



Ultrasound-Guided Transversus Abdominis Plane Block in laparoscopic surgeries: A scoping review

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ABSTRACT

Background: Pain following laparoscopic surgeries is a major concern that has been managed by several modalities with varying results. Ultrasound-Guided Transversus Abdominis Plane Block (TAPB) is considered a modality that may help decrease postoperative pain and opioid consumption and its related side effects which may contribute to reduction of hospital stay and improvement in functional recovery.

Objective: The aim of this scoping review was to demonstrate the efficacy of ultrasound guided TAPB for pain relief following laparoscopic surgeries and its effect on minimizing opioid consumption and incidence of side effects

Method: This scoping review was reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extension for scoping review guidelines. A search of PubMed, Scopus, and Web of Science databases was conducted. The titles and abstracts of potentially relevant studies were screened before the retrieval of the full texts, which were then examined to determine which studies met the eligibility criteria (adult patients, receiving TAPB and undergoing laparoscopic surgeries, English language, full text articles related to TAPB and laparoscopic surgeries)

Results: One hundred and seventeen potentially eligible studies were identified. 98 records were excluded as they were either duplicates or did not meet the eligibility criteria leaving 19 articles. 13 articles were found discussing the efficacy of TAPB on pain intensity, most of which concluded that TAPB provided superior pain relief when compared with other methods. Most of the reviewed articles found no significant difference in the incidence of postoperative nausea and vomiting (PONV) or the quality of functional recovery among patients who received TAPB.

Conclusion: This scoping review suggests that TAPB is an effective technique for analgesia following laparoscopic surgeries. Further studies are required to better elucidate the effects of TAPB on the incidence of side effects and on patients' functional recovery due to the limited number of reports discussing these outcomes.

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1. Introduction

Laparoscopic techniques are widely spreading nowadays in many procedures such as cholecystectomy, nephrectomy, appendectomy, among others. Adequate postoperative pain relief is mandatory to improve surgical outcomes; this can be achieved by Transversus Abdominis Plane Block (TAPB). TAPB is a technique of regional anesthesia that can be used to achieve abdominal wall field block that aims to inject a local anesthetic in the fascial plane between the transversus abdominis and the internal oblique muscles targeting spinal nerves in this plane. TAPB can be performed either pre-incisional, after the induction of general anesthesia (GA), or post-incisional, after wound closure. According to the type of surgical procedure TAPB can be performed either unilaterally or bilaterally [1].

There are several approaches to TAPB including subcostal, lateral, posterior, and oblique subcostal, which differ in the needle insertion technique and the level of block. TAPB can also be administered as a continuous infusion by inserting a catheter in the fascial plane between the transversus abdominis and the internal oblique muscles while performing the block [2]. The introduction of ultrasound guided TAPB has reduced the use of blind TAPB techniques which is beneficial in ensuring the exact needle depth between the layers. Moreover, real time visualization of the correct placement of the needle can help prevent complications such as vascular or visceral puncture. TAPB is particularly useful in laparoscopic procedures as it has been shown to increase patient satisfaction, facilitate early

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ambulation, and reduce postoperative pain which in turn decreases postoperative intravenous analgesic consumption and its related side effects [3].

A variety of local anesthetic drugs have been used in TAPB such as lidocaine, liposomal or non-liposomal bupivacaine, and ropivacaine. Dezocine and dexmedetomidine have been used as adjuvants, among other drugs, to prolong the duration of TAPB [3]. Most patients undergoing laparoscopic surgeries complain of postoperative pain which leads to an increase in the consumption of postoperative analgesics as well as the development of side effects related to their excess use. This in turn prolongs the length of hospital stay and reduces patient satisfaction. In this study, we reviewed the effect of ultrasound guided TAPB on improving pain scores and reducing intra and postoperative opioid requirements and minimizing the side effects and length of hospital stay as well as improving patient functional recovery following elective laparoscopic surgeries in adult patients.

2. Materials and methods

This scoping review was performed according to the “Current recommendations of Cochrane Collaboration” and reported according to the “Preferred Reporting Items for Systematic Reviews and Meta-Analyses” (PRISMA) extension for scoping review guidelines [4].

