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REVIEW

The Analgesic Efficacy of Transversus Abdominis Plane Block After Bariatric Surgery: a Systematic Review and Meta-analysis with Trial Sequential Analysis

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Abstract

The transversus abdominis plane (TAP) block has been used to relieve pain after bariatric surgery but with conflicting data on its analgesic efficacy. We conducted this systematic review and meta-analysis with trial sequential analysis to clarify whether TAP block provides effective postoperative analgesia in patients undergoing bariatric surgery. We systematically searched the literature for any trials comparing TAP block with a control group (no block or sham injection). The primary outcome was pain scores at rest (analog scale, 0–10) at 2 postoperative hours. Secondary pain-related outcomes included pain scores at rest at 12 and 24 h and both dynamic pain scores and intravenous morphine equivalent consumption at 2, 12 and 24 h. Additional secondary outcomes sought were rates of postoperative infection, haematoma, visceral injury and local anaesthetic systemic toxicity. Thirteen trials totalling 1025 patients were identified. Pain scores at rest at 2 postoperative hours were significantly lower in the TAP block group compared with the control group, with a mean (95% CI) difference of − 1.8 (− 2.5, − 1.1); I2 = 85%; $p < 0.00001$. All other secondary pain-related outcomes were also significantly lower in the intervention group with the exception of dynamic pain scores and intravenous morphine equivalent consumption at 2 postoperative hours. Rates of block-related complications were not significantly different between groups. The overall quality of evidence was moderate-to-low. There is moderate-to-low level evidence that the TAP block improves postoperative analgesia after bariatric surgery up to 24 postoperative hours, when compared with a control group, without major reported complications. Clinical Trial Number

PROSPERO – registration number: CRD42019136542.

Keywords Bariatric surgery · Analgesia · Regional anaesthesia · Postoperative pain · TAP block

Introduction

Bariatric surgery is effective in producing weight loss and in reducing obesity-related comorbidities [1]. Even if this surgical procedure is performed with a minimal invasive approach, patients suffer from moderate-to-severe pain starting immediately after surgery [2]. Providing analgesia after bariatric surgery might be challenging due to a high prevalence of obstructive sleep apnoea syndrome and the increased sensitivity to respiratory depression with opioid administration [3]. Hence, regional anaesthetic techniques represent a valuable option as they improve patient comfort while reducing opioid-related side effects [4].

Among these regional anaesthetic techniques, the transversus abdominis plane (TAP) block consists of injecting local anaesthetic in the plane between the internal oblique and the transversus abdominis muscles to anaesthetise the sensory nerves supplying the anterior abdominal wall [5]. While this regional technique has been employed to relieve pain after different

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abdominal surgical procedures, an area of uncertainty exists around the analgesic efficacy of this block following bariatric surgery due to conflicting data published in the literature [4].

In order to provide reliable evidence, we undertook a systematic review and meta-analysis with trial sequential analysis to determine whether TAP block provides effective postoperative analgesia in patients undergoing bariatric surgery when compared with a control group.

Methods

Literature Search and Inclusion Criteria

This investigation followed the 'Preferred Reporting Items for Systematic Reviews and Meta-Analyses' (PRISMA) statement recommended process [6] and was prospectively registered on the International Prospective Register of Systematic Reviews (registration number CRD42019136542). The PRISMA flow diagram is depicted in Fig. 1.

The authors searched the following electronic databases up to February 15, 2020: MEDLINE, Embase, Cochrane Central Register of Controlled Clinical Trials and Web of Science. The following population search terms were applied: Bariatric OR Abdominal Surgery OR Bypass OR By Pass. The results of this initial search were combined with Block OR Transversus abdominis OR TAP OR OSTAP Surgery. The limits of Clinical trials OR Random allocation OR Therapeutic use were then applied to the results. The following words were searched as keywords: Bariatric surgery, Gastric bypass surgery, Incisi*, Operation*, Operative*, Surger*, Surgical*, Perioperati*, Pain*, Nociception*, Analges*, Anesthe*, Anaesthe*, Transversus abdominis plane block, Transvers* and Block*.

The results of this search strategy were limited to randomised controlled trials and humans. No language limits were placed on the search. In addition, the authors scrutinised the references of all retrieved articles for any applicable trials that might not have been captured by the above approach. Finally, Google Scholar™ was queried in order to identify any remaining relevant publications, and authors that registered clinical trials on clinicaltrials.gov were contacted.

Population

The meta-analysis addresses male and female adult patients undergoing any bariatric surgery.

Intervention and Comparator

Only trials that investigated pain outcomes and compared TAP block to a control group (no block or sham injection) were included in this meta-analysis.

