Combined Subcostal and Posterior Transversus Abdominis Plane Block for Postoperative Pain Relief after Abdominoplasty: A Randomized Clinical Trial

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Abstract

Background: Abdominoplasty is a common esthetic surgery for adequate pain management during the postoperative period. Transversus abdominis plane block (TAPB) is a therapeutic complement for analgesia for postoperative pain following abdominal surgery.

Aim: To compare the outcomes of TAPB and systemic opioids in patients undergoing abdominoplasty.

Methods: Fifty-eight patients undergoing abdominoplasty were randomly assigned to two groups: Combined subcostal and posterior TAPB group (BG, n=29) and Control group (CG, n=29). The standard postoperative analgesic regimen for both groups consisted of IV Paracetamol 1 g every 6 h. The visual analog scale (VAS) scores for pain were recorded postoperatively, and once the patient had a VAS ≥4, IV pethidine was administered. The primary outcome was pethidine consumption in the first 72 h postoperatively; the secondary outcomes included VAS scores at rest and during movement in the first 72 h postoperatively, time to first ambulation, and time to first incentive spirometer at 900 mL/min.

Results: Pethidine consumption in the first 72 h was 208.62±85.64 in the CG group and 20.69±25.06 in BG ($p<0.05$). VAS was lower in BG during the first 72 h both at rest and during movement ($p<0.05$). Time to first ambulation was 12.41±5.04 h in the CG group and 4.62±1.08 h in BG ($p<0.05$), time to first incentive spirometer at 900 mL/min was 11.45±5.05 h in CG and 4.27±1.09 h in BG ($p<0.05$).

Conclusion: Combined subcostal and posterior TAPB offers a longer postoperative analgesic effect and reduced postoperative opioid requirements with fewer postoperative complications.

Trial Registration

Clinical Trial: TCTR20200602001 "Retrospectively registered"

Date of registration on May 30, 2020.

Background

Abdominoplasty is an esthetic surgical procedure. It is estimated that more than 800,000 people undergo this surgery every year, making it the sixth most common cosmetic procedure worldwide.[1] It is performed to improve the abdominal wall contour by removing the redundant skin and fat from the abdominal region and includes rectus sheath plication and umbilicus transposition. The procedure can be combined with liposuction for further improvement of the contour.[2] It is generally an elective procedure undergone by healthy patients whose expectations can be ruined by a subsequent complication.[3] Complications of abdominoplasty vary in severity and in the impact they have on the esthetic outcomes. Postoperative pain is the main cause of both delayed ambulation in patients and respiratory complications. Respiratory insufficiency or distress may develop secondary to the plication of the rectus abdominis sheath or due to excessive tension, which can be further complicated by the respiratory depressant effects of the opioids

used for analgesia.[4] Systemic complications are the most feared due to their severity. Delayed patient ambulation postoperatively increases the risk of developing deep vein thrombosis.[5] Reports of fat embolism following abdominoplasty are scarce.[6] Reduction of pain during the postoperative period leads to earlier ambulation, shortening of hospital stay, reduced hospital costs, and increased patient satisfaction.

Recently, systemic painkillers have been found to be more effective but they too have their limitations, especially opioids, which are associated with dose-related side effects including nausea, vomiting, drowsiness, and respiratory complications. Hence, the use of multimodal analgesia technique is preferred for additive or synergistic analgesic effect while minimizing the adverse events caused by larger doses of a single analgesic. Nerve block is considered as the cornerstone of multimodal analgesia technique for postoperative pain control as it possesses all these characteristics.[7]

Patients undergoing such surgeries usually suffer from preoperative emotional stress and anxiety due to the expected postoperative pain. The pain following abdominal surgeries has two components: somatosensory pain originating from the cutaneous, subcutaneous, and muscular layers of the incision site; and visceroperitoneal inflammatory pain involving the viscera and deeper peritoneal layers.[8]

Abdominoplasty is an extraperitoneal surgical procedure that is devoid of the visceroperitoneal pain component. Besides the extensive incision, most of the pain is initially related to the fascial plication of the abdominal wall.[9] Hence, adequate pain management during the postoperative period is of utmost importance. Previous studies on pain management after abdominoplasty have failed to cover adequate analgesia beyond the recovery room. Therefore, the search for a safe and reliable analgesic technique for complete postoperative pain management continues.[10]

TAPB is a regional anesthetic technique that involves injecting a local anesthetic (LA) in the neurovascular plane between the transversus abdominis muscle and the internal oblique muscle, for providing an early postoperative analgesic effect and reducing analgesic requirements.[11] it was used as a method of analgesia in many types of abdominal surgeries.[12] There are various techniques for performing a TAPB (subcostal, lateral, and posterior), each one providing different dermatomes coverage. The appropriate technique should be selected based on the surgical incision and the dermatomes involved. The subcostal TAPB covers the T6 to T9 dermatomes and is usually suitable for upper abdominal surgeries. Lateral TAPB is for T10 to T12 dermatomes whereas the posterior TAPB approach covers T9 to T12 and L1, and is known to provide analgesia for a longer duration with some visceral analgesic effect.[13]