2.1. Search strategy and study selection

Six researchers independently searched PubMed, Scopus, and Web of Science databases using the following strategy: “ultrasound-guided” AND “transversus abdominis plane block” AND “local anesthetic infiltration” AND “laparoscopic surgery”, for all three databases. The search was performed between February 10th and 25th 2020. Initially, publications in English language and dating between January 2016 and February 2020 were included. The number of included articles was 13 out of 61 retrieved articles. Retrieval of additional information was achieved by reviewing the reference lists from the identified articles. The search results were then de-duplicated using Endnote “Thomson Reuters, New York, USA”. The titles and the abstracts of relevant articles were reviewed before retrieving the full texts. All six researchers examined the full articles to decide which studies met the inclusion criteria. Disagreements about the studies selected were resolved by discussion and consensus. By reviewing the reference list for the primary search and determining the articles of interest, the search was extended to articles dating between 2009 and 2015. Six out of 56 articles were assessed for eligibility after the secondary search which was conducted through Google Scholar based on several criteria such as English language, full

text articles as well as articles related to TAPB and laparoscopic surgeries. Figure 1 shows the flow chart of TAPB study selection.

2.2. Inclusion and exclusion

Inclusion criteria:

- Study Design: “randomized controlled trials”, “systematic reviews”, “meta-analyses”
- Population: Adult surgical patients undergoing elective laparoscopic surgery (age ≥ 18 years)
- Intervention: Efficacy of TAPB in pain relief after laparoscopic surgeries.
- Outcomes:
 - Primary Outcome: Postoperative pain relief
 - Secondary Outcome: Analgesic consumption (intra and postoperative), quality of functional recovery, length of hospital-stay, and side effects

Exclusion criteria were as follows:

- Articles that were not in English language
- Unavailability of full text
- TAPB performed for surgeries other than laparoscopic
- Irrelevance of the study to TAPB

2.3. Extraction of data and analysis

A data extraction form was developed by the researchers and utilized to evaluate all included articles. The six researchers extracted the following data from eligible studies: Authors, year of publication, region, number of patients in the study, characteristics of patients, intervention, and outcomes. Disagreements about the data extracted were resolved by discussion and consensus

3. Results

In total, 61 potentially eligible studies were identified through the initial literature search. We excluded 48 records that were either duplicates or did not meet the inclusion criteria leaving us with 13 articles. Our secondary search yielded a further 56 records of which 50 were excluded leaving 6 additional articles, bringing the total to 19 articles which ultimately met the inclusion criteria. The characteristics of the studies included are displayed in Table 1.

3.1. Primary outcome- Postoperative pain relief

One of the most challenging issues that affect the patient’s motor function and return to normal activities is postoperative pain. Multimodal analgesia is often