Outcomes

Defined outcomes were extracted from each article following the routine approach previously described in meta-analyses on acute postoperative pain [7–9]. The primary outcome was rest pain score at 2 postoperative hours. Secondary pain-related outcomes included rest pain score at 12 and 24 postoperative hours; dynamic pain score at 2, 12 and 24 postoperative hours; intravenous (iv) morphine equivalent consumption at 2, 12 and 24 postoperative hours; time to first analgesic request; rate of postoperative nausea and vomiting within the first 24 postoperative hours; and patient satisfaction assessed on a 11-point numeric rating scale (0, totally dissatisfied; 10, highly satisfied). Other secondary outcomes sought were rates of haematoma, postoperative infection, visceral injury and local anaesthetic systemic toxicity induced by the TAP block. We also aimed to capture hospital resource-related outcomes including hospital length of stay.

Trial Characteristics

Extracted trial characteristics included type of surgical procedure and TAP block technique; timing of the TAP block; type, concentration and volume of local anaesthetic administered; medication used for anaesthetic maintenance; and prescription of postoperative analgesia.

Rating of the Studies

For each randomised trial, the methodologic quality was evaluated using the Cochrane Collaboration's Risk of Bias Tool [10]. Both authors employed this method to independently screen, review and score the items for each trial. Disagreements in scoring or extracted data were disagreements in scoring or extracted data were adjudicated by KRK.

Data Extraction

The texts, tables or images from the source articles were evaluated to extract the number of participants, number of events, means, standard deviations, standard error of means and 95% confidence intervals (CI). For articles that failed to describe the sample size or results as a mean and standard deviation or standard error of the mean and 95% CI, we contacted the corresponding author twice by email with a request for access to the relevant data or to the complete dataset. If the corresponding author failed to reply, we employed the median and interquartile range as approximations of the mean and standard deviation, by estimating the mean as equivalent to the median and the standard deviation as the interquartile range divided by 1.35 or the range divided by 4 [10]. All opioids were converted to equianalgesic iv morphine doses (iv morphine 10 mg = iv hydromorphone 1.5 mg = oral morphine

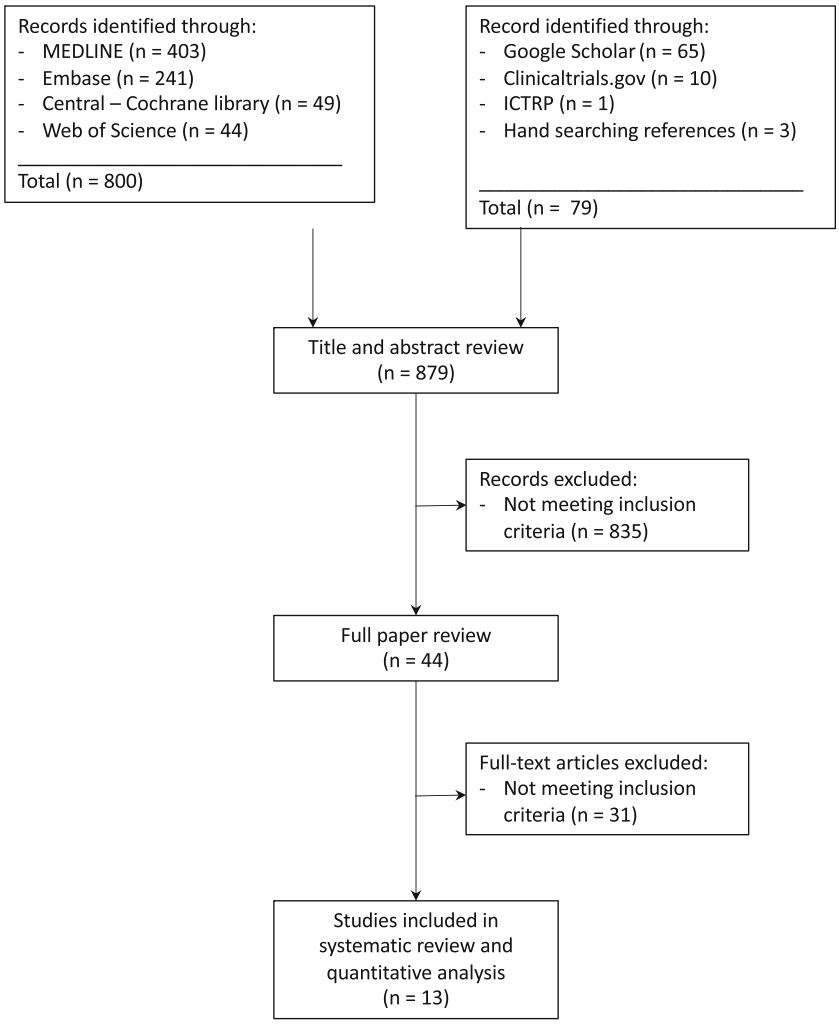

Fig. 1 PRISMA flow diagram showing literature search results. Thirteen randomised controlled trials were included in the analysis. ICTPR, International Clinical Trials Registry Platform (from Word Health Organization)

