging. Conflicting results are nowadays available in literature on the real

advantages of using TAP block compared with port-site infiltrations in bariatric surgery, in terms of postoperative pain and outcomes of recovery. Further clinical trials are warranted to clarify the role of TAP block in obese patients undergoing abdominal surgery and the optimal approach to perform abdominal wall blocks. These studies should be procedure-specific and should include also patients with a high body mass index.

### Key messages

- TAP block is an interesting alternative for abdominal wall analgesia, when central axis blocks are contraindicated or difficult to be performed, such as in obese patients. However, in this population, the thickness of the subcutaneous fat can theoretically increase the difficulty in the US identification of the transversus abdominis plane.
- The use of TAP block in the context of multimodal analgesia is particularly interesting in obese patients, which are at increased risk of postoperative pulmonary complications. However, the evidence of any additional analgesia from combining TAP block with trocar site infiltration in obese patients is still fair.
- In bariatric surgery, laparoscopic-guided TAP block and eventually the laparoscopically-placed catheters are a good alternative approach to the traditional ultrasound-guided technique.
- Many clinical studies on the efficacy of TAP block excluded patients with a high Body Mass Index, therefore the benefits of this technique could be even less in obese patients, where blocks can be more challenging and arguably more likely to fail.

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