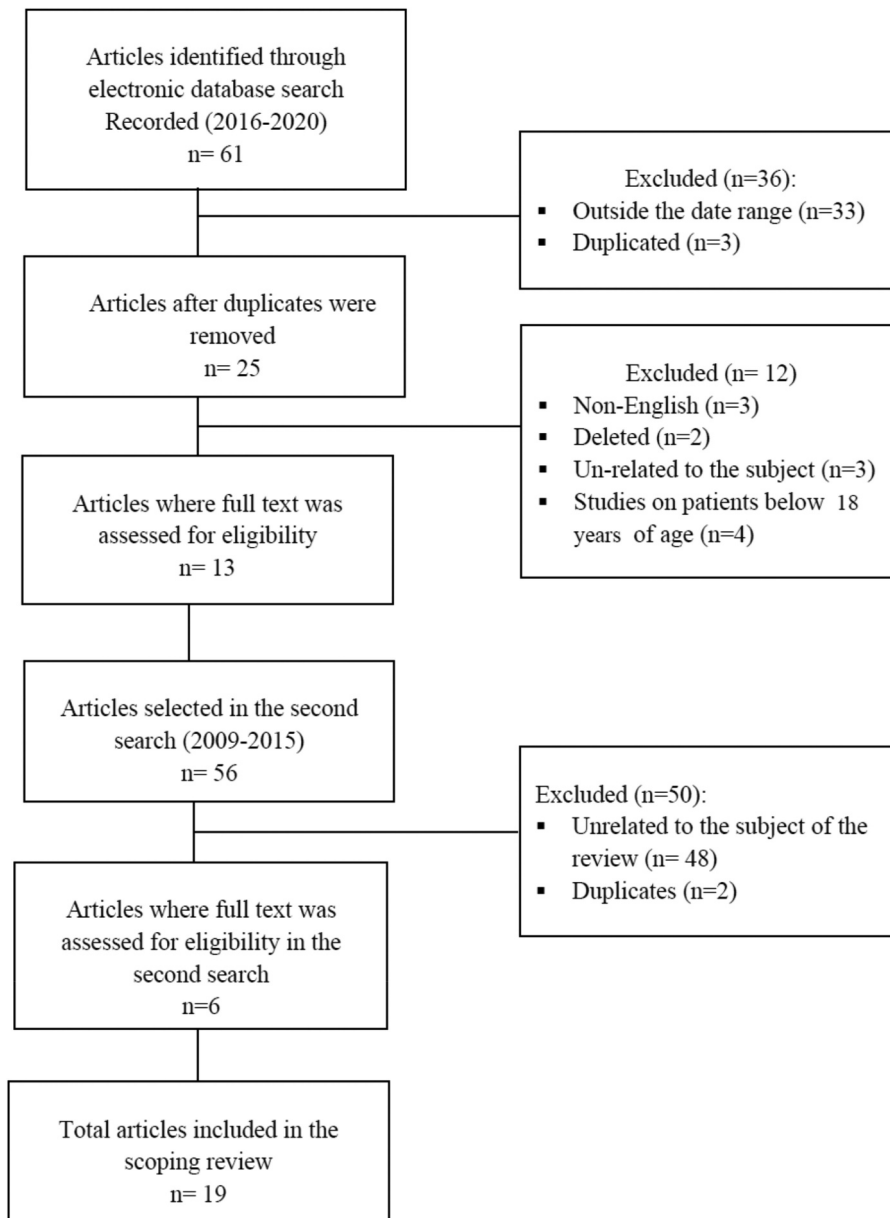


Figure 1. Flow chart of TAPB study selection.

considered to improve the satisfaction of the patient and to decrease the incidence of side effects associated with increased consumption of analgesic. TAPB is one of the analgesic modalities that manage post-operative pain and reduce analgesic consumption in the intraoperative and the postoperative period. In our search we found 13 articles discussing the efficacy of TAPB on pain relief by using different types of pain scales including the Visual Analogue Scale (VAS), verbal numerical rating scales to measure the intensity of pain at rest and during movement.

Bhatia et al., (2014) performed a prospective randomized and double blinded study on 60 patients focusing on measuring the pain score by using VAS during rest and movement. Three groups were randomly selected, each group consisted of 20 patients. Standard general anesthesia was given to the first group while the second group received posterior TAPB and the last group

received subcostal TAPB. Patients receiving subcostal TAPB had significantly reduced pain scores at rest and during movement [5].

Shin et al., (2014) performed a randomized controlled observer blinded study on 45 patients assessing the effect of Oblique Subcostal Transversus Abdominis Plane Block (OSTAP) compared to lateral TAPB on verbal numerical rating scale pain score reduction after laparoscopic cholecystectomy. The authors concluded that OSTAP was more effective in comparison to lateral TAPB [6].

Tolchard et al., (2012) performed a randomized study on 43 patients aiming to measure the serial VAS values for patients who received subcostal TAPB. Their results demonstrated significantly lower pain scores in patients receiving TAPB compared to patients who received local port site infiltration [7].

Table 1. Characteristics of the studies included in the review.

Author(s)	Year	Place	Age	N	Pain Score	Outcomes				
						Intraoperative opioid consumption	Postoperative opioid consumption	Side effects (PONV)	Length of hospital stay	Functional recovery
TAPB in comparison to port site local infiltration										
Tolichard et al. [7].	2012	UK	Adult	43	↓	↓	↓	↓	↓	↓
Araújo et al. [14].	2017	Portugal	Adult	39	-	-	-	-	-	-
Wu et al. [21].	2019	China	Adult	180	↓	↓	↓	↓	↓	↓
Baral & Poudel [8]	2018	Nepal	Adult	60	↓	↓	↓	↓	↓	↓
Arora et al. [9].	2016	India	Adult	71	↓	↓	↓	↓	↓	↓
Kadam et al. [1].	2016	Australia	Adult	48	-	-	-	-	-	-
Bava et al. [16].	2016	India	Adult	42	↓	↓	↓	↓	↓	↓
Rashid et al. [15].	2017	UK	Adult	71	-	-	-	-	-	-
Comparison between different techniques of TAPB and different local anesthetic drugs, concentrations, and adjuvants that were used										
Bhatia et al. [5].	2014	India	Adult	60	↓	↓	↓	↓	↓	↓
Ra et al. [12].	2010	Korea	Adult	54	↓	↓	↓	↓	↓	↓
Shin et al. [6].	2014	Korea	Adult	45	↓	↓	↓	↓	↓	↓
Salimnia et al. [19].	2015	Iran	Adult	54	↓	↓	↓	↓	↓	↓
Yoshiyama et al. [11].	2016	Japan	Adult	67	↓	↓	↓	↓	↓	↓
Hutchins et al. [10].	2016	USA	Adult	59	↓	↓	↓	↓	↓	↓
Analgesic efficacy of TAPB in comparison to conventional analgesics										
El-Dawlatly et al. [17].	2009	Saudi Arabia	Adult	42	↓	↓	↓	↓	↓	↓
Petersen et al. [13].	2012	Denmark	Adult	80	↓	↓	↓	↓	↓	↓
Chen et al. [18].	2013	Malaysia	Adult	40	-	-	-	-	-	-
Jain et al. [20].	2019	India	Adult	50	↓	↓	↓	↓	↓	↓
Systematic Review										
Jakobsson et al. [24].	2015	Sweden	Adult	11 ^a	↓	↓	↓	↓	↓	↓