30 mg = oral oxycodone 20 mg = oral hydrocodone 30 mg = oral hydromorphone 7.5 mg = iv tramadol 100 mg = iv pethidine 75 mg = iv sufentanil 10 μg = iv fentanyl 100 μg) [11]. For pain scores employing an 11-graduation verbal, visual or numeric rating scale, results were transposed to a 0–10 analog scale to permit statistical evaluation. When trials had several intervention groups, data from all groups were used for comparison. In addition, the Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) Working Group system was applied to each outcome to evaluate the quality of evidence [12].

Statistical Analysis

All meta-analyses were conducted using the Review Manager software (RevMan version 5.3.5; Copenhagen, The Nordic Cochrane Centre, The Cochrane Collaboration 2014). For continuous data, this software estimates the weighted mean differences, and similarly the risk ratio for categorical data between groups, with an overall estimate of the pooled effect. A meta-analysis was conducted when two or more trials reported any given outcome. We calculated the I^2 coefficient in order to assess heterogeneity and set predetermined limits for low (25–49%), moderate (50–74%), and high (> 75%) levels [13]. A random effects model was applied in circumstances when moderate or high heterogeneity was observed; otherwise, a fixed effects model was employed [14]. As an attempt to account for sources of heterogeneity, subgroup analyses were conducted for our primary outcome according to the type of surgery (sleeve gastrectomy vs gastric bypass vs other surgery), the TAP block technique (ultrasound-guided vs laparoscopy-guided), the TAP block timing (before incision vs intraoperatively or after surgery), the infiltration of trocar port sites (infiltration vs no infiltration) and the prescription of multimodal analgesic treatment (yes or no). The risk of publication bias associated with the primary outcome was estimated by drawing a funnel plot of the mean difference standard error of rest pain score at 2 postoperative hours (y-axis) as a function of the mean difference of rest pain score at 2 postoperative hours (x-axis) [15] and confirmed with Duval and Tweedie's trim and fill test [16]. This assessment was performed using Comprehensive Meta-analysis Version 2 software (Biostat, Englewood, NJ, USA).

Finally, trial sequential analysis was performed on the primary outcome to confirm whether firm evidence was reached or not (TSA software version 0.9.5.10 Beta; Copenhagen Trial Unit, Center for Clinical Intervention Research, Rigshospitalet, Copenhagen, Denmark) [17].

We present results as the mean difference or relative risk (RR) with 95% CI, and a 2-sided p value < 0.05 was deemed to be significant.

Results

Of the 879 trials identified from the literature search, 13 met the inclusion criteria [18–30], gathering a total of 1025 patients (Fig. 1). Figure 2 summarises the risk of bias of the different trials. Seven authors were contacted [19, 21, 24, 27–30], and none provided additional data; means and standard deviations were approximated from median, interquartile range or range in two trials [19, 28].

Table 1 presents the trial characteristics. The number of patients ranged from 40 [26] to 165 [29], except for one study which included 19 patients [19]. All surgical procedures were performed by laparoscopy: 3 studies focused on gastric bypass [18, 23, 28]; 6, on sleeve gastrectomy [21, 22, 24, 25, 29, 30]; 1, on gastric banding [19]; and 3 carried out a mix of these 3 different procedures [20, 26, 27]. Authors accomplished the TAP block under ultrasound guidance in 10 trials [18–22, 24, 26–28, 30] and under laparoscopic vision in two trials [23, 25]; one trial performed an intercostoiliac approach following anatomic landmarks before incision combined with a subcostal block during laparoscopy [29]. The TAP block was performed after induction of general anaesthesia in four studies [18, 19, 21, 26], intra- or postoperatively in nine studies [20, 22–29]. All authors injected a single bolus of long-acting local anaesthetic bilaterally with various concentrations (bupivacaine 0.125–0.5%; ropivacaine 0.2–0.5%) and volumes (15–40 ml per side), with the exception of study that ran a continuous infusion through a catheter placed intraoperatively, without preliminary bolus [25]. One trial compared the control group with two intervention groups that received bupivacaine with and without epinephrine [24]. Authors prescribed multimodal analgesia in all trials except 4 [25, 26, 28, 30].