The use of ultrasound-guided TAPB in such cases require more experience in spite of the technique is an easy procedure but the presence of excessive redundant abdominal wall and fat folds, overweight patients also tissue edema after liposuction all has its own limitations.[14]

We hypothesized that abdominal wall nerve blocks provide an efficient sensory block to cover the postoperative pain caused by abdominoplasty, which allows the patients to start early ambulation postoperatively and prevention of respiratory complications and nausea caused by opioids. Therefore, this study was designed to investigate the outcome of ultrasound-guided, combined subcostal and posterior TAPB in patients undergoing abdominoplasty in comparison to those who depend on systemic opioids as the main postoperative analgesic agents. The primary outcome was pethidine requirement in the first 72 h postoperatively, and the secondary outcomes included VAS scores in the first 72 h postoperatively, time to ambulation initiation, and time to first incentive spirometer at 900 mL/min.

Methods

This prospective, randomized, controlled study was conducted on 58 patients undergoing abdominoplasty, in accordance with the CONSORT guidelines,[15] after obtaining the hospital ethics committee's approval and informed written consent from all patients. The study adhered to the principles of the Declaration of Helsinki, 7th revision (2013).

Based on a previous study,[6] the reduction in the mean dose of postoperative analgesic opioids was 39%. Authors considered a 25% increase in the reduced mean dose of opioids requirement postoperatively to 64% to be clinically significant. Assuming an α error of 0.05, β error of 0.1, and the power of study to be 90%, 24 patients were needed in each group to detect any clinical effect. We enrolled 29 patients in each group to accommodate for any dropout.

The inclusion criteria comprised patients undergoing abdominoplasty with rectus sheath plication and those with the American Society of Anesthesiologists (ASA) physical status (I-II).[16] Exclusion criteria consisted of patients with a history of known hypersensitivity to local anesthesia, psychiatric disorders, and use of psychiatric medications, and patients refusing to participate in the study.

Patients were randomly assigned through computer-generated numbers using the random allocation software QuickCals (GraphPad Software Inc., La Jolla, CA, USA) to two groups – BG (n=29) and CG (n=29).

Preoperatively, the patients were educated on the use of the incentive spirometer and VAS to monitor their pain postoperatively (wherein 0 represented no pain and 10 indicated the worst possible pain).

The anesthesia management for all patients was the same. On arrival in the operation theater, patients were monitored using electrocardiography (ECG), non-invasive blood pressure (NIBP) measurement, and pulse oximetry. Intravenous infusion of warm Ringer's lactate solution was initiated. All patients received general anesthesia. Midazolam 0.03 to 0.05 mg/kg was given intravenously after adequate pre-oxygenation anesthesia was induced by IV fentanyl 1 to 2 μg/kg, propofol 1.5 to 2 mg/kg, and cisatracurium 0.15 to 0.2 mg/kg. Tracheal intubation was done and the ventilator settings were adjusted to maintain the end-tidal carbon dioxide tension at 30 to 35 mmHg. Anesthesia was maintained using 1.2 Monitored Anesthesia Care (MAC) isoflurane, 40% oxygen and 60% nitrous oxide mixture, and IV

cisatracurium in incremental doses. Also, incremental doses of morphine 0.01 to 0.03 mg/kg were given intraoperatively with an interval of 30 min between each dose or when needed to avoid any increase in the vital signs of >20% of basic vitals preoperatively.

Standard abdominoplasty and rectus sheath plication with or without liposuction were performed for all patients by the same experienced surgeon. The procedure was initiated with liposuction, if indicated, by infiltrating the subcutaneous abdominal layer with normal saline mixed with adrenaline, followed by the suctioning of most of the fat layer using a 2-4 mm cannula through small skin incisions.

For abdominoplasty – initially, the umbilicus was separated from the abdominal wall through a circular incision and a dissection was performed along the umbilicus stalk. Then, an incision was made horizontally at the pubic hair boundary, approximately 3-4 cm caudal to the anterior superior iliac spine on both sides. The flap was dissected cranially along the superficial fascia in a lateral direction as far as the xiphoid process and the costal arch while ensuring immediate hemostasis at all times.

Plication of the rectus sheath was carried out by doubling the fascia longitudinally to achieve a good result for the tightening of the abdominal wall. The first layer was sutured using interrupted mattress sutures whereas the second layer, which formed a sort of a mesh, was sutured using a continuous loop suture. The flap was then pulled down and the excess skin/fat layer excised. The wound was closed in three layers. Finally, the new umbilicus site was created.