N: sample size, PONV: Postoperative nausea and vomiting, TAPB: Transversus abdominus plane block,

↑: Increase, ↓: Decrease, -: No Difference, ∅: Not Measured.

^aMeta- analyses.

Baral and Poudel, (2018) performed a prospective randomized interventional study aiming to measure the pain score for 60 patients who were divided into two groups; one received ultrasound guided subcostal TAPB and the other received port site infiltration. The pain score was evaluated by VAS postoperatively during rest and movement. Results showed a significant difference at rest in the initial two hours in favor of the TAPB group, and a significant difference up to one hour for this group on movement [8].

Arora et al., (2016) conducted a randomized study that focused on measuring the pain score for 71 patients. Thirty-five patients received ultrasound guided TAPB while 36 received port site infiltration. The pain score was evaluated by VAS at rest and on deep-breathing, knee-bending, and walking at 24 hrs postoperatively. The results showed significant reduction of pain scores in TAPB group compared to port site infiltration group at all times except at 1 and 4 hours postoperatively at rest, whereas on deep breathing the TAPB group had significantly reduced VAS at 6 hrs. Furthermore, on knee-bending and on walking, the TAPB group had significantly reduced VAS at 24 hrs compared to the port site infiltration group [9].

Hutchins et al., (2016) carried out a prospective randomized observer blinded study on 59 patients to compare subcostal TAPB using liposomal bupivacaine versus non-liposomal bupivacaine for postoperative pain relief following laparoscopic nephrectomy donor surgery. Their findings showed that the maximal pain score for patients receiving liposomal bupivacaine were significantly lower compared with those receiving non-liposomal bupivacaine in the first 24–48 hours following surgery, unlike the minimum pain scores which were the same for the two groups [10].

Yoshiyama et al., (2016) conducted a retrospective study on 34 patients receiving lateral TAPB and 33 patients who received posterior TAPB. The patients were evaluated for pain using the VAS at rest throughout the first 24 hours following surgery. Patients receiving posterior TAPB showed significantly lower VAS pain scores compared to those who received lateral TAPB [11].

Ra et al., (2010) conducted a randomized study on 54 patients divided into 3 groups. Patients in the control group did not receive ultrasound guided TAPB while the other groups received TAPB with 30 ml of 0.25% or 0.5% levobupivacaine. The verbal numerical rating scale was measured at 20 minutes, then at ½, 1, 6, 12 and 24 hours after surgery and reported significantly lower pain scores compared to the control group which did not receive the ultrasound guided TAPB [12].

Petersen et al. (2012) performed a randomized, double-blind study, of 80 patients undergoing laparoscopic cholecystectomy who were allocated to

receive either bilateral ultrasound guided posterior TAP blocks (20 mL 0.5% ropivacaine) or placebo blocks. The authors found that patients who received TAP block in addition to a basic analgesic regimen with acetaminophen and ibuprofen had reduced pain scores while coughing as well as reduced morphine consumption in the first 2 postoperative hours as compared to placebo. The authors concluded that the procedure was without reported complications and may be considered as part of multimodal analgesic treatment for laparoscopic cholecystectomy in day-case surgery. [13]

On the other hand, Araújo et al., (2017) performed a prospective study on 39 patients who received TAPB or port site local infiltration. The study focused on measuring the pain score by using VAS at rest and while coughing upon admission to the post-anesthesia care unit, and at patient discharge as well as one day after surgery. The results demonstrated no significant difference in VAS score among groups [14].

Similarly, Kadam et al., (2016) carried out a retrospective study on 48 patients divided into 2 groups. Group 1 received TAPB and consisted of 29 patients while group 2 received local infiltration and consisted of 19 patients. The study aimed to evaluate the pain score at two points upon the arrival to the recovery room and after 1 hour of admission to the recovery room. The results showed no significant difference in pain score among groups [1].