The mean (SD) rest pain score at 2 postoperative hours was significantly reduced in the TAP block groups compared with control, with a mean difference (95% CI) of − 1.8 (− 2.5, − 1.1), I^2 = 85%, p < 0.00001 (Fig. 3). Subgroup analyses did not reveal any difference between types of surgery (p = 0.38), TAP block techniques (p = 0.59) and the prescription of multimodal analgesic treatment (p = 1.00). Subgroup differences were present with TAP block timing (p = 0.01) and trocar port sites infiltration (p = 0.0003); however, these analyses did not allow to reduce heterogeneity (Table 2).

The trial sequential analysis indicated that firm evidence was reached regarding the contribution of TAP block to decrease rest pain score at 2 postoperative hours (Fig. 4). Regarding the risk of publication bias for the primary outcome, Duval and Tweedie's trim and fill test calculated the combined studies point estimate to be − 1.06 (95% CI, − 1.59, − 0.55) with a random effects model. Using trim and fill, these values were unchanged, suggesting that no studies are missing.

The rate of postoperative nausea and vomiting was significantly reduced in patients with TAP blocks [18–23, 26, 27, 29], with a risk ratio (95% CI) of 0.57 (0.33; 0.98; p = 0.04). Table 3 presents the other secondary pain-related outcomes that were all significantly reduced with the exception of dynamic pain score at 2 postoperative hours and cumulative iv morphine equivalent consumption at 2 and 24 postoperative hours. According to the GRADE system, the quality of evidence for the primary outcome was moderate and moderate-to-low for the secondary outcomes (Fig. 2).

Four out of 551 patients from seven studies developed a haematoma with a risk ratio (95% CI) of 1.5 (0.4, 6.2), I^2 = 19%; p = 0.58 [18, 20, 21, 23, 24, 27, 30]. While postoperative infection was not recorded by any study, there was no visceral injury produced by the block, as sought in 2 studies [18, 21], and no local anaesthetic systemic toxicity, as captured by 5 studies [18, 21, 27, 29, 30]. Finally, duration of hospital stay, recorded by 4 studies [18–20, 23], was similar between groups with a mean difference (95% CI) of 1.8 h (− 1.6, 5.2 h); I^2 = 50%; p = 0.30.

Discussion

This systematic review and meta-analysis explored the analgesic efficacy of TAP block in patients undergoing bariatric surgery. Based on 13 randomised controlled trials which included a total of 1025 patients, we demonstrated that TAP block in the setting of bariatric surgery reduces rest pain scores at 2, 12 and 24 postoperative hours, dynamic pain scores at 12 and 24 postoperative hours, cumulative iv morphine equivalent consumption at 24 postoperative hours and the rate of PONV during the first 24 postoperative hours, while increasing the time to first analgesic request by 2 h and improving patient satisfaction. Noteworthy, the TAP block technique was not associated with any reported local or systemic complications. Following the GRADE system, the overall level of evidence was moderate-to-low.

With a mean difference in pain scores above 1.0 that was sustained up to 24 postoperative hours, we believe the TAP block represents a valuable option to improve patient comfort following bariatric surgery. While the difference is limited in absolute magnitude, we agree with previous authors that this reduction constitutes a clinically important improvement [31]. In addition, we consider that a reduction of 12 mg of iv

