

Transversus Abdominis Plane Block versus Quadratus Lumborum Block for Postoperative Pain in Abdominal Surgery: A Systematic Review and Meta-analysis

Utsav Malla¹, Nathan Murray¹, Ruan Vlok^{2,3}, Thomas Melhuish^{4,5}, Willem Basson¹, Leigh White^{1,6*}

Background: Regional anaesthesia for the prevention and minimization of postoperative pain aims to decrease postoperative pain, opioid consumption and patient controlled analgesia (PCA) requirements. Quadratus Lumborum (QL) blockade and Transversus Abdominis Plane (TAP) blockade are two options for regional anaesthesia following abdominal surgery. The aim of this systematic review was to compare the efficacy of QL versus TAP blockade for management of postoperative pain in abdominal surgery.

Methods: A systematic review of 5 databases (Pubmed, Web of Science, SCOPUS, Medline and CINAHL) was performed. Studies comparing QL block to TAP block for postoperative pain management in abdominal surgery were included. The primary outcome was pain postoperatively. Secondary outcomes included time to rescue analgesia, adverse effects and morphine consumption.

Results: Four studies with a total of 188 patients were included in the final review. A significant reduction in postoperative pain was identified with QL blockade by -0.42 (95%CI= -0.67 to -0.17 ; I²= 94%; $p=0.001$). Two high quality studies showed a significant reduction in 24-hour morphine consumption when utilising QL blocks (13.63 mg; 95%CI= 1.48 to 25.78 mg; I²= 98%; $p=0.03$). However, this review identified no significant difference in time to breakthrough analgesia of 459.69 minutes with QL block (95%CI= -85.33 to 1004.71; I²= 100%; $p=0.10$). The incidence of adverse effects was similar between the two blocks.

Conclusion: QL blockade leads to a significant reduction in 24-hour morphine consumption and postoperative pain scores, with no increase in adverse event rates. Therefore, QL blockade is likely a preferable regional analgesic technique to TAP blockade, but further large randomised controlled trials are required to confirm these findings.

keywords: quadratus lumborum; transversus abdominis plane; pain; abdominal surgery

Effective early postoperative analgesia decreases the incidence of chronic postoperative pain [1]. Regional anaesthesia allows for decreased postoperative opioid requirements with subsequent decreased opioid related adverse effects and complications [2-3] and has been directly associated with a decreased incidence of chronic postoperative pain [4]. Advances such as ultrasonography have led to regional anaesthesia becoming a rapidly developing field, and many techniques' clinical implications are continuously being described.

Reliable analgesia following regional anaesthesia for abdominal surgery remains difficult. A variety of techniques

are available, two of which include Transversus Abdominis Plane (TAP) blockade and Quadratus Lumborum (QL) blockade.

TAP blocks are a relatively recent development in regional anaesthesia [5-6] and entail the infiltration of local anaesthesia into the neurofascial plane between the internal oblique and transversus abdominis muscles. A review of TAP block for postoperative pain by Jakobsson et al, which looked at 11 meta-analyses, has found a clear opioid-sparing effect and markedly less 24 and 48-hour postoperative morphine consumption in abdominal surgery when compared to a placebo or no TAP block. This same review found a markedly lower cumulative morphine requirement as well as a significantly extended time until rescue morphine in laparoscopic cholecystectomies, caesarean sections with Pfannesnstiel incisions, bowel resections with midline incisions and total abdominal hysterectomies [7].

Blanco et al recently introduced the QL block as a variation of the TAP block, suggesting it to be a reliable approach for minimising post abdominal surgery pain [8]. TAP blockade is a block of the anterior abdominal wall and has huge inter-individual variability in its distribution of blockade and its field of coverage [7,9]. While searching for a block with a greater distribution and a longer lasting analgesic affect, the QL block was developed. The QL blockade is a block of the posterior abdominal wall where anaesthetic is injected

From the ¹Department of Anaesthesia and Pain Medicine, Sunshine Coast University Hospital, QLD, Australia.

²Wagga Wagga Base Hospital, NSW, Australia.

³School of Medicine Sydney, University of Notre Dame Australia, NSW, Australia.

⁴School of Medicine, University of New South Wales, NSW, Australia.