Again, Rashid et al. (2017) performed a randomized controlled study on 71 patients who were randomized to receive either TAP block or wound infiltration. The TAP blocks were performed under ultrasound guidance to deliver 40 ml of 0.25% bupivacaine post-induction into the transverse abdominis plane. The control group received 40 ml of 0.25% bupivacaine injected around the trocar and the extraction site by the surgeon. The authors concluded that infiltration of port and extraction sites with local anesthetic (LA) at the end of surgery was equivalent to bilateral ultrasound-guided TAP blocks performed on induction using the same concentration and volume of LA, in terms of total morphine consumption, pain control and recovery 6 h after surgery [15].

Furthermore, Bava et al. (2016) conducted a study on 42 patients undergoing single injection laparoscopic cholecystectomy (SILC) who were randomized to receive either ultrasound-guided (USG) bilateral mid-axillary TAP blocks with 0.375% ropivacaine or local anesthetic infiltration of the port site. The primary outcome measure was the requirement of morphine in the first 24 h postoperatively. The authors demonstrated that USG bilateral TAP blocks were not as effective in decreasing 24 h morphine requirement as local anesthetic infiltration although it provided some analgesic benefit intraoperatively and in the initial 4

h postoperatively. The authors added that the benefits of TAP blocks were not worth the effort and time spent for administering them for this surgery [16].

Overall, most of the articles (9 out of 13 reviewed articles) found that the use of TAPB for pain control in laparoscopic surgeries resulted in reduction of pain scores as assessed by different types of pain scales in comparison to other methods used for pain relief. Accordingly, TAPB can be considered an effective method for analgesia following laparoscopic surgeries in adults.

3.2 Secondary outcomes

3.2.1. Effect of TAPB on intraoperative and postoperative opioid consumption

Analgesia is an essential component of GA which is frequently accomplished by giving systemic opioids which can be associated with a number of serious side effects. Several ways exist that may contribute to the reduction of intraoperative as well as postoperative consumption of analgesics; this includes the use of TAPB. Five articles were found discussing the effect of TAPB on intra and postoperative analgesic consumption.

El Dawlatly et al., (2009) performed a prospective randomized double-blind study on 42 patients aiming to measure the intraoperative opioid consumption during laparoscopic surgery. Patients were divided into two groups, one received TAPB and showed a decrease in the amount of opioid consumed compared to the other group who did not receive TAPB [17].

Similarly, Chen et al., (2013) performed a randomized controlled trial that measured the intraoperative opioid consumption during laparoscopic cholecystectomy for 40 patients divided into two groups, 20 received OSTAP while the other group received intravenous morphine. Results showed that the group that needed more rescue fentanyl was the intravenous morphine group [18].

Bhatia et al., (2014) conducted a prospective randomized double-blinded study on 60 patients to assess the analgesic consumption during the first 24 hours following laparoscopic surgery in three groups of patients. The results showed that patients receiving subcostal TAPB had reduced postoperative intravenous opioid consumption than the standard GA group and the posterior TAPB group [5].

Again, Saliminia et al., (2015) conducted a randomized, placebo-controlled, double-blinded study on 54 patients to assess the total analgesic consumption in the first 24 hours following laparoscopic surgery. The results showed that the group that received TAPB with normal saline consumed more opioids postoperatively than the group that received TAPB with bupivacaine and the group that received TAPB with sufentanil as an adjuvant [19].

On the other hand, Araújo et al., (2017) conducted a prospective study on 39 patients who received TAPB aiming to measure the analgesic consumption during laparoscopic nephrectomy in comparison to local infiltration. The results showed no significant difference between the patients who received TAPB and those who received local infiltration as regards intraoperative analgesic consumption [14].

Overall, most of the articles (four out of five reviewed articles) demonstrated that the use of TAPB lead to a lower consumption of opioids in the intra and postoperative periods following laparoscopic surgical procedures as measured at different time intervals.

3.2.2. Effect of TAPB on incidence of PONV, quality of functional recovery, and length of hospital stay

Most patients in the reviewed studies were diagnosed with diseases such as cholecystitis, appendicitis etc., that required laparoscopic surgeries. These conditions together with the use of opioid analgesics can lead to various complications and side effects such as PONV that may result in prolonged hospital stay. As a result, the quality of functional recovery may be affected. We reviewed several studies that examined the effects of TAPB on these complications.