By the end of the surgery – a bilateral subcostal and posterior TAPB was done to provide a sensory block for the anterior abdominal wall dermatomes from T6 to L1 in the BG group after wound closure and dressing. Ultrasound-guided block was performed using a high-frequency linear probe 7-15 MHz, a 22-gauge needle for injection, and 2 mg/kg of isobaric bupivacaine 0.25% as local anesthetic with dexamethasone 0.1 to 0.2 mg/kg to increase the duration of local anesthesia. For the subcostal TAPB, the transversus abdominis muscle was identified starting beneath the rectus abdominis muscle. The target was to visualize the fascial plane between the internal oblique and transversus abdominis muscles where 10 mL of LA was injected on each side. For the posterior TAPB, the three layers of the abdominal wall muscles (external and internal oblique as well as the transversus abdominis muscles) were visualized, and the fascial plane between the internal oblique and the transversus abdominis muscles was injected with 15 to 20 mL of LA on each side.

The use of ultrasound aids in performing the block with a clear vision of the needle tip, and also for observing the spread of the LA which allows us to avoid injuring the internal structures (intestine/vascular) and to deposit just the right amount of LA to achieve the wanted effect without the risk of dose-related toxicity.

After completing the block, isoflurane was discontinued. Neuromuscular blockade was reversed with 0.025 to 0.05 mg/kg neostigmine and 0.01 to 0.02 mg/kg atropine, followed by extubation of all patients.

In the post-anesthesia care unit (PACU), where the patients were observed and monitored for 1 h; ECG, NIBP, pulse oximetry, respiratory rate, and effort were monitored as also the VAS at rest and during movement (or with knee flexion) at 1 h (H1). After arrival to PACU, all patients received IV pethidine 50 mg when VAS ≥4.

In the ward, patients' data were recorded for 72 h postoperatively, including opioids consumption, VAS at rest and during movement (or with knee flexion) at 3 h (H3), 6 h (H6), 12 h (H12), 24 h (H24), 36 h (H36), 48 h (H48), 60 h (H60), and 72 h (H72). Also, time to first ambulation and time to first incentive spirometer when the patient was able to reach 900 mL/min were recorded.

For all the patients, the analgesic regimen consisted of IV Paracetamol 1 g every 6 h. VAS values were recorded postoperatively and once the patient had a VAS ≥4, pethidine 50 mg IV was administered with an interval not less than 3 to 4 h between each pethidine dose and the VAS recorded every 30 min until the pain improved.

Data entry and analyses were performed using the SPSS statistical package, version 27 (SPSS, Inc., Chicago, IL, USA). The data were examined for normal distribution using the Shapiro-Wilk test. For parametric data, t-test was used for mean ± SD whereas for nonparametric data, Wilcoxon signed rank test was applied for median or frequency. The statistical significance level was set at $p \leq 0.05$, post-hoc power test SPSS was also performed using G power 3.1.9.7 to determine the sample size. All calculated P values were two-tailed.

Results

A total of 58 patients were included in the study and randomized into two groups: BG (n=29) and CG (n=29). Both groups were similar with regard to demographic characteristics, BMI, and ASA physical grade; where the p-value was >0.05 which was not significant (Table 1).

Total pethidine consumption during the first 72 h postoperatively was significantly higher in the CG group (208.62±85.64) compared to the BG group (20.69±25.06), and the difference was significant (p<0.0001) (Table 2).

The VAS at rest and during movement for the first 72 h postoperatively was significantly higher (p<0.0001) in the CG group compared to BG group (Figure 2).

Time to first ambulation postoperatively and time to first incentive spirometer when the patient was able to reach 900 mL/min postoperatively were both significantly higher in CG (12.41±5.04, 11.45±5.05 h, respectively) when compared to BG (4.62±1.08, 4.27±1.09 h, respectively) and the difference was significant (p<0.0001) (Table 2).

Discussion

Our results were in agreement with those of Araco et al[17] who reported that TAPB reduced the stress response and facilitated earlier rehabilitation and recovery; and also with the findings of Abo-Zeid et al who noted that direct bilateral TAPB offered longer postoperative analgesia and required lesser morphine consumption when compared with rectus sheath block (RSB) and subcutaneous infiltration (SCI).[18]

Abd El-Hamid et al concluded that patients with TAPB had lower pain scores and less total postoperative morphine requirements compared to local anesthetic wound infiltration after open inguinal hernia repair.[19] Feng also described a combination of intercostal, pararectus, iliohypogastric, and ilioinguinal nerve blocks for abdominoplasty, and she reported substantial improvements in the pain scores and a reduction in narcotic use in her study.[20]