⁵Department of Intensive Care Medicine, Royal Prince Alfred Hospital, NSW, Australia.

⁶School of Medicine, University of Queensland, QLD, Australia.

Received: 2 Jun 2018, Revised: 24 Jun 2018, Accepted: 8 July 2018

The authors declare no conflicts of interest.

*Corresponding author: Leigh White, MD. Department of Anaesthesia and Pain Medicine, Sunshine Coast University Hospital, QLD, Australia. E-mail: lw844@uowmail.edu.au

Copyright © 2018 Tehran University of Medical Sciences

adjacent to the anterolateral aspect of the Quadratus Lumborum muscle and its fascia. This block is presently utilized for a wide variety of patient populations (paediatrics, adults and pregnant women) who are undertaking abdominal surgery [10-11,15]. Whilst there have been numerous systematic reviews comparing TAP blockade to placebos, Quadratus Lumborum blockades to placebos and TAP and QL blockades to other types of analgesia (for example infiltration analgesia, spinal analgesia), currently, there have been no systematic reviews directly comparing the efficacy of Quadratus Lumborum blockade and Transversus Abdominis Plane blockade.

The aim of this study was to compare the analgesic efficacy of TAP blockade versus QL blockade post abdominal surgery by performing a systematic review and meta-analysis. This study also aims to assess the association between these procedures and analgesic requirements and adverse effects.

Methods

Search Strategy

A systematic search of the following databases was performed: Pubmed, Web of Science, SCOPUS, Medline and CINAHL using the terms (1) Quadratus lumborum, (2) Transversus abdominis plane OR TAP, AND (3) Abdominal surgery. Results included papers up to May 2018. A manual search was also incorporated into the search strategy to identify other potentially missed reviews and studies. Every step in the search process was performed by two independent searchers (UM and LW).

Inclusion Criteria

A study was included in the systematic review if the authors reported on the clinical outcome of post-operative pain. All study designs were considered for inclusion. Two independent reviewers (UM and LW) collaborated to decide on each study's suitability for inclusion into the systematic review.

Data extraction

Studies that met the inclusion criteria were analysed by two independent reviewers (UM and LW) who extracted the data and collaborated to assure homogeneity. The data extracted included the following items: Number of patients in the study, patient groups/demographics, indications for the regional anaesthesia and the clinical outcomes.

Level of Evidence, Risk of Bias & Outcome Level of Evidence Ranking

Articles were assessed according to the Centre for Evidence Based Medicine (CEBM): Levels of Evidence Introduction Document [12]. The Cochrane Collaboration's tool for assessing the risk of bias was utilized to evaluate for risk of bias and quality of the methodology [13-14].

Statistical Analyses

The collective data was analysed using RevMan 5.3 software (The Nordic Cochrane Centre, Copenhagen, Denmark). The relative risk (RR) with 95% confidence interval (CI) for dichotomous outcomes, and the weighted mean difference (WMD) with 95% CI for continuous outcomes. The Mantel-Haenszel (M-H) random effects model was utilized. Heterogeneity was assessed using the I² statistic, with an I²>50% indicating significant heterogeneity. P value of <0.05 provided evidence of

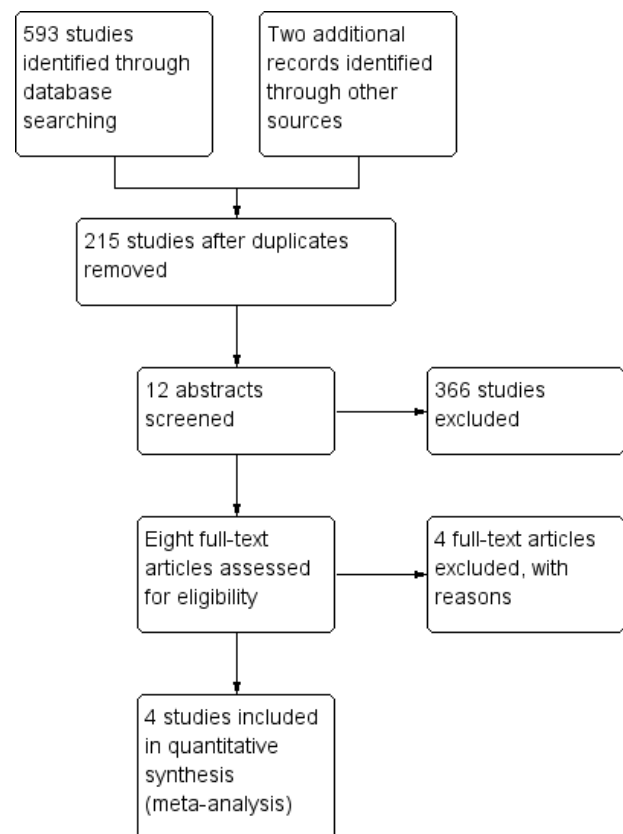
significant RR and WMD. A p value of <0.10 was used to demonstrate heterogeneity of intervention effects.