Table 1 Trial characteristics

Reference	Group (*n*)	Surgical procedure	TAP block technique	TAP block timing	Medication used		Anaesthetic maintenance	Trocar port sites infiltration with local anaesthetic	Postoperative analgesia
					TAP block (total volume)	Control			
Albrecht et al., 2013 [18]	TAP block (27) Control (30)	Gastric bypass	Ultrasound	Before incision	Bupivacaine 0.25% + epinephrine 5 μg ml^{-1}, 60 ml	No intervention	Desflurane	Yes	Paracetamol, oxycodone, morphine
De Oliveira et al., 2014 [19]	TAP block (10) Control (9)	Gastric banding	Ultrasound	Before incision	Ropivacaine 0.5%, 40 ml	Sham injection	Desflurane	No	Paracetamol, ketorolac, hydrocodone, hydromorphone,
Emile et al., 2019 [20]	TAP block (46) Control (46)	Different procedures	Ultrasound	After surgery	Bupivacaine 0.25%, 40 ml	No intervention	Isoflurane	No	Paracetamol, pethidine
Ibrahim et al., 2014 [21]	TAP block (21) Control (21)	Sleeve gastrectomy	Ultrasound	Before incision	Bupivacaine 0.25%, 60 ml	Sham injection	Sevoflurane	No	Paracetamol, lornoxicam, morphine
Mittal et al., 2018 [22]	TAP block (30) Control (30)	Sleeve gastrectomy	Ultrasound	After surgery	Ropivacaine 0.375%, 80 ml	No intervention	Not specified	No	Paracetamol, diclofenac
Ruiz-Tovar et al., 2020 [23]	TAP block (70) Control (70)	Gastric bypass	Laparoscopy	Intraoperatively	Bupivacaine 0.25%, 30 ml	No intervention	Not specified	Yes	Paracetamol, morphine
Sabre et al., 2019 [24]	TAP block (31/27) Control (32)	Sleeve gastrectomy	Ultrasound	Intraoperatively	Bupivacaine 0.25% ± epinephrine 5 μg ml^{-1}, 40 ml	Sham injection	Not specified	No	Paracetamol, gabapentin, hydromorphone, morphine
Said et al., 2017 [25]	TAP block (45) Control (45)	Sleeve gastrectomy	Laparoscopy	After surgery	Bupivacaine 0.25%, continuous infusion of 4 ml/h during 24 h	No intervention	Isoflurane	No	Morphine
Shafeek et al., 2018 [26]	TAP block (20) Control (20)	Different procedures	Ultrasound	Before incision	Bupivacaine 0.125%, 0.4 ml/kg	No intervention	Isoflurane	No	Morphine
Sherif et al., 2015 [27]	TAP block (48) Control (47)	Different procedures	Ultrasound	After surgery	Bupivacaine 0.5%, 40 ml	No intervention	Sevoflurane	No	Paracetamol, morphine
Sinha et al., 2013 [28]	TAP block (50) Control (50)	Gastric bypass	Ultrasound	After surgery		Sham injection	Not specified	No	Tramadol

Table 1 (continued)

Reference	Group (*n*)	Surgical procedure	TAP block technique	TAP block timing	Medication used		Anaesthetic maintenance	Trocar port sites infiltration with local anaesthetic	Postoperative analgesia
					TAP block (total volume)	Control			
					Ropivacaine 0.375%, 40 ml				
Tülübaş et al., 2019 [29]	TAP block (80) Control (85)	Sleeve gastrectomy	Anatomic landmarks/-laparoscopy	Before incision/-intraoperatively	Bupivacaine 0.25%, 60 ml	Sham injection	Sevoflurane	No	Tenoxicam, tramadol
Wassef et al., 2013 [30]	TAP block (10) Control (25)	Sleeve gastrectomy	Ultrasound	After surgery	Ropivacaine 0.2%, 60 ml	No intervention	Desflurane	No	Hydromorphone

morphine equivalents or 24 mg of oxycodone equivalents on postoperative day 1 is highly significant in itself but also an important reduction as a strategy to decrease overall postoperative opioid consumption [7]. Consequently, given the excellent safety profile of this particular block, its inclusion as part of an ERAS program for bariatric surgical procedures seems warranted [32].

Bariatric surgery as an entity is not homogeneous, and the impact of the block could theoretically vary depending on the surgical approach. Our subgroup analyses revealed no difference in the TAP block effectiveness between gastric bypass and sleeve gastrectomy. However, with only two trials

