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International Journal of Clinical Anesthesiology

Review Article

Effectiveness of the Transversus Abdominis Plane Block in Post Appendectomy Pain Control: Systematic Review

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Submitted: 21 September 2018

Accepted: 16 November 2018

Published: 19 November 2018

ISSN: 2333-6641

Keywords
- Blocking; Transversus abdominis plane; Appendectomy; Children

Abstract

Background: The optimal multimodal strategy for the management of postoperative pain in the pediatric population is still unknown; the use of regional blocks such as transverses abdominis block (TAP) in patients undergoing open appendectomy may reduce morphine requirements and increase the interval between boluses when using PCA.

Objectives: To assess the effectiveness of TAP for the management of postoperative pain in the pediatric population who undergo open or laparoscopic appendectomy by comparing it to the use of placebo, exclusive systemic analgesia or wound infiltration. The secondary outcomes we asses were degree of patient satisfaction, nausea and postoperative and duration of hospitalization

Selection Criteria: Randomized controlled clinical trials in patients younger than 18 years undergoing an open or urgent laparoscopic appendectomy under general anesthesia. The use of transversus abdominis plane block of the abdomen is compared to placebo, exclusive management with systemic analgesia or only wound infiltration.

Data collection and analysis: Three reviewers independently assessed the trials to determine eligibility and risk of bias, then, data extraction was done.

Main Results: Twenty-nine studies conducted until July 2017 was identified. Three of them were included and there were a total of 177 participants. Although not all included studies used the same measure for each outcome, the combination of the results of the three studies suggested that TAP blocks provide effective analgesia after appendectomy in the first two postoperative hours. In addition, when the surgical technique is open, the benefit extends up to 18 hours compared to standard opioid-based postoperative regimens, the consumption of opioids decreases and the time for the first dose increases.

ABBREVIATIONS

TAP: Transversus Abdominis Plane Block; IQR: Interquartile Range; MD: Means Difference; PCA: Patient-Controlled Analgesia

INTRODUCTION

Pain, according to the international association for the study of pain (IASP), is always subjective and is learned through experiences related to injuries at an early age. Children experience pain; it has been proven that even fetuses at 10 weeks can have a stressful response to noxious stimuli. The exposure in pediatric age to painful stimuli does not translate into a higher threshold of pain; on the contrary it could be counterproductive [1,2]. Currently, it has been found that approximately 40% of pediatric patients suffer from moderate to severe postoperative pain and that 75% have had insufficient analgesia [3].

The recommended analgesic strategy in pediatric patients is still unknown. It has previously been shown that the use of regional blocks such as transversus abdominis plane block in patients undergoing open appendectomy can reduce morphine requirements by 50% and have an extended dosing interval of up to 24 hours [5].

The TAP block was defined by McDonnell in 2004 and an ultrasound-guided approach was subsequently described by Hebbard [6]. It is used in patients who are going to be taken to a surgery that involves incisions in the anterior wall of the abdomen. The block can be given with or without the help of ultrasonography. Generally, it is given after anesthetic induction; it has few complications and provides analgesia to the parietal peritoneum and the abdominal wall. It is commonly used in conjunction with other analgesics to reduce postoperative pain [7]. The TAP block involves the injection of a local anesthetic, usually under ultrasound guidance, at the level of the virtual space between the internal oblique and transverse muscles of the abdomen, in which the subcostal (T12), iliohypo gastric, and ilioinguinal nerves are blocked, which produces an area of anesthesia that extends to the lateral and lower part of the abdomen [8,9].

Appendicitis is the most common non-traumatic surgical disorder in 2-year-old children and older. From 1% to 8% of pediatric patients with abdominal pain in the emergency services will be diagnosed with appendicitis. The incidence increases from 1 to 2 cases per 100,000 4-year-old children and to 25 cases per 100,000 children between 10 and 17 years [10,11].

Appendectomy is a frequently performed procedure, especially in the pediatric population. It is usually performed under general anesthesia and it is managed with non-steroidal anti-inflammatory drugs and opioids as analgesia. However, there is a large number of patients who require high doses of medication to achieve adequate pain control. In addition, it is associated with postoperative pain and significant discomfort [12,5].

Thus, the research question used to define the study was: Does the use of transversus abdominis plane block in children reduce the postoperative pain of appendectomy?