Results

Literature Search Results

The initial systematic literature search yielded 593 citations, of which twelve were retrieved for review. These articles were selected for retrieval based on a review of their abstract, which appeared to meet the search criteria. Of these twelve articles, four met the inclusion criteria (Figure 1). These four studies included 188 patients with the indication for abdominal surgery (Table 1). Each study was then screened for risk of bias and methodological quality using the Cochrane Collaboration's tool for assessing the risk of bias (Figure 2). Three were rated high quality and one low quality.

Figure 1- Study identification algorithm. This diagram outlines the filtering process from the literature search through to study inclusion.



Outcomes:

Two high quality and one low quality study found no significant difference in time to breakthrough analgesia of 459.69 minutes with quadratus lumborum block (95%CI= -85.33 to 1004.71; I²= 100%; p=0.10); (Figure 3). Two high quality studies showed a significant reduction in 24-hour morphine consumption (13.63 mg; 95%CI= 1.48 to 25.78 mg; I²= 98%; p=0.03).

Two high quality studies measured pain scores, overall there was a significant reduction with quadratus lumborum blockade by -0.42 (95%CI= -0.67 to -0.17; I²= 94%; p=0.001); (Figure 4). The time points where quadratus lumborum blockade had a significant reduction in pain

scores compared to TAP blockade were one hour (WMD= -0.80; 95%CI= -1.27 to -0.34; I2= 77%; p=0.0007); (Figure 4) and two hours (WMD= -0.89; 95%CI= -1.61 to -0.81; I2=93%; p=0.01); (Figure 4). The reductions in pain scores at four, six, twelve and twenty-four hours were non-significant (p>0.05); (Figure 4).

Three of the four studies investigated the incidence of

adverse effects such as nausea, vomiting, respiratory depression, hypotension and sedation. There were no adverse effects recorded in any of the studies. One study investigated patient satisfaction showing a significant improvement with quadratus lumborum blockade compared to TAP blockade.

Figure 2- Screening of bias and methodological quality based on the Cochrane Collaboration’s tool for assessing the risk of bias

