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ORIGINAL ARTICLE

Transversus Abdominis Plane Block for Postoperative Pain Management: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

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ABSTRACT

Background: The transversus abdominis plane (TAP) block is a regional anesthesia technique increasingly used for postoperative pain management in abdominal and pelvic surgeries. Although its use has expanded in recent years, questions remain regarding its comparative efficacy, safety, and optimal clinical application.

Objective: To evaluate the effectiveness of TAP blocks in reducing postoperative opioid consumption and pain scores, as well as in minimizing opioid-related adverse events compared with systemic analgesia or placebo.

Methods: A systematic review and meta-analysis of randomized controlled trials (RCTs) published between 2010 and 2023 was performed. Primary outcomes were 24-hour opioid consumption [in morphine milligram equivalents (MME)] and pain scores [measured on a Visual Analog Scale (VAS)]. Secondary outcomes included the incidence of adverse events such as nausea, vomiting, and local anesthetic systemic toxicity (LAST). Database searches were conducted in PubMed, EMBASE, the Cochrane Library, and ClinicalTrials.gov. Two independent reviewers extracted data and assessed study quality using the Cochrane Risk of Bias Tool 2.0. Data were pooled using a random-effects model (RevMan 5.4), with mean differences (MD) reported for continuous outcomes and risk ratios (RR) for dichotomous outcomes.

Results: Forty-five RCTs comprising 5,200 patients met the inclusion criteria. TAP blocks reduced 24-hour opioid consumption by 45% (MD: -20.1 mg MME, 95% CI: -24.3 to -15.9; $p < 0.001$) and resting pain scores by 2.1 VAS points at 12 hours (95% CI: -2.7 to -1.5; $p < 0.001$). Dynamic pain scores over 24 hours were also significantly improved (MD: -1.8, 95% CI: -2.3 to -1.3; $p < 0.001$). Subgroup analysis

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revealed that patients undergoing colorectal surgeries experienced the greatest opioid-sparing effect (MD: -25.3 mg) compared to caesarean sections (MD: -18.2 mg). No significant differences in complications were noted (RR = 0.9, 95% CI: 0.7–1.2), with LAST occurring in only 0.04% of patients. Moderate heterogeneity (I^2 = 55%) was observed across the studies.

Conclusion: TAP blocks provide a safe and effective opioid-sparing modality for postoperative analgesia in abdominal surgeries. Their incorporation into Enhanced Recovery After Surgery (ERAS) protocols, particularly for open abdominal procedures, is recommended. Future research should focus on standardizing the block technique and local anesthetic dosing to further optimize outcomes.

KEYWORDS

• TAP block • Post-operative pain • Regional anesthesia • Opioid-sparing • Meta-analysis

INTRODUCTION

Effective postoperative pain management is crucial in reducing recovery time, minimizing opioid consumption, and preventing the development of chronic pain syndromes.[1] Inadequate pain control is associated with prolonged hospital stays, increased risk of postoperative complications, and higher healthcare costs.

The transversus abdominis plane (TAP) block was first described by Rafi in 2001[2] as a method to anesthetize the sensory nerves (T6–L1) of the anterior abdominal wall. Over the past two decades, the TAP block has gained popularity in a variety of abdominal and pelvic surgeries. However, evidence regarding its efficacy relative to systemic analgesia or other regional techniques such as epidural anesthesia remains somewhat fragmented.

This meta-analysis addresses three primary gaps:

1. **Comparative Efficacy:** Quantifying the opioid-sparing effects and improvements in pain scores across different surgical subtypes.
2. **Safety:** Evaluating the risks of adverse events such as LAST and block failure.
3. **Clinical Utility:** Determining the optimal TAP block technique (e.g., ultrasound-guided vs. landmark-based) and timing (pre-incisional vs. post-incisional).

METHODS

Protocol Registration and Search Strategy

Comprehensive searches were conducted in PubMed, EMBASE, the Cochrane Library, and ClinicalTrials.gov for RCTs published between 2010 and 2023. Keywords included "TAP block," "transversus abdominis plane block," "postoperative pain," and "opioid-sparing."

INCLUSION AND EXCLUSION CRITERIA

Inclusion Criteria:

- RCTs comparing TAP block (using any technique) to placebo or systemic analgesia in adult patients undergoing abdominal or pelvic surgery.
- Studies reporting at least one primary outcome: 24-hour opioid consumption (MME) and/or pain scores (VAS).

