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Editorial II

Transversus abdominis plane block: what is its role in postoperative analgesia?

Over the past 3 yr, a series of studies have highlighted the value of the transversus abdominis plane (TAP) block, after the initial description of the technique by Rafi.[1] The technique involves injection of local anaesthetic solution into a plane between internal oblique (IO) and transversus abdominis (TA) muscles. This plane contains the thoracolumbar nerves originating from T6 to L1 spinal roots which supply sensation to the anterolateral abdominal wall. These multiple mixed segmental nerves branch and communicate as they run through the lateral abdominal wall between IO and TA muscles, within the TA fascial plane.[2]

The TAP block is performed usually bilaterally, within the ilio-lumbar triangle of Petit, bounded inferiorly by the iliac crest, posteriorly by the latissimus dorsi, and anteriorly by the external oblique (EO) muscles. The blunt technique uses a double-loss of resistance as the needle is advanced through the EO and IO fascia layers.[3] The aim is to place the tip of the needle between the IO and the TA muscles. It is not yet clear as to what the actual spread of the block is. Studies in cadavers and healthy volunteers suggest that a 20 ml solution spreads from the iliac crest to the costal margin and ensures a complete sensory blockade of the abdominal wall.[3] However, other studies have shown a more limited distribution of a dye solution injected in cadavers, extending from L1 to T10.[4] Although this technique is apparently safe, it may be difficult, especially in obese patients because of failure to identify the landmark of the triangle of Petit resulting in an incorrect location of the needle. In addition, damage to viscera (liver and bowel) may occasionally occur.[5]

Thus, despite the initial description of the block using the blind technique, it appears prudent to recommend the use of ultrasonography to make a more precise and safer approach. Although thin nerve structures are difficult to identify clearly with ultrasonography, it provides reliable images of the three parietal muscles, their fascia, the intraperitoneal cavity, and the digestive tract. A needle is usually advanced 'in-plane', parallel to the ultrasound probe that is itself placed along the axial plane above the iliac crest, caudal to the costal margin. Since the structures are quite superficial, a high-frequency (7.5–12 MHz) transducer probe can be used. The image can be optimized by sliding the probe anteriorly and posteriorly. After location of the needle tip, local anaesthetic solution ~15–20 ml is injected on both sides, resulting in non-echo surface extending between IO and TA.

The analgesic efficacy of the TAP block has been demonstrated in prospective randomized trials compared with placebo, in different surgical procedures such as abdominal surgery,[6] hysterectomy,[7] retropubic prostatectomy,[8] Caesarean section,[9] laparoscopic cholecystectomy,[10] and, in this issue of the *British Journal of Anaesthesia*, appendicectomy.[11] All the studies have reported superiority of the TAP block in terms of reduction in visual analogue scale scores and morphine consumption (Table 1). Careful examination of the results raises some questions. In two studies, authors suggest that the decrease in morphine consumption lasted for 2 days.[6 8] However, the figures describing morphine consumption show that although the difference in morphine consumption between patients receiving TAP block and those in the placebo group remained significant between 24 and 48 h, this difference was established during the first 24 h and remained stable thereafter. In addition, despite a statistically significant increase in the delay before the first analgesic request in TAP groups compared with placebo, the mean or median delay was about 2–3 h and may sometimes be even shorter (Table 1). These results could be interpreted in two ways. On one hand, it could be suggested that effective analgesia provided by a TAP block is of limited duration. On the other hand, one can argue that, though decreasing, the analgesic effect of the block persists for at least 24 h and that the block could be considered as an integral part of a multimodal analgesic strategy including systemic analgesic agents to control residual pain. The fact that block may contribute to decreasing the incidence of morphine side-effects such as nausea and vomiting is also beneficial to the patient's rehabilitation.