3.2.2.1 Side effects such as PONV.

Jain et al., (2019) performed a prospective randomized single-blinded study on 50 patients targeting to measure the incidence of side effects such as PONV following laparoscopic surgery. Patients were divided into two groups, one of them received conventional systemic analgesia and showed an increase in the incidence of PONV compared to the second group who received pre-incisional TAPB combined with systemic analgesia [20].

On the other hand, Arora et al., (2016) conducted a randomized study that measured the incidence of PONV in 71 patients. Thirty-five patients received ultrasound guided TAPB while the other 36 received port site infiltration. The results showed no significant difference in PONV between the two groups [9].

Similarly, Baral and Poudel, (2018) conducted a prospective randomized interventional study on 60 patients to measure PONV after laparoscopic surgery. Patients were divided into 2 groups. Group 1 received ultrasound guided subcostal TAPB and Group 2 received port site infiltration. The results showed no significant difference in the incidence of PONV between the two studied groups [8].

3.2.2.2 Length of hospital stay

Hutchins et al., (2016) performed a prospective randomized observer blinded study on 59 patients to assess the length of hospital stay for patients who received TAPB with liposomal bupivacaine in comparison with

those who received non-liposomal bupivacaine. Their results suggested that the length of hospital stay was significantly lower in patients receiving liposomal bupivacaine [10].

Similarly, Jain et al., (2019) performed a prospective randomized single-blinded study on 50 patients aiming to assess the length of hospital stay following laparoscopic surgery. The first group received conventional analgesia whereas the second group received pre-incisional TAPB in addition to systemic analgesia. The results showed significant decrease in hospital length of stay for the group that received pre-incisional TAPB [20].

3.2.2.3 Quality of functional recovery

Jain et al., (2019) conducted a prospective, randomized, single blinded study on 50 patients who underwent laparoscopic intraperitoneal-only mesh repair (IPOM) aiming to assess the functional recovery. Patients were divided into 2 groups. Group 1 consisted of 25 patients who received conventional systemic analgesia while the Group 2 received pre-incisional TAPB in addition to conventional systemic analgesia. Group 2 demonstrated a significantly improved functional recovery compared to group one at 12 and 24 hours following surgery [20].

On the other hand, Wu et al., (2019) conducted a randomized double blinded inferiority study on 180 patients divided into 3 groups. The study aimed to compare the functional recovery including sleep quality and unassisted walking time. A mixture of ropivacaine and dexmedetomidine was injected around the trocar for the first group, while the second group received ultrasound guided posterior TAPB and the third group received both. No difference was found in unassisted walking time, and sleep quality among the three groups [21].

Similarly, Araújo et al., (2017) performed a prospective study on 39 patients to compare the difference in functional recovery following laparoscopic surgery between patients who received TAPB and those who received local anesthetic infiltration. There was no statistically significant difference in functional recovery between the two groups [14].

Overall, most of the reviewed articles found that there were no significant differences in the incidence of PONV or the quality of functional recovery between patients who received TAPB and those who received other analgesic modalities. However, the length of hospital stay was lower in patients receiving TAPB as shown by one reviewed study.

4. Discussion

This scoping review surveyed the literature on the effects of ultrasound guided TAPB on postoperative pain relief, analgesic consumption, and the incidence

of adverse effects in adult patients undergoing laparoscopic surgeries. The use of TAPB for pain control in laparoscopic surgical procedures resulted in a reduction of pain scores as assessed by different types of pain scales in comparison to other methods used for pain relief. In addition, most of the reviewed articles found that TAPB resulted in a reduction of opioid consumption which in turn may decrease the incidence of opioid related side effects, reduce the length of hospital stay and decrease the complications associated with prolonged hospitalization. However, the use of ultrasound guided TAPB did not significantly decrease the incidence of PONV or improve the quality of functional recovery as compared to other analgesic modalities.

Scoping reviews help to map the available literature. By reviewing the current literature, we found that there was an abundance in studies comparing TAPB to port site local infiltration as well as studies comparing the different techniques of TAPB. There was also a good number of studies comparing the analgesic efficacy of TAPB to conventional analgesic techniques such as systemic opioid administration. On the other hand, there were gaps in the literature as regards the effects of TAPB on hospital length of stay, quality of functional recovery, and side effects related to opioid consumption. These lacunae in available evidence need to be addressed in further studies.