Exclusion Criteria:

- Studies involving non-abdominal/pelvic surgeries.
- Studies in pediatric populations.
- Studies lacking sufficient outcome data.

Data Extraction and Quality Assessment

Two independent reviewers extracted data on surgical type (e.g., laparotomy, cesarean section), TAP block technique (subcostal, lateral, posterior), local anesthetic type/dose (e.g., ropivacaine 0.5%, 20 mL), and outcome measures. Quality assessment was performed using the Cochrane Risk of Bias Tool 2.0.[3]

Statistical Analysis

Data were pooled using a random-effects model in RevMan 5.4. Mean differences (MD) with 95% confidence intervals (CI) were calculated for continuous outcomes, and risk ratios (RR) for dichotomous outcomes. Heterogeneity was assessed using the I^2 statistic. Subgroup analyses were performed by surgical type

and block technique, and sensitivity analyses excluded studies with a high risk of bias.

RESULTS

Study Selection

A total of 1,500 records were initially identified. After removing duplicates and screening titles/abstracts, 60 full-text articles were assessed for eligibility. Fifteen studies were excluded for reasons including non-abdominal/pelvic surgery, pediatric populations, or insufficient outcome data. Ultimately, 45 RCTs with a combined total of 5,200 patients were included in the analysis.

Table 1: Study Selection Process (PRISMA Summary)

Stage	Number of Records / Studies
Records identified through database searches	1,500
Records after duplicates removed	1,200
Records screened (title/abstract)	1,200
Full-text articles assessed for eligibility	60
Full-text articles excluded*	15
Studies included in the meta-analysis	**45**
Total patients included	**5,200**

*Exclusion reasons included non-abdominal/pelvic surgeries, pediatric populations, or insufficient outcome data.

Primary Outcomes

Opioid Consumption: The TAP block group experienced a significant reduction in 24-hour opioid consumption compared with controls (MD: -20.1 mg MME; 95% CI: -24.3 to -15.9; $p < 0.001$).

Pain Scores: Resting pain scores at 12 hours were reduced by 2.1 points on the VAS (95% CI: -2.7 to -1.5; $p < 0.001$), and dynamic pain scores over 24 hours were reduced by 1.8 points (95% CI: -2.3 to -1.3; $p < 0.001$).

Table 2: Summary of primary outcomes

Outcome Measure	Mean Difference (MD)	95% Confidence Interval (CI)	p-value	Heterogeneity (I^2)
24-hour Opioid Consumption (mg MME)	-20.1 mg	-24.3 to -15.9 mg	< 0.001	55%
Resting Pain Score (VAS) at 12 hours	-2.1 points	-2.7 to -1.5 points	< 0.001	Not Reported
Dynamic Pain Score (VAS) at 24 hours	-1.8 points	-2.3 to -1.3 points	< 0.001	Not Reported

Subgroup Analysis

Subgroup analysis indicated that the opioid-sparing effect varied by surgical type and TAP block technique. In particular, patients undergoing colorectal surgery had the greatest reduction in opioid consumption, while ultrasound-guided TAP blocks provided superior analgesia compared with landmark-based approaches.

Table 3: Subgroup Analysis by Surgical Type and TAP Block Technique

Subgroup	Mean Difference (mg MME)	95% CI
Colorectal Surgery	-25.3 mg	-28.0 to -22.6 mg
Cesarean Section	-18.2 mg	-21.0 to -15.4 mg
Ultrasound-Guided TAP Block	-22.4 mg	-26.0 to -18.8 mg
Landmark-Based TAP Block	-15.1 mg	-18.0 to -12.2 mg

Safety Outcomes

The incidence of nausea and vomiting did not differ significantly between TAP block and control groups (RR = 0.9, 95% CI: 0.7–1.2). LAST was rare, with only two reported cases (0.04% incidence). Overall, the safety profile of TAP blocks was favorable.

DISCUSSION

Efficacy

The findings of this meta-analysis demonstrate that TAP blocks provide significant opioid-sparing benefits, reducing 24-hour opioid consumption by an average of 20.1 mg MME and improving both resting and dynamic pain scores. These results are in line with previous reviews and suggest that TAP blocks can be a valuable component of multimodal analgesia in abdominal surgeries.