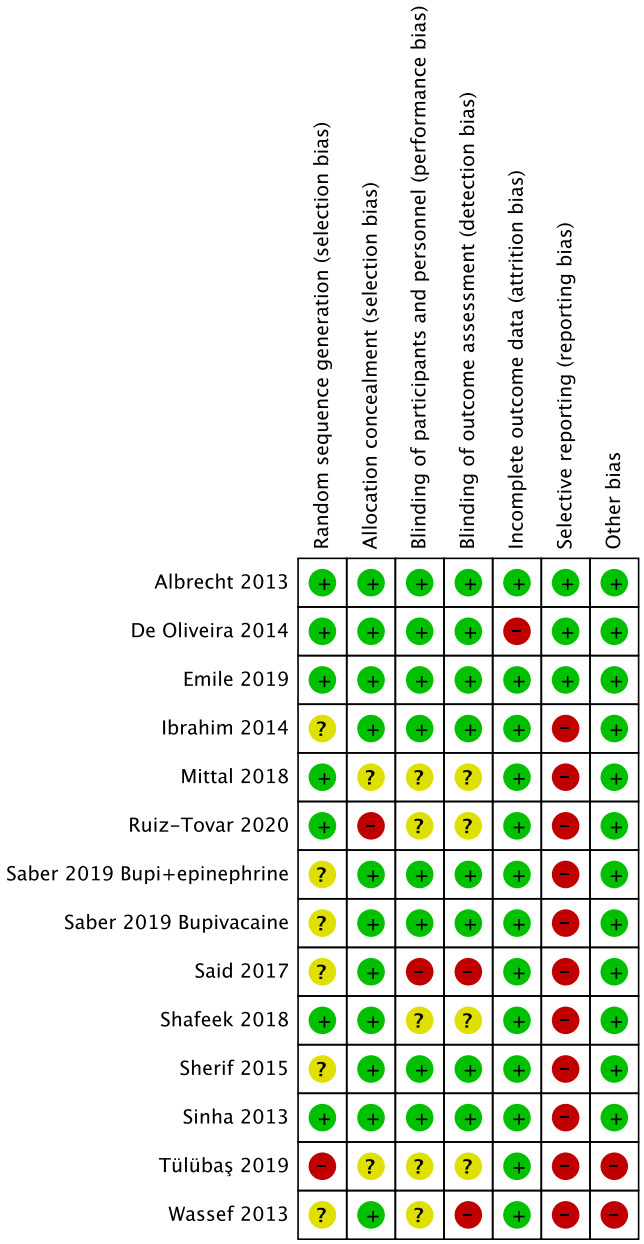

Fig. 2 Cochrane collaboration risk of bias summary: evaluation of bias risk items for each included study. Green circle, low risk of bias; red circle, high risk of bias; yellow circle, unclear risk of bias

Table 2 Subgroup analyses of the primary outcome

Outcome	Number of trials	References	Total number of patients		Mean difference (95% CI)	I^2 (%)	*p* value for overall effect	*p* value for subgroup differences
			TAP block	Control				
Rest pain score at 2 postoperative hours (analog scale, 0–10)								
According to the type of surgery								0.38
Sleeve gastrectomy	4	Mittal 2018 [22], Sabre 2019 [24], Said 2017 [25], Wassef 2013 [30]	143	164	−1.6 [−2.1, −1.1]	36	< 0.00001	
Gastric bypass	2	Albrecht 2013 [18], Sinha 2013 [28]	77	80	−0.8 [−3.0, −1.5]	81	0.50	
Other	3	Emile 2019 [20], Shafeek 2018 [26], Sherif 2015 [27]	114	113	−2.5 [−3.8, −1.1]	91	0.0003	
According to the TAP block technique								0.59
Ultrasound-guided	8	Albrecht 2013 [18], Emile 2019 [20], Mittal 2018 [22], Sabre 2019 [24], Shafeek 2018 [26], Sherif 2015 [27], Sinha 2013 [28], Wassef 2013 [30]	289	312	−1.9 [−2.7, −1.1]	86	< 0.00001	
Laparoscopy-guided	1	Said 2017 [25]	45	45	−1.6 [−2.1, −1.1]	N/A	< 0.00001	
According to the TAP block timing								0.01
Before surgery	2	Albrecht 2013 [18], Shafeek 2018 [26]	47	50	−0.4 [−1.7, 0.9]	73	0.51	
Intraoperative or after surgery	7	Emile 2019 [20], Mittal 2018 [22], Sabre 2019 [24], Said 2017 [25], Sherif 2015 [27], Sinha 2013 [28], Wassef 2013 [30]	287	307	−2.2 [−2.9, −1.5]	81	< 0.00001	
According to trocar port sites infiltration								0.0003
Infiltration	1	Albrecht 2013 [18]	27	30	0.3 [−0.8, 1.4]	N/A	0.60	
No infiltration	7	Emile 2019 [20], Mittal 2018 [22], Sabre 2019 [24], Said 2017 [25], Shafeek 2018 [26], Sherif 2015 [27], Sinha 2013 [28], Wassef 2013 [30]	307	327	−2.1 [−2.7, −1.4]	82	< 0.00001	
According to the prescription of multimodal analgesic treatment								1.00
Multimodal analgesic treatment	5	Albrecht 2013 [18], Emile 2019 [20], Mittal 2018 [22], Sabre 2019 [24], Sherif 2015 [27]	209	217	−1.8 [−2.8, −0.7]	89	0.0007	
No multimodal analgesic treatment	4	Said 2017 [25], Shafeek 2018 [26], Sinha 2013 [28], Wassef 2013 [30]	125	140	−1.8 [−2.6, −0.9]	63	0.0001	
Total			334	357	−1.8 [−2.5, −1.1]	85	< 0.00001	