MATERIALS AND METHODS

Methodology

Eligibility criteria: A search was made until June 25, 2017; the inclusion criteria of the study are: Randomized clinical trials that compare the use of transversus abdominis plane block to placebo or exclusive management with systemic analgesia or only wound infiltration in patients younger than 18 years regardless of sex or race, taken to open appendectomy or urgent laparoscopy under general anesthesia. No study was excluded according to the block prior to the incision or after the end of the surgery.

The primary desirable outcomes were: Pain score, postoperative opioid consumption and time to the first dose of rescue analgesia. The secondary outcomes were: patient satisfaction, adverse events, duration of hospitalization, nausea and vomiting.

Search methods: A search was made until June 25, 2017 in the following databases: MEDLINE, US National Library of Medicine database (1966 to date); EMBASE, Excerpta Medica database (1980 to date); The Cochrane Central Register of Controlled Trials (CENTRAL); Cochrane Database of Systematic Reviews - CDSR; LILACS;

Google Scholar We also conducted a search of studies in process in World Health Organization International Clinical Trials Registry Platform Search Portal and National Institutes of Health ClinicalTrials.gov (USA). In addition, a manual search of articles of interest was carried out according to the bibliographic references found.

1. **Data extracti**All the potential studies located by the search strategy were obtained and evaluated to corroborate the presence of the previously described inclusion criteria. When differences arose, they were shared and discussed until an agreement was reached. When a consensus was not reached, an independent consultant was called.

2. Three reviewers independently examined the references found in the databases, starting with the titles and abstracts if possible, the remaining articles were reviewed in full text to determine eligibility, finally obtaining the articles of interest according to the inclusion criteria. Disagreements were resolved by discussion among the reviewers and by referral to a fifth reviewer if consensus was not reached. The extracted data were entered in Review Manager 5.3 to continue their analysis.

Assessment of the risk of bias:

• Three reviewers assessed the risk of bias for each study, using the criteria described in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2008). The disagreement was resolved by discussion or by involving a fourth review author.

RESULTS AND DISCUSSION

Description of studies

Demographic characteristics of the studies: The studies were all small, each involved between 40 and 93 participants. Only one study (Shaaban AR 2014) included characterization by sex and it found a majority of male patients. The ages of the patients were 6-12 years (Shaaban AR 2014), 7-16 (Sandeman et al. 2011)

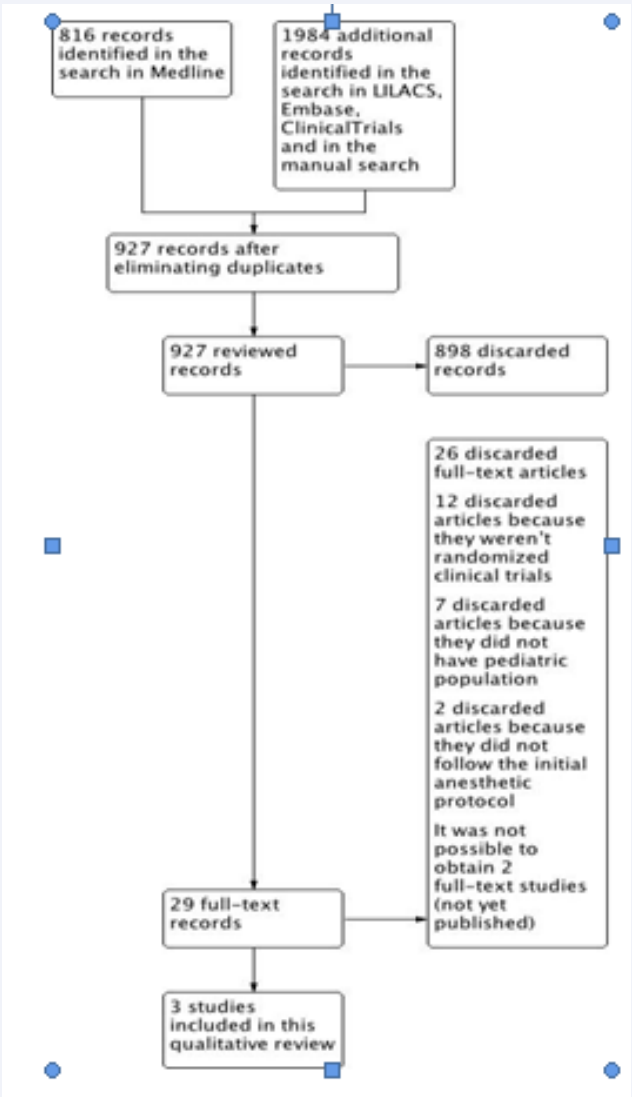

Figure 1 Flowchart of the search.