Laparoscopic surgeries are associated with pain and discomfort that may cause a number of side effects such as PONV, delayed functional recovery and increased length of hospital stay [22]. Opioids are efficient methods used to manage pain after laparoscopic surgeries, however their use is frequently accompanied by nausea, vomiting, pruritus, and respiratory depression which may in turn lead to poor patient outcomes and increased cost [12]. TAPB is a technique of regional anesthesia first described by Rafi in 2001, that blocks the afferent fibers in the abdominal wall by injection of a local anesthetic solution in the neurofascial plane between the internal oblique and the transversus abdominus muscle [23]. Several approaches exist for TAPB including subcostal, lateral, posterior and OSTAP. The first approach which is subcostal TAPB blocks the cutaneous nerve fibers supplying the area of upper abdomen below the xiphoid process and parallel to the costal margin. Lateral and posterior TAPB block the nerve fibers supplying the anterior abdominal wall at the infra-umbilical region. However, the lateral approach provides the possibility of blocking the nerve supply to the lateral abdominal wall between the iliac crest and the costal margin. The fourth and last approach is the oblique subcostal TAPB (OSTAP) that blocks the nerve supply to the upper and lower abdomen [3].

Our results showed that TAPB provided superior pain relief after laparoscopic surgery as compared to local anesthetic infiltration and systemic opioids

regardless of the techniques and drugs used. These results support the findings obtained by Jakobsson et al., (2015) who summarized a meta-analysis conducted by Zaho et al. aiming to review the efficacy of TAPB on pain relief after laparoscopic surgery. The meta-analysis included 14 studies and a total of 905 patients. The results showed that pain scores were significantly reduced 6 hours after surgery. However, there were no difference in pain scores after 24 hours [24]. Again, Bava et al., (2016) conducted a prospective, randomized controlled double-blind trial that compared the analgesic effect of bilateral ultrasound guided TAPB with local anesthesia infiltration in laparoscopic cholecystectomy in 43 patients. Pain scores were evaluated by using VAS at rest and on coughing. The results showed lower VAS for the TAPB group at rest in the initial 4 hours while on coughing there was no reduction in VAS during the first 12 hours postoperatively [16].

On the other hand, Wu et al., (2019) conducted a randomized, double-blind study on 180 patients undergoing laparoscopic procedures. Their results showed that bilateral ultrasound guided subcostal TAPB and local anesthesia infiltration had the same results on postoperative pain relief as measured by VAS. However, subcostal TAPB was found to be superior as it could be easily performed in a short time [21]. Similarly, Rashid et al., (2017) carried out a randomized controlled double blinded study on 71 patients to demonstrate the benefits of ultrasound guided TAPB compared to local infiltration in laparoscopic surgery of the colon. The pain scores were recorded using the VAS at 6 hrs, 12 hrs, 24 hrs, and 48 hrs after surgery. The results showed no significant difference between ultrasound guided TAPB and local infiltration as regards pain scores during the first 24 hours following the surgery [15]. The discrepancies between our results and those obtained by Wu et al., (2019) may be explained by the fact that various types of laparoscopic surgeries were included in our scoping review as opposed to including a specific type of surgery in their trial.

Our results also showed that the use of TAPB decreased the overall consumption of opioids intraoperatively and postoperatively following laparoscopic surgery. These results confirm the findings obtained by Arora et al., (2016) who performed a randomized trial that measured the opioid consumption for 71 patients undergoing laparoscopic repair of inguinal hernia. In their study, 35 patients received ultrasound guided TAPB while the second group received port site infiltration. The results showed that the fentanyl requirements in the intraoperative period were lower for patients who received ultrasound guided TAPB [9]. Similarly, Baral and Poudel, (2018) conducted a prospective randomized interventional study to compare the analgesic effect of ultrasound guided subcostal

TAPB with port site infiltration and the need for rescue analgesia as well as opioids consumption. Sixty patients divided into 2 groups were included in this study. The first group received bilateral ultrasound guided subcostal TAPB with 10 ml of 0.25% bupivacaine postoperatively whereas the second group received a similar amount of local infiltration in the laparoscopic port sites. The results showed lower need for rescue analgesia and 24 hour opioid consumption in patients receiving subcostal TAPB [8].

On other hand, Chen et al., (2013) performed a prospective, randomized, controlled study on 40 patients. The patients who were involved in the study were divided into 2 equal groups; one group received OSTAP, and the other group consisted of 20 patients who received intravenous morphine. The results demonstrated no significant difference in postoperative opioid consumption between the two studied groups [18]. This can be explained by the fact that TAPB is effective in relieving somatic pain after laparoscopic surgery. However, visceral pain may still require the addition of systemic analgesic agents as a part of multimodal analgesia to better improve patient outcomes.