CI confidence interval, *N/A* not applicable

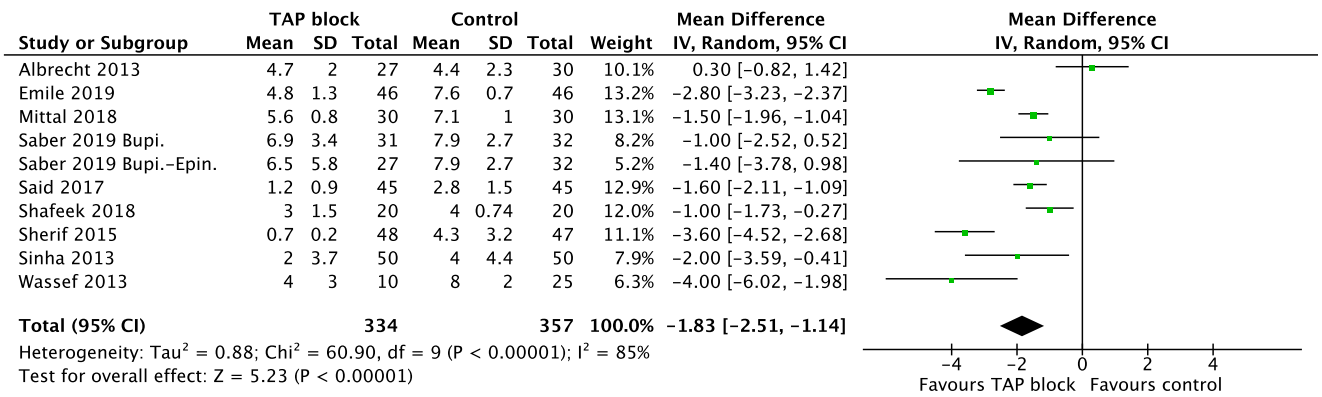

Fig. 3 Rest pain score at 2 postoperative hours in patients undergoing laparoscopic bariatric surgery with TAP block vs no TAP block

included in this subgroup analysis, a type-II error may explain the absence of difference. A similar concern applies for the non-significant difference between TAP blocks performed prior to surgery when compared with intraoperatively or after completion of surgery. Despite the absence of evidence in this meta-analysis, we believe that this is an area warranting further investigation to determine whether administration of local anaesthetics before the surgical incision may contribute to a

Table 3 Secondary pain-related outcome

Outcome	Number of trials	References	Total number of patients		Mean difference (95% CI)	I^2 (%)	*p* value for overall effect
			TAP block	Control			
Rest pain score at 12 po hours (analog scale, 0–10)	7	Emile 2019 [20], Mittal 2018 [22], Ruiz-Tovar 2020 [23], Said 2017 [25], Shafeek 2018 [26], Sherif 2015 [27] Sinha 2013 [28]	309	308	− 1.0 [− 1.7, − 0.3]	94	0.003
Rest pain score at 24 po hours (analog scale, 0–10)	9	Albrecht 2013 [18], De Oliveira [19], Emile 2019 [20], Mittal 2018 [22], Ruiz-Tovar 2020 [23], Said 2017 [25], Shafeek 2018 [26], Sherif 2015 [27] Sinha 2013 [28]	346	347	− 1.1 [− 1.8, − 0.4]	96	0.003
Dynamic pain score at 2 po hours (analog scale, 0–10)	3	Albrecht 2013 [18], Mittal 2018 [22], Sherif 2015 [27]	105	107	− 1.5 [− 3.5, 0.5]	95	0.15
Dynamic pain score at 12 po hours (analog scale, 0–10)	2	Mittal 2018 [22], Sherif 2015 [27]	78	77	− 2.2 [− 3.6, − 0.8]	95	0.002
Dynamic pain score at 24 po hours (analog scale, 0–10)	3	Albrecht 2013 [18], Mittal 2018 [22], Sherif 2015 [27]	105	107	− 1.3 [− 2.2, − 0.4]	90	0.005
Cumulative iv morphine equivalent consumption at 2 po hours (mg)	4	Albrecht 2013 [18], Ibrahim 2014 [21], Sherif 2015 [27], Tülübaş 2019 [29]	173	183	− 5.1 [− 12.1, 2.0]	100	0.16
Cumulative iv morphine equivalent consumption at 12 po hours (mg)	0	None	N/A	N/A	N/A	N/A	N/A
Cumulative iv morphine equivalent consumption at 24 po hours (mg)	8	Albrecht 2013 [18], De Oliveira 2014 [19], Ibrahim 2014 [21], Said 2017 [25], Shafeek 2018 [26], Sherif 2015 [27], Tülübaş 2019 [29], Wassef 2013 [30]	261	282	− 12.0 [− 24.1, − 0.03]	100	0.049
Time to first analgesic request (min)	3	Albrecht 2013 [18], Ibrahim 2014 [21], Shafeek 2018 [26]	68	71	137 [36, 238]	99	0.008
Patient satisfaction (analog scale, 0–10)	3	Mittal 2018 [22], Said 2017 [25], Sinha 2013 [28]	125	125	1.5 [0.7, 2.4]	78	0.0006