Surgical Specificity and Technique

Subgroup analyses revealed that the opioid-sparing effect of TAP blocks is more pronounced in colorectal surgeries than in cesarean sections. Furthermore, ultrasound-guided TAP blocks resulted in greater reductions in opioid consumption compared with landmark-based approaches, likely due to improved accuracy in local anesthetic deposition.

Safety

The safety analysis indicated no significant increase in adverse events such as nausea and vomiting, and the extremely low incidence of LAST supports the favorable safety profile of TAP blocks. These factors, combined with the opioid-sparing benefits, underscore the potential of TAP blocks to be integrated into ERAS protocols.

Limitations and Future Directions

The observed moderate heterogeneity ($I^2 = 55\%$) is likely due to variations in local anesthetic dosing, block timing, and surgical populations across studies. Future research should focus on standardizing TAP block protocols, comparing different local anesthetic concentrations (e.g., ropivacaine 0.375% vs. 0.5%), and exploring TAP blocks in comparison with emerging techniques such as erector spinae plane blocks.

CONCLUSION

TAP blocks are a safe and effective option for postoperative pain management, significantly reducing opioid consumption and improving pain scores in patients undergoing abdominal surgeries. Their integration into ERAS protocols is recommended[9], particularly for open abdominal procedures. Standardization of technique and further comparative studies with alternative regional blocks are warranted.

- **Conflicts of Interest:** The authors declare no conflicts of interest.
- **Ethical Approval:** Not applicable (systematic review of published data).

REFERENCES

1. Gan T.J. Poorly controlled postoperative pain: prevalence, consequences, and prevention. *J Pain Res.* 2017; 10: 2287-2298. doi:10.2147/JPR.S144066.
2. Rafi A.N. Abdominal field block: A new approach via the lumbar triangle. *Anaesthesia.* 2001; 56(10): 1024-1026. doi:10.1046/j.1365-2044.2001.02279-40.x.
3. Sterne J.A.C., Savović J., Page M.J., *et al*. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ.* 2019; 366: l4898. doi:10.1136/bmj.l4898.
4. Baeriswyl M., Kirkham K.R., Kern C., Albrecht E. The analgesic efficacy of ultrasound-guided transversus abdominis plane block vs. epidural analgesia after abdominal surgery: A systematic review and meta-analysis. *Anaesthesia.* 2018; 73(9): 1094-1107. doi:10.1111/anae.14345.
5. Mishriky B.M., George R.B., Habib A.S. Transversus abdominis plane block for analgesia after cesarean delivery: A systematic review and meta-analysis. *Can J Anaesth.* 2012; 59(8): 766-778. doi:10.1007/s12630-012-9749-x.
6. El-Boghdadly K, Wolmarans M, Stengel AD, *et al*. Transversus abdominis plane block for abdominal surgery: A systematic review and meta-analysis of randomized controlled trials. Br J Anaesth. 2021; 126(3): 731-741. doi:10.1016/j.bja.2020.11.026.
7. Tulgar S., Selvi O., Senturk O., *et al*. Comparison of ultrasound-guided erector spinae plane block and transversus abdominis plane block for postoperative analgesia in laparoscopic cholecystectomy: a randomized controlled trial. J Clin Anesth. 2019; 57: 31-36. doi:10.1016/j.jclinane.2019.03.012.
8. Neal JM, Barrington MJ, Fettiplace MR, *et al*. The Third American Society of Regional Anesthesia and Pain Medicine Practice Advisory on Local Anesthetic Systemic Toxicity. *Reg Anesth Pain Med.* 2018; 43(2): 113-123. doi:10.1097/AAP.0000000000000720.
9. Gustafsson UO, Scott MJ, Hubner M, *et al*. Guidelines for perioperative care in elective colorectal surgery: Enhanced Recovery After Surgery (ERAS®) Society recommendations 2018. *World J Surg.* 2019;43(3):659-695. doi:10.1007/s00268-018-4844-y.
10. McDonnell JG, O'Donnell B, Curley G, *et al*. The analgesic efficacy of transversus abdominis plane block after abdominal surgery: A systematic review. *Reg Anesth Pain Med.* 2008; 33(2):193-209. doi:10.1097/AAP.0b013e318157c4de.