It is appropriate to consider the potential advantages and drawbacks of the TAP block. Potential advantages include that it is a simple and effective analgesic technique, appropriate for surgical procedures where parietal pain is a significant component of postoperative pain. It can be performed when neuroaxial blocks are

Table 1 Evaluation of TAP block in prospective comparative studies. Results are expressed as mean (SD) except for * corresponding to median (range)

	McDonnell (2007)	**McDonnell (2008)**	**Carney (2008)**	**El-Dawlatly (2009)**	**Niraj (2009)**
Surgical procedure	Abdominal surgery	Caesarean section (under spinal anaesthesia)	Abdominal hysterectomy	Laparoscopic cholecystectomy	Appendicectomy
Comparator (number of patients)	TAP block (16) *vs* no block (16)	TAP block (25) *vs* sham block (25)	TAP block (24) *vs* sham block (26)	TAP block (21) *vs* no block (21)	Unilateral TAP block (26) *vs* no block (26)
Local anaesthetic solution	Levobupivacaine 3.75 mg ml^{-1} (20 ml) on each side	Ropivacaine 7.5 mg ml^{-1} (15–20 ml) on each side	Ropivacaine 7.5 mg ml^{-1} (15–20 ml) on each side	Bupivacaine 5 mg ml^{-1} (15 ml) on each side	Bupivacaine 5 mg ml^{-1} (20 ml)
Time of lower VAS scores in TAP group (h)	24	6–12	48		24
Time to first request of morphine (min)	24.1 (6.9) *vs* 157.2 (27.9)	90 (55–190) *vs* 220 (150–380)*	12.5 (0–23) *vs* 45 (26–116)*		
Morphine requirement (mg)	21.9 (8.9) *vs* 80.4 (19.2) (24 h)	66 (26) *vs* 18 (14) (48 h)	55 (17) *vs* 27 (20) (48 h)	10.5 (7.7) *vs* 22.8 (4.4) (24 h)	50 (19) *vs* 28 (18) (24 h)

contraindicated, and it provides an alternative analgesic solution in that setting. Potential drawbacks include that a bilateral block is required in most surgical procedures, and, in addition, the duration of the block may be limited to a few hours and could be too short to guarantee a pain-free postoperative course. To avoid this disadvantage, a catheter could be placed for continuous local anaesthetic infusion but only on one side.

A further important point is that direct comparison with 'gold standard' analgesic techniques for each surgical procedure has not yet been performed. For abdominal surgery, a comparison with epidural analgesia and with continuous lidocaine i.v. infusion is required. For laparoscopic cholecystectomy and other surgical procedures that induce both parietal and visceral pain, other techniques could be more appropriate such as local anaesthetic instillation combined with infiltration. A comparison with those techniques should help clinicians to make their own choice according to the surgical procedure proposed. In patients undergoing abdominal hysterectomy, a comparison with continuous infiltration of the surgical incision would be of value. Similarly, the value of the block should be assessed in plastic surgery of the abdominal wall and parietal abdominal wall repair procedures such as umbilical hernia repair that only produce parietal postoperative pain. Last but not least, the current published series only include a limited number of patients. Although these are enough to assess the efficacy of the technique, they are insufficient for evaluation of safety and failure rate. More information needs to be collected to complete the picture of this technique and to determine accurately its place in the postoperative pain control.

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References

1 Rafi AN. Abdominal field block: a new approach via the lumbar triangle. *Anaesthesia* 2001; **56**: 1024–6

2 Rozen WM, Tran TMN, Ashton MW, Barrington MJ, Ivanusic JJ, Taylor GI. Refining the course of the thoracolumbar nerves. A new understanding of the innervations of the anterior abdominal wall. *Clin Anat* 2008; **21**: 325–33

