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Review Article

Transversus abdominis plane block: The new horizon for postoperative analgesia following abdominal surgery

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Abstract Post operative pain management is the key factor to decide the outcome of the patient. TAP block is relatively newer method for management of postoperative pain after abdominal surgery. Technique involves the injection of local anesthesia into the plane between the internal oblique and transversus abdominis muscle and thus giving pain relief. The technique when performed under ultrasound guidance improves the yield. TAP block provides good analgesia between T10 and L1 level hence very useful for lower abdominal and gynecological procedures. This significantly reduces the analgesic requirement in postoperative period and hence reduces the side effects of analgesics.

Contents

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1. Introduction

Since the times, pain has remained the most significant issue making patients to seek medical consultation. In post operative period, potent analgesia is required not only to make patients to bear the surgical stress but also it helps in early ambulation and thereby limits many complications such as lung atelectasis and deep vein thrombosis [1–4]. The opioid analgesics are most commonly used as parenteral agents to take care of post operative pain but the problem of respiratory depression remains to be considered [5]. There has been an everlasting concern among anesthetists to provide adequate relief for post operative pain especially in immediate post operative period. There is plenty of published literature to find out the role of various techniques and various agents in the management of post operative analgesia; but with varied potency, efficacy, safety and ease of administration.

The abdominal surgeries, may it be open or laparoscopic, are associated with significant post operative pain. In addition to parenteral opioids and NSAIDS, various other methods used for post operative analgesia are infiltration of local anesthetic agents, dermal patches, patient controlled analgesia and epidural catheters, etc.

Transversus abdominis plane (TAP) block is a relatively newer and a novel approach of injecting local anesthesia into the plane between the internal oblique and transversus abdominis muscle and thus giving pain relief. It was first described by Kuppuvelumani et al. in 1993 and was formally documented in 2001 by Rafi [6–8]. TAP block has been found to be a safe and effective tool in a variety of general, gynecological, urological, plastic, and pediatric surgeries, and it is suggested as part of the multimodal anesthetic approach to enhance recovery after lower abdominal surgeries [9–19]. The efficacy of TAP block has been studied and found in patients who undergone laparoscopic cholecystectomy as well [20].

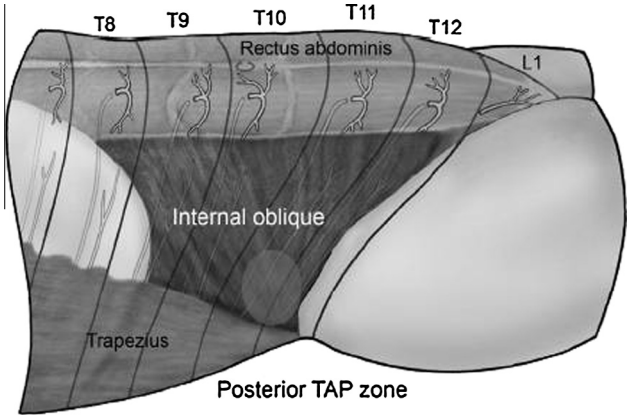

Figure 1 Anatomy of transversus abdominis plane (reproduced from JANKOVIC Z). Transversus abdominis plane block: the holy grail of anesthesia for (lower) abdominal surgery. PERIODICUM BIOLOGORUM 2009, 111(2): 203–208.

The guidance of TAP block with ultrasound has facilitated the injection of local anesthetic into the transversus abdominis fascial plane, where the nerves from T6 to L1 are located [20].

2. Aim

The aim of this article was to explore the various considerations regarding TAP block and to evaluate its clinical utility in reference to currently available literature.

3. Anatomical considerations

The transversus abdominis plane is a triangular fascial plane over abdomen in between the internal oblique and transversus abdominis muscles. Its anterior border is formed by linea semilunaris, which consists of the aponeuroses of both the internal and external oblique muscles and the transversus abdominis muscle, and extends from the cartilage of rib 9 to the pubic tubercle [21]. The superior border of the TAP plane is formed by the subcostal margin, from 9^{th} to 12^{th} costal cartilage continued into the border of the latissimus dorsi muscle and the lumbar triangle of Petit. The inferior border of the TAP is the inguinal ligament, iliac crest and posterior border of lumbar triangle of Petit [22]. Hence myocutaneous sensory blockade can be achieved by deposition of local anesthetic in the space (Fig. 1). The TAP blockade therefore disrupts the abdominal wall neural afferents. The sensory supply of the