CI confidence interval, *po* postoperative, *NA* not applicable

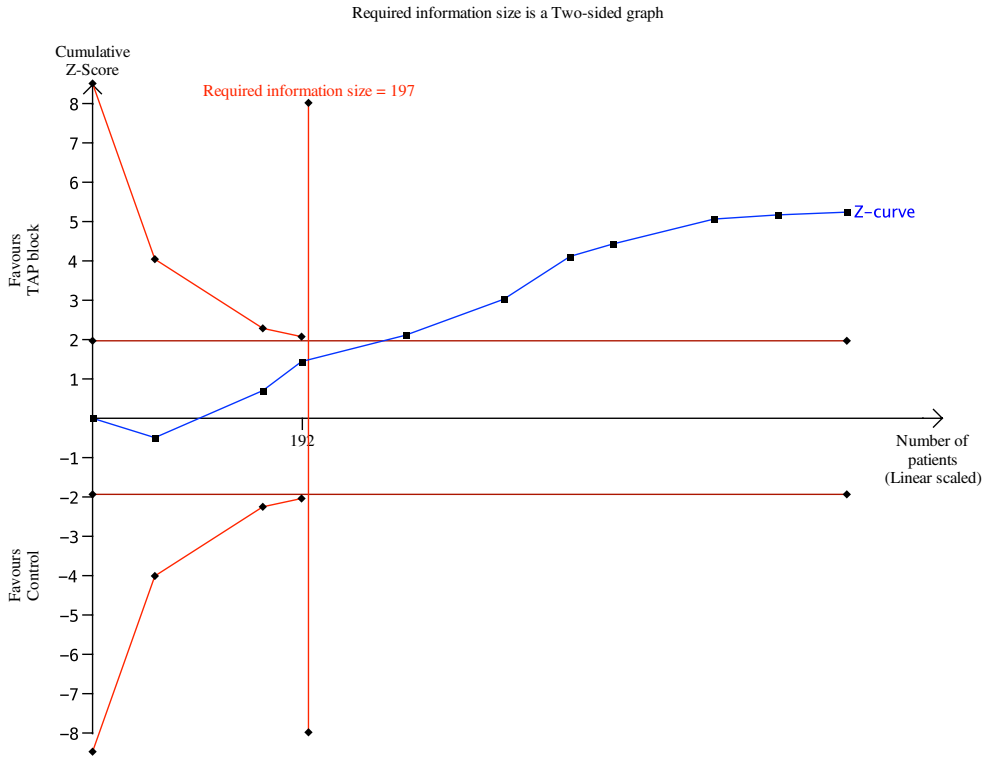

Fig. 4 Trial sequential analysis for rest pain score at 2 postoperative hours. The cumulative Z curve (blue) crosses the monitoring boundary curve (red) and reaches the required information size, indicating firm evidence that TAP block is superior to no TAP block

reduction in the intraoperative consumption of opioids, as part of a multimodal analgesic treatment [33]. That said, the TAP block is not the only regional technique that may confer benefit in this population. Indeed, infiltration of the trocar port sites has also been suggested to provide effective postoperative analgesia [18]. While we have not reviewed the literature examining this comparison in detail, another meta-analysis determining the relative role of the TAP block and wound infiltration for postoperative pain relief would be valuable.

This meta-analysis suffers from several drawbacks. First, our hypotheses and subgroup analyses did not allow us to adequately account for the coefficient of heterogeneity found related to our primary outcome. Differences in the local anaesthetics regimen employed by the authors may be contributing unpredictably to our findings. In addition, the majority of the included studies suffer from potential reporting bias as the authors did not register these trials prior to their conduct. Finally, we were unable to draw any conclusion for non-laparoscopic bariatric surgery, as all included patients underwent a laparoscopic approach although we acknowledge this is by far the predominant approach for these procedures.

In conclusion, there is moderate-to-low level evidence that the TAP block improves postoperative analgesia after bariatric surgery for up to 24 postoperative hours, when compared with controls and without major reported complications.

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Compliance with Ethical Standards

Conflict of Interest EA has received grants from the Swiss Academy for Anaesthesia Research (SACAR), Lausanne, Switzerland (no grant numbers attributed), from B. Braun Medical AG, Sempach, Switzerland (no grant numbers attributed) and from the Swiss National Science Foundation to support his clinical research. EA has also received an honorarium from B. Braun Melsungen AG, Melsungen, Germany.

The authors declare that they have no conflict of interest.

Ethical Approval For this type of study, formal consent is not required.

Informed Consent Informed consent does not apply.

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