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Review

Transversus abdominis plane (TAP) blocks—A review

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ABSTRACT

Introduction: Effective post-operative pain management can positively influence patient outcome. Multimodal analgesic regimes are often limited by side-effects. Epidural analgesia may be resource-consuming, restrict mobility and have negative cardiovascular and gastrointestinal consequences. Consequently, there is a need for regional anaesthetic techniques to minimise opioid use, and provide alternatives to epidurals, especially within the context of minimally invasive abdominal surgery and enhanced recovery programmes. This review aims to evaluate the evidence base underlying Transversus abdominis plane (TAP) blockade.

Methods: A literature search was performed using the PubMed database (http://www.ncbi.nlm.nih.gov/pubmed/) using the parameters 'transversus abdominis plane' and 'TAP'. The references within were then searched for applicable studies. Case reports and correspondence were excluded.

Findings: Thirteen studies assessed technique and mechanisms of action. Fourteen clinical studies involved a total of 1250 patients. Seven studies (6 Randomised Controlled Trials, RCTs) demonstrated reductions in post-operative morphine requirements (33.3%–73.1%). Five RCTs demonstrated concomitant improvements in pain scores. Five RCTs demonstrated reduced opioid side effects. The one study assessing functional outcome (a Prospective Controlled Trial, PCT) demonstrated earlier return of gastrointestinal function and hospital discharge.

Conclusion: The limited evidence to date suggests that TAP blockade is an effective adjunct to multimodal post-operative analgesia following a range of abdominal surgical procedures. Whether TAP blocks are a viable alternative to epidural analgesia remains to be determined. However, it is likely that as this technique grows in popularity its role, particularly that in enhanced recovery programmes, will be better delineated and refined.

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Introduction

Anterior abdominal wall incisions cause considerable post-operative pain,[1] an important variable in the surgical stress response and outcome.[2,3] Whilst reduced by minimal access surgery,[4] effective analgesic regimes are still paramount. Consequently, parenteral opioids are widely used, often as patient-controlled analgesia (PCA).[5] However, their efficacy is often limited by side effects, including suppression of gastrointestinal function.[6,7] Consequently, local anaesthetic blockade (either centrally or peripherally) is often used as an alternative or supplementary measure. Central neuraxial blockade, such as epidural analgesia, is commonly used after major abdominal surgery.[8] It improves pain scores and reduces respiratory failure (by 7%) as compared with PCA[9,10] Overall benefits may be small, with one study reporting a number-needed-to-treat of 477 to reduce overall 30 day mortality.[11] Other studies have found no benefit[12]; indeed, ineffective epidural analgesia may contribute to vasoparesis, hypotension and splanchnic hypoperfusion[13] with potentially greater morbidity.[14] In some, epidurals may be contra-indicated, for example the coagulopathic and septic.[15] Therefore, there is a need for viable alternatives; potential candidates include peripheral nerve blocks, for example of the transversus abdominis plane (TAP).[16]

The TAP is a neurofascial plane in the anterior abdominal wall lying between internal oblique and transversus abdominis. The terminal branches of the lower six thoracic and first lumbar nerve lie within, providing somatic innervation of the anterior and lateral abdominal wall. Ramification and communication (causing overlap of dermatomes), forms the TAP plexus running with the deep circumflex artery.[17] TAP blockade has recently become popular, encouraged by evidence suggesting it is safe and effective. This review aimed to critically appraise this evidence.

Methods

A literature search was performed using the PubMed database (http://www.ncbi.nlm.nih.gov/pubmed/) using the parameters 'transversus abdominis plane' and 'TAP'. Letters and case reports were excluded. The references within all articles were then searched for applicable studies. Thirty five articles were identified. Fourteen clinical studies were included: ten double-blind randomised controlled trials (RCTs), two non-randomised prospective controlled trials (PCTs), and two retrospective case controlled studies (Table 1).

Results

Studies assessing techniques

The original landmark technique was described by Rafi in 2001.[18] This involves identifying the lumbar triangle of Petit (bounded inferiorly by the iliac crest, posteriorly by latissimus dorsi and anteriorly by external oblique). A needle is introduced with two losses of resistance (external and internal oblique fascia respectively). Rarely, visceral injuries occur.[19,20] However, the triangle is absent in 17%,[21] and its location highly variable, small[22] and difficult to locate in the obese.[18]

Subsequently, Hebbard described an ultrasound-guided technique.[23] This has gained popularity[24] and been adapted for paediatric[25] and neonatal use.[26] Hebbard then described the oblique subcostal approach near the xiphoid, to optimise supra-umbilical analgesia, potentially missed with a conventional TAP block.[27] A 'multi-injection' technique, with anaesthetic injected in multiple aliquots to maximise spread via hydrodissection has been described, as have continuous infusion via subcutaneous catheter,[28,29] and intra-operative blocks under vision.[30]

Anatomical studies

Three cadaveric studies have assessed the deposition of dye, using landmark[31] and ultrasound[32,33] techniques. Overall spread was less with ultrasound.[31,32] In the former study a lower block (T11-L1) was found, with no involvement of T7-9. In another study, multiple injections were more effective than single.[33]

Clinical studies assessing efficacy

Four small uncontrolled experimental studies have assessed efficacy in volunteers. The first, using the landmark technique and radio-opaque dye, demonstrated T7-L1 blockade in all of three volunteers; one reported loss to T4.[31] Blockade was maximal at 90 min, diminished after 4 h and persisted for 24 h. This correlated dye signal intensity on magnetic resonance imaging (MRI). On MRI and computed tomography (CT), dye spread widely within the TAP, from iliac crest to costal margin and posteriorly to quadratus lumborum. In two studies the ultrasound technique provided minimal block above T10,[27,34] and in one there was 50% failure of L1 blockade.[35] These discrepancies between techniques may represent differing locations of injection.[32]

Pharmacokinetic studies

Two studies have assessed serum local anaesthetic concentrations[36,37] ($n = 40$ total). Both found clinically significant increases with the maximum weight-dependent dose. Potentially toxic (but asymptomatic) levels occurred in 11, although comparable to other local anaesthetic blocks. Theoretically, the TAP is avascular, therefore systemic absorption must be due to misplaced injection or spread beyond the TAP.

Comparative clinical studies

Study characteristics and design are presented in Table 1.

Techniques

Blocks were administered bilaterally in twelve and unilaterally in two studies.[38,39] Five used a landmark technique,[38,40–43] six ultrasound,[39,44–48] one a combination[49] and two intra-