Table 1: Summary of selected articles.

	Carney et al. 2010	Sandeman et al. 2011	Shaaban AR 2014
Methods	Randomized Controlled Clinical Trial	Randomized Controlled Clinical Trial	Randomized Controlled Clinical Trial
Participants	40 children undergoing open appendectomy	93 children aged 7-16 years taken to laparoscopic appendectomy	44 children aged 4-16 years under open appendectomy
Interventions	TAP block guided by anatomical references compared with placebo	TAP lock ecoguided compared to not doing it	Ultrasound-guided TAP block compared to local infiltration by the surgeon
Outcomes	Primary: Morphine consumption at 48 hours postoperatively. Secondary: Time of the first dose of morphine. Measurement of the visual analogue scale and adverse effects associated with the consumption of morphine.	Primary: the proportion of subjects who used more than 200 mcg / kg of morphine in the first 16 h from arrival in the recovery room. Secondary: Consumption of morphine in PCA from 0 to 8 and from 8 to 16 hours after surgery. Measurement of pain by means of the self-reported visual analog scale, in the recovery room and at 2-4, 6-8, 10-12 and 14-16 hours after the operation. Time for the first analgesic dose not provided by PCA. Time to the first dose of morphine administered by PCA. Sedation scores at the time of discharge from the recovery room, at 6-8 h, and at 10-12 h. Postoperative nausea and vomiting. Time to discharge from hospital	Primary: Maximum pain score, the time of the first analgesic requirement and the number of analgesic requirements at 48 hours. Secondary: Vital signs and adverse effects.

Abbreviations: TAP: Transversus Abdominis Plane Block; PCA: Patient-Controlled Analgesia

and 4-16 (Carney et al. 2010). Only one study (Sandeman et al. 2011) described the physical state of the participants according to the ASA score: no participant in these studies exceeded ASA grade III.

All surgeries were urgent. All three studies included participants under standardized general anesthesia. Shaaban AR 2014 used intrarectal paracetamol as post-operative analgesia for all patients; Carney et al. 2010 used oral acetaminophen, intrarectal diclofenac and opioid with schedule or by PCA according to the age of the patient for all participants; Sandeman et al. 2011, used opioid by PCA and acetaminophen with a schedule.

Two studies performed the right lateral TAP block (Carney et al. 2010; Shaaban AR 2014), the other study performed lateral TAP on both sides (Sandeman et al. 2011). The block doses were 0.5 ml / kg 0.2% ropivacaine for each side of the block in the study of Sandeman et al. 2011 0.4 ml / kg of 0.25% bupivacaine in Shaaban AR 2014 and 0.3 ml / kg of 0.75% ropivacaine in Carney et al. 2010.

Search results: Twenty-nine studies conducted until July 2017 was identified. Three of them were included and there were a total of 177 participants; 24 studies were excluded and two are awaiting classification as they are currently available as abstracts and more details are being sought with the authors.

EFFECT OF THE INTERVENTION

Primary outcomes

Postoperative pain assessment scale: Sandeman et al., reported the severity of the pain as median and IQR. In this study, the pain was significantly less severe at two postoperative hours in the TAP group versus the standard care group, but this difference was not apparent at 24 hours. Shaaban AR stated that the postoperative pain score, up to the first 24 hours, was lower in the TAP group presented only as graphs. The postoperative pain scores at rest and in movement were significantly reduced with TAP at all points at 48 hours in Carney et al., [presented only as graphics].

Opioid postoperative requirement: All three studies recorded morphine consumption up to 48 postoperative hours.