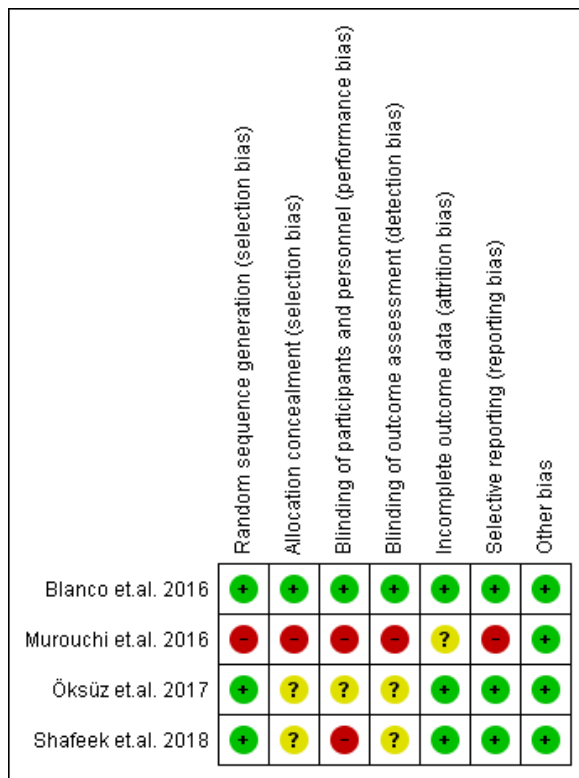


Table 1- Study Characteristics

Study	Number of Patients (QL/ TAP)	Patient Group	Indication	Outcome(s)	Level of Evidence*
Blanco et.al. 2016	38/38	Adults	Laprosopic Bariatric Surgery	Morphine Consumption Adverse Effects	1
Murouchi et.al. 2016	11/11	Adults	Laprosopic Surgery	Time to Rescue Analgesia	3
Öksüz et.al. 2017	20/20	Adults	Caesarean Section	Time to Rescue Analgesia Pain Scores Patient Satisfaction Adverse Effects	1
Shafeeket.al. 2018	25/25	Paediatrics	Lower Abdominal Surgery	Time to Rescue Analgesia Morphine Consumption Pain Scores Adverse Effects	1

*Level of Evidence assessed using the Centre for Evidence Based Medicine (CEBM): Levels of Evidence Introduction Document [12]. TAP= Transversus Abdominus; QL= Quadratus Lumborum

Figure 3- Time to breakthrough analgesia [16,17,18].

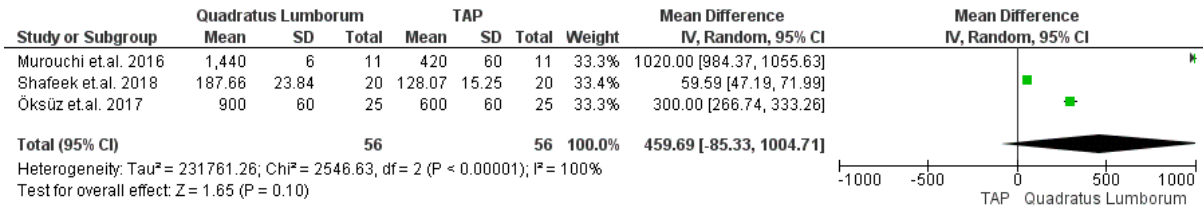
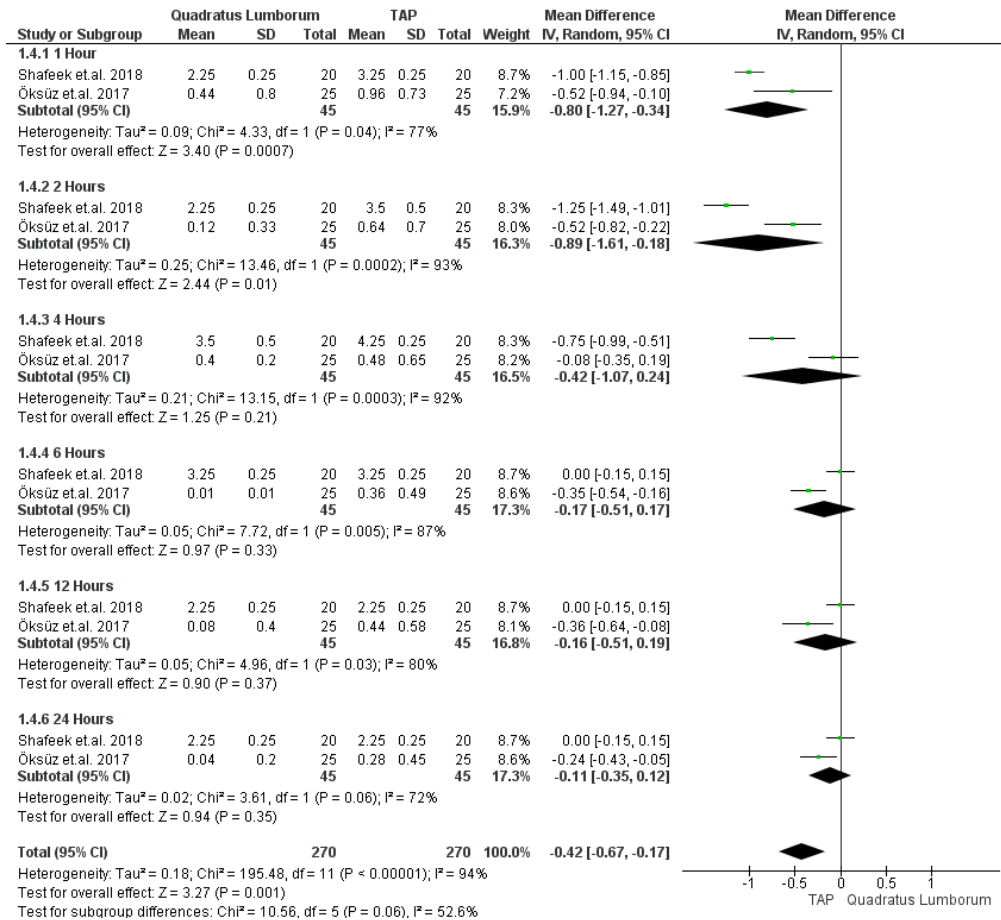