The results of our scoping review showed that TAPB did not decrease the incidence of PONV in patients undergoing laparoscopic surgery. These results support the findings obtained by Petersen et al., (2012) who conducted a randomized placebo controlled clinical trial that measured the incidence of side effects such as PONV in 80 patients who were undergoing laparoscopic cholecystectomy and were divided into groups to receive either bilateral ultrasound guided posterior TAPB (20 ml 0.5% ropivacaine) or placebo. The results showed no significant differences in incidence of PONV between the group receiving TAPB and the group receiving placebo [13]. Similarly, Chen et al., (2013) conducted a prospective, randomized, controlled study on 40 patients who underwent laparoscopic cholecystectomy. Twenty patients received OSTAP while the other 20 received intravenous morphine. PONV was measured using the same scoring system, however the authors could demonstrate no significant differences among groups [18].

On the other hand, Yoshiyama et al., (2016) conducted a retrospective study on 67 patients to assess the efficacy of posterior TAPB in comparison to lateral TAPB for patients undergoing laparoscopic gynecologic surgical procedures. Patients were divided into 2 groups; the first group received lateral TAPB while the other group received posterior TAPB. The incidence of PONV was assessed in the first 24 hours following the surgery. The results showed that the incidence of PONV was significantly lower in patients receiving posterior TAPB [11]. These conflicting results regarding PONV may be explained by the fact that PONV following laparoscopic surgery may be influenced by several

confounding factors including the type of laparoscopic surgery, patient characteristics, and preexisting medical conditions. Hence, there is difficulty in assessing the effect of a specific type of analgesic technique on the incidence of this complication.

The findings that were obtained in our scoping review could not support a decrease in the hospital length of stay among patients receiving TAPB as compared to those receiving other analgesic modalities. A single study conducted by Jain et al., (2019) to compare the length of hospital stay following laparoscopic surgery between patients receiving conventional analgesia and those receiving pre-incisional TAPB showed a decrease in hospital length of stay for patients that received TAPB [20]. Conflictingly, the prospective study carried out by Araújo et al., (2017) on 39 patients who underwent laparoscopic nephrectomy could not demonstrate any difference in hospital length of stay between patients receiving trocar site infiltration and those receiving unilateral ultrasound guided TAPB after induction [14]. Similarly, Rashid et al., (2017) who conducted a double-blind randomized controlled trial on 70 patients to compare the effect of TAPB and port site local infiltration on the hospital length of stay after elective laparoscopic colonic surgery found no significant difference in hospital stay between the two groups [15]. However, the limited number of reports related to this outcome prevent us from drawing conclusions about the relative benefit of TAPB regarding hospital length of stay.

Furthermore, the results of our review showed that TAPB had no significant effect on quality of functional recovery such as mobilization, sleep quality, etc. as compared to patients who did not receive TAPB or who received port site local infiltration. These results support the findings obtained by Rashid et al., (2017) who conducted a double-blind randomized controlled trial on 71 patients who were scheduled for laparoscopic colonic surgery and were divided randomly into two groups to assess the functional recovery of patients. Group 1 received bupivacaine 0.5% by ultrasound guided TAPB post-induction while group 2 received bupivacaine 0.25% injected around the port site. The results showed no significant difference in the time of mobilization among groups [15]. On the other hand, Ra et al., (2010) conducted a randomized study on 54 patients to assess the functional recovery for patients who received TAPB after laparoscopic cholecystectomy. The patients who were involved in the study were divided into 3 groups, the control group did not receive TAPB whereas the other two groups received TAPB with concentrations of bupivacaine 0.25% and 0.5% respectively. The results showed that the group that received TAPB with 0.5% bupivacaine had a significantly lower incidence of sleep disturbances that lead to a better functional recovery [12]. Again, the limited number of reports regarding this

outcome prevent us from drawing definite conclusions as regards the effect of TAPB on the quality of functional recovery following laparoscopic surgery.

5. Conclusion

This scoping review suggests that TAPB is an effective technique for analgesia which can be used post-induction or before the end of laparoscopic surgeries. Based on the results in this scoping review, it was evident that intra and postoperative opioid consumption was reduced in patients receiving TAPB while no generalizable difference could be demonstrated in the incidence of PONV and patients' functional recovery or length of hospital stay due to the limited number of reports discussing these outcomes. Further studies are required to better elucidate the effect of TAPB on the incidence of side effects and on patient recovery.

Disclosure statement

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