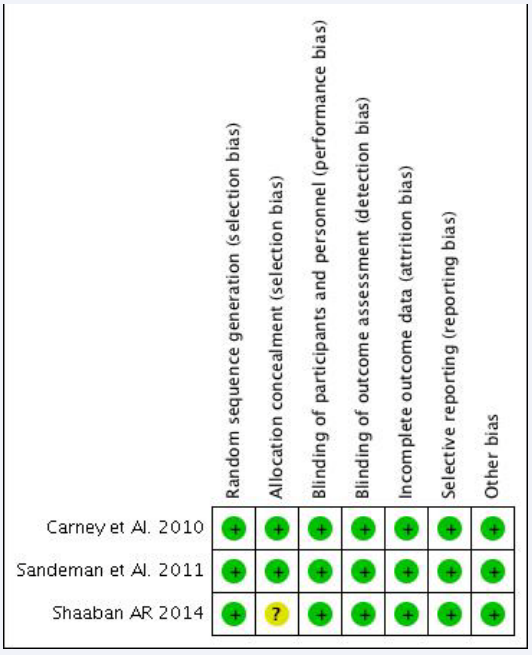

Figure 2 Individual risk of bias.

Sandeman et al. 2011 and Shaaban AR 2014 compared TAP with wound infiltration and Carney et al. 2010 compared TAP with placebo; Sandeman et al.; Shaaban AR they used ultrasound techniques while Carney et al. used the loss of resistance method. In Carney et al. and Shaaban AR there was a significant reduction in morphine consumption; Carney et al. reported cumulative total morphine doses (10.3 ± 12.7 mg Vs 22.3 ± 14.7 mg) while Shaaban AR 2014 reported consumption in µg / kg in intervals at 0-6h, 6-12h, 12-18h and 18-24h and found differences at 6, 12 and 18 (0 µg / kg Vs 3.2 µg / kg ± 1.2; 31 µg / kg (10-109) Vs 60 µg / kg (47-159); 13 µg / kg (13-77) Vs 32 µg / kg (17-97); there were no significant differences in Sandeman et al.,).

Time for the first dose of rescue analgesia: In Carney et al. and Shaaban AR participants in the TAP blocking group took longer, on average, to request morphine compared to those in the standard care group [55 [30-300] minutes Vs 16 [7-30] minutes and 10.4 ± 1.5 hrs Vs 5.4 ± 1.5 respectively].

In Sandeman et al., no significant difference was observed between the TAP group and the wound infiltration [580 [SD 416] Vs 483 [SD 486] minutes].

Secondary outcomes

Degree of patient satisfaction: No study measured the patient satisfaction.

Nausea and postoperative vomiting: For postoperative nausea and vomiting there were no statistically significant differences among the groups in any of the three studies included.

Duration of hospitalization: None of the studies made a clear report of the time of hospital discharge for the patients.

Adverse effects

Inadvertent peritoneal puncture: There was no report of inadvertent peritoneal puncture or any other block-related complication in any of the studies.

DISCUSSION

Three studies [Carney et al.; Sandeman et al.; Shaaban AR] that examined the effects of TAP on pain relief after appendectomy in pediatric patients were included. There was considerable heterogeneity between the studies, probably due to differences in study protocols, different surgeries and block methods. As a consequence, and due to the small number of studies and participants, the conclusions about TAP are not definite.

SUMMARY OF PRIMARY OUTCOMES

The measures of the effectiveness of TAP block included: the dose of morphine needed in the postoperative period, the time until the first application of morphine and the pain scores. Although not all included studies used the same measure for each outcome, the combination of the results of the three studies suggested that TAP blocks provide effective analgesia after appendectomy in the first two postoperative hours and when the surgical technique is open, the benefit extends up to 18 hours compared to standard opioid-based postoperative regimens. In addition, if the technique is open, there is a decrease in the consumption of opioids and an increase in time to the first dose. There is insufficient evidence to demonstrate whether ultrasound localization techniques are more effective than resistance loss / benchmarking techniques in reducing opioid use at 18 hours postoperatively, since the small number of studies involved is insufficient to draw firm conclusions about the relative effectiveness of localization techniques.

In general, TAP blocks do not seem to alter the incidence of postoperative nausea and vomiting or sedation, although once again there was considerable variation in the way they were evaluated. No adverse block effects were observed. It is not clear whether the reduction in opioid requirements and pain scores is of great clinical importance. The clinical importance could be represented by the decrease in the adverse effects associated with the use of opioids, such as sedation, nausea and vomiting or pruritus, or greater patient satisfaction. None of these factors was significantly altered with the use of TAP blocks.