Figure 4- Postoperative pain scores.



Discussion

This was the first meta-analysis performed to compare the efficacy and adverse effects of quadratus lumborum blockade with TAP blockade in abdominal surgery. From the search conducted, four studies with 188 patients were found. Of these three were high quality, two in adult patients and one paediatric patients. The other was a low quality study in adult patients. Three measures of analgesia were common to the four studies, this included time to breakthrough analgesia, morphine consumption and pain scores. All three measures favoured quadratus lumborum blockade, however only morphine consumption and pain scores were statistically significant.

Interestingly, all of the individual studies showed a significant increase in time to breakthrough analgesia with quadratus lumborum. This was not reflected in overall analysis. The loss of statistical significance in our analysis was related to the high degree of variation in effect sizes.

This is supported by a heterogeneity of 100% on I2 analysis. This did however translate into a significant reduction in morphine consumption by 13.63 mg and a significant reduction in pain scores over one, two and the aggregate of twenty-four hours. With pain scores being lower at all other time points without statistical significance. Currently the exact mechanism of action of quadratus lumborum blockade remains uncertain. The leading theory is that there is greater proximity to the paravertebral space, which may potentially result in a denser inhibition of common pathway nerve roots [15-17].

Importantly, this improvement in analgesic effect was accompanied by no increase in the negligible rate of adverse effects. Given that these two blocks are essentially the same, but in two different planes this makes sense. The only theoretic disadvantage in relation to potential adverse effects could be related to the fact that a quadratus lumborum block is infiltrated into a fascial plane where vessels exit from the paravertebral space [15,18]. This then could result in

paravertebral haematomas and infections. This potential complication has yet to be established in the literature to our knowledge. Given the current opioid epidemic and significant adverse effects of opioid analgesia [19-21], the results of this study are important in highlighting the significant benefits of regional analgesia, especially the quadratus lumborum block.

There are several significant limitations to this review. The most prominent limitation is the lack of available studies and limited patient population. These results in the present study included both adult and paediatric populations with a wide variety of abdominal surgeries and incision types. Furthermore, the comparisons made between these studies were limited by the lack of consistency in outcome reporting. Of the comparisons that were made, it is questionable whether the individual studies were adequately powered to detect significant differences, particularly in the rates of adverse effects.

In conclusion, we have found that quadratus lumborum blockade leads to a significant reduction in morphine consumption and post operative pain scores, with no increase in adverse event rates. We do urge caution when interpreting these results due to the very small heterogenous patient population. Therefore, quadratus lumborum blockade is likely a preferable regional analgesic technique to TAP blockade, but further large randomised controlled trials are required to confirm these findings.