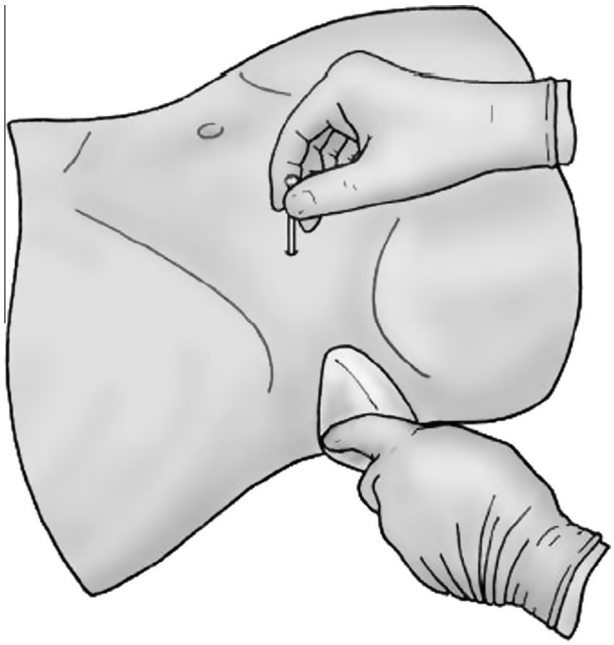

Figure 2 USG guided TAP block (reproduced from JANKOVIC Z). Transversus abdominis plane block: the holy grail of anesthesia for (lower) abdominal surgery. PERIODICUM BIOLOGORUM 2009, 111(2): 203–208.

skin, muscles and parietal peritoneum of the anterior abdominal wall is derived from the anterior rami of the lower six thoracic nerves and the first lumbar nerve. The intercostal, subcostal, iliohypogastric and ilioinguinal nerves course through the lateral abdominal wall within the TAP before they pierce the musculature to innervate the abdomen [23,24]. There is extensive branching of and communication between nerves within the TAP [25].

4. Technical considerations

The TAP block aims at injecting local anesthetic agent in the plane between the internal oblique and transversus abdominis muscles targeting the spinal nerves in this plane and hence the innervation to abdominal skin, muscles and parietal peritoneum will be interrupted. This block can be achieved blindly or with the aid of the ultrasound [24].

5. Blind TAP

The blind technique aims at the lumbar triangle of Petit which is bounded superiorly by costal margin, inferiorly by iliac crest, anteriorly by the external oblique muscle and posteriorly by the latissimus dorsi. There is a feeling of double pops as the needle traverses the external oblique and internal oblique muscles, which signifies the correct location of needle; however, loss of resistance will be better appreciated using a blunt needle [26].

6. Ultrasound-guided TAP

While doing ultrasound guided TAP blockade, the ultrasound probe is placed in a transversus plane to the lateral abdominal wall in the midaxillary line, between the lower costal margin and iliac crest (Fig. 2). This allows for accurate deposition of the local anesthetic in the correct neurovascular plane [26].

7. Continuous TAP block

There are few case reports in the literature which suggest that by using a catheter placed in transversus abdominis plane under ultrasound guidance, a continuous TAP block could be achieved [27,28]. The resistance encountered during insertion of catheter can be reduced by injecting 5–10 ml of saline beforehand. The workers have described surgically assisted catheter placement under direct vision and use of infusion device during procedure [24].

8. Agent and concentration

The local anesthetic agent used for TAP blockade and concentration to be used have changed over time. The initial report was with 0.5% lignocaine then 0.375% bupivacaine 20 ml, levobupivacaine to a maximum dose of 1 mg/kg each side, and finally 0.75% ropivacaine up to 1.5 mg/kg (to a maximum dose of 150 mg) on each side for bilateral block [23,29,30]. Higher doses were used to achieve prolonged postoperative analgesia. The effect may also be prolonged by adding adrenaline, ketamine or clonidine to local anesthetic solution, in concentrations recommended for other peripheral blocks. For continuous infusions, ropivacaine at concentrations of 0.2–0.5% is used.

9. Indications and clinical use

The main indications of TAP block are lower abdominal surgeries viz-appendectomy, hernia repair, cesarean section, abdominal hysterectomy and prostatectomy [23,25,29]. There are reports of using TAP block in laparoscopic surgery [30].

The controversy exists in currently available literature regarding level of block achieved by TAP Block. Few studies claim T7 to L1 spread with a single posterior injection making the block suitable for midline abdominal incisions; while some of them have failed to demonstrate a spread cephalad to T10 making it more suitable for lower abdominal surgery [31,32]. In a published report from a small cadaveric study, T11, T12 and L1 were found to be most consistently present in the transversus abdominis plane, while T10 was present in 50% of the cases [33].

Hence it can therefore be inferred that TAP block is capable of giving good analgesic effect in the region between T10 and L1 following a single posterior injection and to achieve higher block up to T7, it needs to be augmented with a subcostal injection.

10. Discussion

The management of post operative pain is usually suboptimally done. The multimodal approach of pain management as defined by the American Society of Anesthesiology (ASA) is, administration of two or more drugs that act by different mechanism for providing proper analgesia [34]. ASA recommendations include a round the clock regimen of acetaminophen, non selective or selective COX-2 inhibiting NSAID as well as regional block with local anesthetics [34,35]. The studies have confirmed that using local anesthetic decreases need for opioids and thereby limits opioid related adverse effect, while increases patient's satisfaction and decreases Length of hospital stay [36,37]. But the main concern about using local anesthetics is their short duration of analgesia which hardly lasts for 6–8 h [37].