Global applicability

Although no study compared TAP with epidural anesthesia, this pain control method is not conventionally used in appendicetomy, so the comparison between opioid-based standard postoperative analgesia and peri-operative TAP block

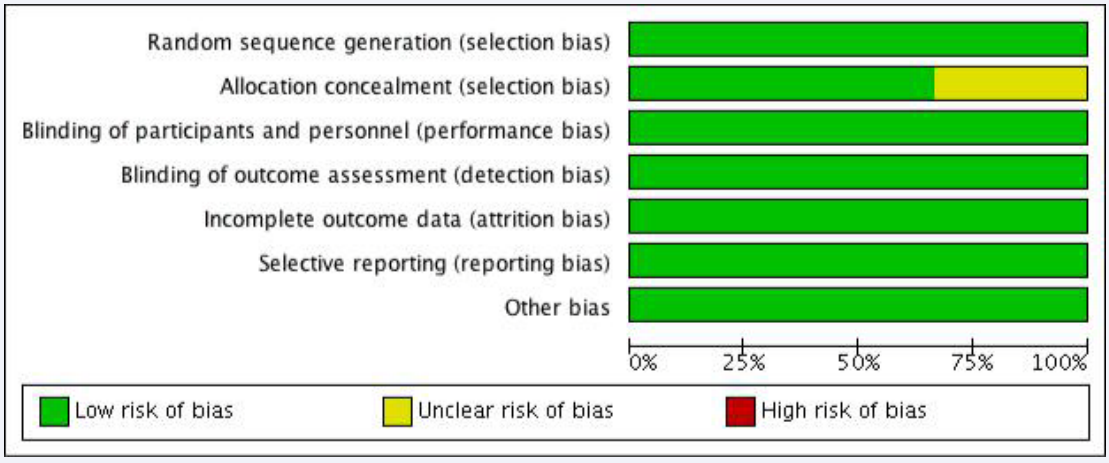

Figure 3 Global risk of bias.

is clinically relevant. However the potential for serious TAP complications, such as intestinal perforation or hepatic laceration of less invasive techniques such as opioids, wound infiltration, NSAIDs, clonidine. or paracetamol should be established.

Quality of the information

This review has found that the evidence for the analgesic efficacy of TAP is based on a few small studies of moderate methodological quality. The studies were enhanced to identify reduced opioid requirements or pain scores, but the number of participants was too low to provide information on the safety of the blocks or the incidence of adverse effects. The important inconsistencies between the studies included different durations of the evaluation of postoperative pain, different types of surgery, unilateral and bilateral blockages, and different moments in which the blockages were performed. Ongoing studies can rectify some of these inconsistencies by standardizing some measures to a greater degree.

Potential biases in the review process

The potential bias was minimized by having two review authors who completed the eligibility assessment, and three who assessed the risk of bias and the data extracted from each study.

CONCLUSION

There is limited evidence that the use of peri-operative TAP block with usual care reduces opioid use and pain scores after appendectomy in pediatric patients compared with usual care alone or with placebo. There is no apparent reduction in postoperative nausea and vomiting or sedation from the small number of studies to date. The improvement seems to be greater until 18 hours postoperatively. There is no apparent reduction in postoperative nausea and vomiting or sedation of studies to date, which are few and involve a small number of participants. There is insufficient data on the method of localization of blockade, the time of blockade, the doses and the volumes of local anesthetic required, and the adverse effects to allow drawing conclusions about the blocking methodology.

IMPLICATIONS OF THE SEARCH

Future research should address not only the effectiveness of TAP block, but also the influence of: block localization method, block time [after induction or at the end of surgery], type, volume and concentration of the local anesthetic used. In addition, more studies that compare TAP block with other postoperative analgesia methods and as adjuvant analgesia to usual care are required. We intend to include the studies pending publication in order to do an updated revision in the near future.

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Cite this article

Rodriguez D, Alzate L, Juan Camilo GS, Ocampo F, Trujillo A (2018) Effectiveness of the Transversus Abdominis Plane Block in Post Appendectomy Pain Control: Systematic Review. Int J Clin Anesthesiol 6(2): 1094.