References

- Macrae WA. Chronic post-surgical pain: 10 years on. *Br J Anaesth*. 2008; 101(1):77-86.
- Elizaga AM, Smith DG, Sharar SR, Edwards WT, Hansen ST Jr. Continuous regional analgesia by intraneural block: Effect on postoperative opioid requirements and phantom limb pain following amputation. *J Rehabil Res Dev*. 1994; 31(3):179-87.
- Johns N, O'Neill S, Ventham NT, Barron F, Brady RR, Daniel T. Clinical effectiveness of transversus abdominis plane (TAP) block in abdominal surgery: a systematic review and meta-analysis. *Colorectal Dis*. 2012; 14(10):e635-42.
- Andreae MH, Andreae DA. Regional anaesthesia to prevent chronic pain after surgery: a Cochrane systematic review and meta-analysis. *Br J Anaesth*. 2013; 111(5):711-20.
- McDonnell JG, O'Donnell BD, Farrell T, Gough N, Tuite D, Power C, et al. Transversus abdominis plane block: a cadaveric and radiological evaluation. *Reg Anesth Pain Med*. 2007; 32(5):399-404.
- Rafi AN. Abdominal field block: a new approach via the lumbar triangle. *Anesthesia*. 2001; 56(10): 1024-6.
- Jakobsson J, Wickerts L, Forsberg S, Ledin G. Transversus abdominal plane (TAP) block for postoperative pain management: a review. *F1000Res*. 2015; 4.
- Blanco R. Tap block under ultrasound guidance: the description of a "no pops" technique: 271. *Reg Anesth Pain Med*. 2017; 32(5):130.
- Akerman M, Pejicic N, Velickovic I. A Review of the Quadratus Lumborum Block and ERAS. *Front Med (Lausanne)*. 2018; 5: 44.
- Kadam VR. Ultrasound-guided quadratus lumborum block as a postoperative analgesic technique for laparotomy. *J Anaesthesiol Clin Pharmacol*. 2013; 29(4): 550-2.
- Ueshima H, Otake H, Lin JA. Ultrasound-Guided Quadratus Lumborum Block: An Updated Review of Anatomy and Techniques. *BioMed Research International*. 2017; 2017.
- Howick J, Chalmers I, Glasziou P, Greenhalgh T, Heneghan C, Liberati A, Moschetti I, Phillips B, Thornton H. The 2011 Oxford CEBM Levels of Evidence (Introductory Document). Oxford Centre for Evidence-Based Medicine. 2011; <http://www.cebm.net/index.aspx?o=5653>. Accessed 09/05/2015.
- Julian PT and Douglas G Altman. Chapter 8: Assessing risk of bias in included Studies. *Cochrane Database*. 2008; http://hiv.cochrane.org/sites/hiv.cochrane.org/files/uploads/Ch08_Bias.pdf. Accessed 09/05/2015.
- Higgins JP, Altman DG, Gotzsche PC, Juni P, Moher D, Oxman AD, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *BMJ*. 2011; 343:d5928.
- Blanco R, Ansari T, Riad W, Shetty N. Quadratus Lumborum Block Versus Transversus Abdominis Plane Block for Postoperative Pain After Cesarean Delivery: A Randomized Controlled Trial. *Reg Anesth Pain Med*. 2016; 41(6):757-62.
- Murouchi T, Iwasaki S, Yamakage M. Quadratus Lumborum Block: Analgesic Effects and Chronological Ropivacaine Concentrations After Laparoscopic Surgery. *Reg Anesth Pain Med*. 2016; 41(2):146-50.
- Shafeek AM, Gomaa GA, AbdElmalek FA. A Comparative Study between Ultrasound Guided Quadratus Lumborum Block versus Ultrasound Guided Transversus Abdominis Plane Block in Laparoscopic Bariatric Surgery. *The Egyptian Journal of Hospital Medicine*. 2018; 70(12):2090-199.
- Öksüz G, Bilal B, Gürkan Y, Urfalıoğlu A, Arslan M, Gişi G, et al. Quadratus Lumborum Block Versus Transversus Abdominis Plane Block in Children Undergoing Low Abdominal Surgery: A Randomized Controlled Trial. *Reg Anesth Pain Med*. 2017; 42(5):674-679.
- White LD, Hodge A, Vlok R, Hurtado G, Eastern K, Melhuish TM. Efficacy and adverse effects of buprenorphine in acute pain management: systematic review and meta-analysis of randomised controlled trials. *Br J Anaesth*. 2018; 120(4):668-78.
- Vlok R, An GH, Binks M, Melhuish T, White L, et al. Sublingual buprenorphine versus intravenous or intramuscular morphine in acute pain: A systematic review and meta-analysis of randomized control trials. *Am J Emerg Med*. 2018; pii: S0735-6757(18)30433-9.
- White L, Vlok R, Melhuish T. Case 37-2017: A Man with Unintentional Opioid Overdose. *N Engl J Med*. 2018. 378 (9), 872-873.