Jankovic compared TAP block with rectus abdominis sheath, paravertebral and ilioinguinal/iliohypogastric blocks to clarify similarities and differences and concluded that TAP block holds considerable promise on account of its efficacy, low complication rate and simplicity. It should be used more often in everyday practice [24].

Bhanulakshmi et al. did a comparative study between ultrasound guided transversus abdominis plane (TAP) block versus intravenous diclofenac for post-operative analgesia in elective LSCS. They concluded that ultrasound guided TAP block can be easily and safely performed in lower abdominal surgeries for post-operative analgesia. TAP block is more effective in the early post-operative period. In their study there was significant decrease in requirement of opioids and also in pain scores in patients who received TAP block [38].

Saha et al. reported bilateral transversus abdominis plane catheters for continuous postoperative abdominal pain relief with intermittent boluses. They have placed TAP catheters under sonographic guidance with intermittent local anesthetic

boluses. They found that it offers a safe supplemental regional anesthetic that substantially decreases opioid requirements and provides satisfactory anesthesia after abdominal wall incisions [39].

Khan et al. studied USG guided TAP block in lower abdominal surgeries and found it efficient mode of analgesia in the intraoperative and immediate post operative period for patients undergoing lower abdominal surgeries (open appendectomy and inguinal hernia surgery) [40].

Sivapurapu et al. did comparison of analgesic efficacy of transversus abdominis plane block with direct infiltration of local anesthetic into surgical incision in lower abdominal gynecological surgeries. They concluded that TAP block is a promising technique in alleviating postoperative pain in patients undergoing lower abdominal gynecological surgeries especially when used as part of multi-modal analgesia regimen. The procedural simplicity of this block, along with reliable level of analgesia (T10–L1), longer duration as well as quality, with lesser opioid requirement and their side-effects makes the TAP block a good option for lower abdominal gynecological surgeries [12].

Petersen et al. did a Randomized Clinical Trial to study the beneficial effect of transversus abdominis plane block after laparoscopic cholecystectomy in day-case surgery. They concluded that patients who received TAP block in addition to a basic analgesic regimen with acetaminophen and ibuprofen after laparoscopic cholecystectomy had reduced pain scores while coughing as well as reduced morphine consumption in the first 2 postoperative hours, but these reductions were rather small. The procedure was without reported complications and may be considered as part of multimodal analgesic treatment for laparoscopic cholecystectomy in day-case surgery [20].

Yu et al. performed a systematic review and meta-analysis of randomized controlled trials on transversus abdominis-plane block (TAP) versus local anesthetic wound infiltration (LAI) in lower abdominal surgery. They found that TAP block is comparable to LAI for short-term analgesia; it could also provide better long-lasting analgesia especially at 24 h after surgery [4].

Kanojia and Ahuja in their study titled comparison of transversus abdominis plane block and caudal block for postoperative analgesia in children undergoing lower abdominal surgery concluded that duration of analgesia was significantly longer in children who received TAP block as compared to caudal block and it is a good alternative for providing postoperative analgesia [41].

El Fawy and El-Gendy studied ultrasound-guided transversus abdominis plane block versus caudal block for postoperative pain relief in infants and children undergoing surgical pyeloplasty. They concluded that unilateral TAP block provided superior analgesia compared with single caudal block injection in the first 24 postoperative hours after surgical pyeloplasty in infants and children aged 6 months to 6 years [42].

11. Conclusion

The transversus abdominis plane block is a novel technique for post operative analgesia especially in initial postoperative period. It has got potential to substitute the use of intravenous opioid analgesics and hence to avoid its complications. It has been proved to cater significant analgesic effect especially below T10 up to L1 level; hence, it is perfectly suited for use after lower abdominal and gynecological surgeries. The use of ultrasound guidance improves the outcome because of better localization of the plane for blockade. Prolonged analgesic effect can be achieved by continuous blockade using catheter for drug delivery, but it is technically more demanding. It can be used even for post operative analgesia in upper abdominal and laparoscopic surgeries but in those cases it has to be frequently used in conjunction with other blocks such as rectus sheath block, hence bears virtue to be used more frequently as a post operative analgesic technique and all the practicing anesthetics need to be familiar with this. There is still scope of long series of cases in which TAP blockade has been used, in order to bring out the various aspects of this procedure.

Conflict of Interest

Figs. 1 and 2 have been originally reproduced from JANKOVIC Z. Transversus abdominis plane block: The Holy Grail of anesthesia for (lower) abdominal surgery. PERIODICUM BIOLOGORUM 2009, 111(2): 203–208.

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