3 McDonnell JG, O'Donnell BD, Farrell T, *et al*. Transversus abdominis plane block: a cadaveric and radiological evaluation. *Reg Anesth Pain Med* 2007; **32**: 399–404
4 Tran TMN, Ivasunic JJ, Hebbard P, Barrington MJ. Determination of spread of injectate after ultrasound-guided transverses abdominis plane block: a cadaveric study. *Br J Anaesth* 2009; **102**: 123–7
5 Farooq M, Carey M. A case of liver trauma with a blunt regional anesthesia needle while performing transversus abdominis plane block. *Reg Anesth Pain Med* 2008; **33**: 274
6 McDonnell JG, O'Donnell BD, Curley G, Heffernan A, Power C, Laffey JG. Analgesic efficacy of transversus abdominis plane (TAP) block after abdominal surgery: a prospective randomized controlled trial. *Anesth Analg* 2007; **104**: 193–7
7 Carney J, McDonnell JG, Ochana A, Bhinder R, Laffey JG. The transversus abdominis plane block provides effective postoperative analgesia in patients undergoing total abdominal hysterectomy. *Anesth Analg* 2008; **107**: 2056–60
8 O'Donnell BD, McDonnell JG, McShane AG. The transversus abdominis plane (TAP) block in open retropubic prostatectomy. *Reg Anesth Pain Med* 2006; **3**: 91
9 McDonnell JG, Curley G, Carney J, *et al*. The analgesic efficacy of transversus abdominis plane block after cesarean delivery: a randomized controlled trial. *Anesth Analg* 2008; **106**: 186–91
10 El-Dawlatly AA, Turkistani A, Kettner SC, *et al*. Ultrasound-guided transverses abdominis plane block: description of a new technique and comparison with conventional systemic analgesia during laparoscopic cholecystectomy. *Br J Anaesth* 2009; **102**: 763–7
11 Niraj G, Searle A, Mathews M, *et al*. Analgesic efficacy of ultrasound-guided transversus abdominis plane block in patients undergoing open appendicectomy. *Br J Anaesth* 2009; **103**: 601–5

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Editorial III

Do approved blood substitutes reduce myocardial infarction size: is this the critical question?

Independent laboratory investigations of haemoglobin-based oxygen carriers (HBOCs) have proven crucial for predicting ultimate success or failure of these compounds.[1] In fact, a first-generation HBOC, alpha-alpha cross-linked haemoglobin/2–3 dispirin cross-linked haemoglobin (HemAssist®, Baxter, Deerfield, IL, USA), failed clinical trials with significantly worse outcomes than controls, and this was predicted by pre-clinical models.[1] Just which models should evaluate these products is not clear, but multiple studies have documented validated models that demonstrate shock and resuscitation with numerous HBOCs [second generations, which were designed to eliminate the renal toxicity of the first generation, such as haemoglobin glutamer-200 bovine and haemoglobin glutamer-201 bovine (Oxyglobin® and Hemopure®, Biopure Corp., Cambridge, MA, USA)].[2 3] These two HBOCs are approved by the European Union and United States Food and Drug Administration for treatment of canine anaemia (Oxyglobin®) and in South Africa by the Medicine's Council for treatment of surgical anaemia in patients (Hemopure®). These studies and others have demonstrated clearly that the beneficial effect of these products may be due to hyperoncotic effects of the HBOCs tested and in part due to enhanced oxygen diffusive properties, and not necessarily increased oxygen delivery.[4 5]

In May 2008, a controversial meta-analysis was published in the *Journal of the American Medical Association*[6] that combined results then available to the authors, but not all subsequently published results.[7] Combined results from three generations of HBOCs, including a third-generation drug currently undergoing phase 3 testing in Europe (Hemospan, Sangart, San Diego, CA, USA), were analysed and the report claimed that morbidity and mortality were higher with all three generations of compounds. Two second-generation products which failed clinical testing (Hemolink™, Hemosol Inc., Toronto, Canada, and PolyHeme®, Northfield Laboratories, Evanston, IL, USA) and the failed first-generation HemAssist were included in this meta-analysis, which looked at subset data analyses, not primary or secondary endpoints. However, the study did highlight concern for cardiac safety with these products, and the need for basic science models specifically to look at the issue of cardiac ischaemia and infarct.[6]

Rempf and colleagues[8] in this issue of the *British Journal of Anaesthesia* should be congratulated for making a serious attempt to create and then validate a cardiac ischaemia and infarct model with the approved veterinary product, Oxyglobin®. It is precisely these types of models and the above hypovolaemia/shock/resuscitation oxygen delivery models that must be applied to the products currently being tested and future generation HBOCs that are designed to avoid the nitric oxide scavenging and systemic and pulmonary hypertension seen with the first two generations of HBOCs.

Although the methods and results are compelling and appear to validate the need for further testing of this HBOC and the related human equivalent (Oxyglobin® and Hemopure®) in this arena, there are a number of issues with the protocol and design of the Rempf study that warrant