Hebbard described a modification of subcostal TAPB (oblique subcostal TAPB) that involved covering the anterior abdominal wall dermatomes from T6 to T12 and L1 and performing one needle prick only using a longer needle to inject local anesthesia in the TAP plane from the subcostal region to the iliac crest. But this procedure was difficult to perform and therefore, it did not gain popularity. The difficulty was in reaching the lower dermatomes and providing good coverage for the lower abdominal wall.[21] Eman reported that continuous bilateral ultrasound-guided TAPB or continuous local anesthetic wound infusion significantly decreased a total of 48 h postoperative PCA morphine consumption.[22]

On the other hand, Azawi et al found that local anesthetic wound infiltration was superior to TAPB with regard to postoperative analgesia after laparoscopic nephrectomy.[23] Kane also noted that TAPB did not improve the postoperative quality of recovery for patients undergoing total laparoscopic hysterectomy.[24] Verma et al described that quadratus lumborum block for post-cesarean section analgesia was superior to TAPB.[25]

With regard to the time to first ambulation in this study, it was significantly shorter in the BG group (4.62±1.08 h) when compared to the CG group (12.41±5.04 h). Effective pain management and early ambulation are both linked together and have a significant impact on recovery after a major surgery.[26,27] Early resumption of ambulation in the immediate postoperative period has been associated with a reduction in the incidence of thromboembolism. Several authors have suggested that there is a relationship between reduced mobility and increased risk of venous thromboembolism, proportional to the degree and length of time for which the patient is confined to bed.[28,29]

Our findings were in agreement with those of Morales et al who observed that liposomal bupivacaine injections for regional blocks in abdominoplasty with rectus plication resulted in patients resuming both earlier ambulation and normal activity.[30]

The time to first incentive spirometer 900 mL/min in this study was significantly shorter in the BG group (4.27±1.09 h) in comparison to the CG group (11.45±5.05 h).

General anesthesia and postoperative pain carry the risk of developing postoperative pulmonary complications including impaired respiratory drive and cough, and weakening of the immune system. It was found that residual neuromuscular blockade can be a major problem in the Canadian RECITE study (56.5% with a train of four ratios <0.9 on arrival in PACU).[31] An effective postoperative analgesia reduces postoperative pulmonary complications and also allows patients to breathe deeply, cough, and mobilize. Chest physiotherapy, early ambulation, sitting-up positioning, deep breathing, and coughing exercises may reduce postoperative pulmonary complications.

Conclusion

Inadequately managed postoperative pain is associated with numerous clinical side effects. The ultrasound-guided TAPB is a promising regional anesthetic technique for postoperative pain relief in abdominal surgery. It offers longer postoperative analgesia and fewer analgesics requirement. We recommend the routine use of combined subcostal and posterior TAPB as part of a multimodal analgesia regimen after abdominoplasty to enhance the recovery process.

Abbreviations

TAPB: Transversus Abdominis Plane Block

VAS: Visual Analog Scale

ECG: Electrocardiography

NIBP: Non-Invasive Blood Pressure

GA: General Anesthesia

CPAP: Continuous Positive Airway Pressure

ASA: American Society of Anesthesiologist

LA: Local Anesthesia

MAC: Monitored Anesthesia Care

Declarations

Hospital ethical committee's approval was obtained on 26/3/2017.

Consent for Publication: Not applicable.

Availability of Data and Materials: The data that support the findings of this study are available in the hospital's data system and can also be obtained from the authors upon reasonable request and

permission of the hospital committee.. An approval to release patients' medical data was taken from the hospital.

Competing Interests: The authors declare no conflicts of interest concerning the research, authorship, and publication of this article.

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Tables

Table 1: Demographic data, BMI, and ASA

Parameter		BG	CG	*P* value
Age (Years)	Mean±SD	42.97±10.7	41.17!9.8	0.540
BMI	Mean±SD	31.33!5.3	32.31!4.1	0.416
Gender	Male	3	3	1.000*
	Female	26	26	
ASA	I	13	17	0.285*
	II	16	12	

P is significant at ≤0.05.

*Chi-Square test.

ASA: American Society of Anesthesiology; BG: Blocked group; BMI: Body Mass Index; CG: Control Group; SD: Standard Deviation

Table 2: Pethidine Consumption/mg, time to first ambulation/hour and time to first incentive spirometer/hour

Parameter	BG	CG	*P* value
	Mean±SD	Mean±SD	
Pethidine/mg	20.69±25.1	208.62±85.6	<0.0001
Time to first ambulation/h	4.62±1.08	12.41±5.05	<0.0001
Time to first incentive spirometer/h	4.28±1.1	11.45±5.0	<0.0001

BG: Blocked Group; CG: Control Group.

Figures

Recruitment	58 Patients were assessed for eligibility	
Enrollment	58 Patients were enrolled in the study	
Randomization	BG(n=29)	CG(n=29)
Follow-up	BG(n=29)	GC(n=29)
Analysis	BG(n=29)	GC(n=29)

Figure 1

Consort flow chart of patients.