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Comparative Study between Levobupivacine versus Levobupivacaine Plus Dexmedetomidine for Transversus Abdominis Plane Block "TAP" in Post-Operative Pain Management after Abdominoplasty

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Abstract

Aim of the work

Transversus abdominis plane "TAP'' block has been reported to be effective for post-operative analgesia for patients undergoing surgery involving abdominal wall incision by blocking anterior branches of thoracolumbar nerves originating from T6 – L1 , which innervates anterior abdominal wall.

Dexmedetomidine has a well – known benefit in the relief of postoperative pain. The objective of this study is to evaluate effect of adding dexmedetomidine to levobupivacaine for preemptive TAP block in the post-operative pain management after abdominoplasty surgery.

Methods

Sixty nine ASA I and II patients undergoing cosmetic abdominoplasty surgery under general anesthesia were randomly assigned in a double – blinded study divided into 3 groups.

One group received bilateral TAP block performed by landmark – based technique with 20 ml 0.375% levobupivacaine plus 1 ml normal saline on each side "L group '' and second dexmedetomidine group "M group ''received same volume of levobupivacaine plus 100µg dexmedetomidinein 1 ml, third control group" C group "received 21 ml normal saline on each side all patients received the block after induction of anesthesia and before surgical incision.

Postoperative pain scores were recorded based on a visual analogue scale "VAS" using a 10 cm ruler where 0= no pain and 10 =worst possible pain just after full recovery and before administration of analgesics.

Patients received meperidine 1mg/kg for every 4 h either on demand or if pain score ≥ 3. Total dose of mepridine consumption was recorded.

Level of sedation, and side effects were also recorded.

Results

23 patients of each group complete the study. Patients in M, L groups had significant lower pain score as compared to C group.

Total postoperative 24 hours meperidine consumption in M, L group were significantly less than C group $p < 0.001$.

Total postoperative 24 hours meperidine consumption in M group was less than in L group P < 0.01.

There were a higher incidence of nausea, vomiting and use of anti-emetic in C group in comparison to L, M groups.

Conclusion

TAP block with 0.375 % levobupivacaine plus dexmedetomidine preemptively decrease pain score and postoperative narcotic consumption in patients undergoing cosmetic abdominoplasty surgery.

Introduction

The transversus abdominis plane "TAP" block is a new, rapidly expanding regional anesthesia technique that provides analgesia following abdominal surgery.

It involves a single large bolus injection of local anesthetic into an anatomical space between the internal oblique and transversus abdominis muscles [1].

With the aid of anatomical landmark guidance, local anesthetic is injected into the transversus abdominis fascial plane, where the anterior branches of thoracolumbar nerves originating from T6 to L1 are located.

Randomized controlled studies have demonstrated the efficacy of TAP block in providing postoperative analgesia for up to 24 hours after abdominal surgery but mainly for lower abdominal surgery [2-5].other reports found analgesic effect last up to 48 hours however some patient may need analgesia for longer than that [6].

Most reports limit the use of this technique to lower abdominal surgery with a success rate of approximately 85% in experienced hands this rate may be lower among the non-experienced [1- 6].

The point of entry for blind TAP block is the lumber triangle of Petit. This triangle is bounded posteriorly by latissimusdorsi muscle, anteriorly by external oblique and inferiorly by iliac crest the floor of the triangle from superficial to deep is composed of subcutaneous tissues and the fascial borders of external oblique, the internal oblique, and the transversus abdominis muscles respectively, [7].

This technique depends on feeling double pops as the needle traverse the external oblique and internal oblique muscle. A blunt needle will make loss of resistance more appreciable [8].

In the triangle of Petit, a blunt regional anesthesia needle is inserted perpendicular to the skin just cephaled to iliac crest and 2 cm behind mid - axillary line. And the transversus abdominis fascial plane is localized with a two pop sensation. first pop indicated penetration of the fascia of external oblique muscle and the second pop indicates penetration of internal oblique muscle and then entering the transversus abdominis fascial plane [8] in this neurovascular plane , a local anesthetic solution can be injected thus blocking the sensory nerves before innervating the different muscles of the anterior abdominal wall.

This blind TAP block technique is a regional anesthetic techniques in which large volume are administered bilaterally some authors administer volumes to an extent that a so called "flank bulge sign" is visible [9]. This blind TAP block technique is described as easy to perform and with few complications [10,11] however, the triangle of Petit may be difficult to palpate in obese patients [12].

It is very suitable in patients who are not candidates for epidural analgesia [13].

There is a single report of TAP block as a method of management hyperalgesia following major abdominal surgery [14].

Pockett [15] stated that noxious stimulation leads to the release of neurotransmitters that bind to various sub - classes of excitatory amino acid receptors. including NMDA receptors, activation of these receptors leads to calcium entry into the cell and initiates a series of central sensitization such as windup and long - term potentiating in the spinal cord in response to the prolonged stimuli, that's why preemptive analgesia is important decrease the release of these neurotransmitters.

&2 - adrenergic receptors agonists had been the focus of interest for their sedative, analgesic, and perioperative sympatholytic effects, Dexmedetomidine and Clonidine had been reported to produce opioid sparing effects in the perioperative setting [16,17]. Dexmedetomidine a potent & 2 adrenoceptor agonist, is approximately 8 times more selective than Clonidine [18].

The mechanism by which & 2 - adrenergic receptors agonist produces analgesia and sedation is not fully understood but likely to be multifactorial peripherally & 2 agonist produces analgesia by reducing the release of norepinephrine and causing &2 receptor- independent inhibitor effect on nerve fiber action potential. centrally &2 agonist produce analgesia and sedation by inhibition of substance P release in the nociceptive pathway at the level of the dorsal root neuron and by activation of &2 adrenoceptor in the locus coeruleus [19,20].

Jaakola et al. [21] demonstrated the analgesic efficacy of dexmedetomidine in human tourniquet pain. In that study, a single IV dose of fentanyl and dexmedetomidine "0.25. 0.5 and 1 µg/kg" was administered, they found that dexmedetomidine clearly demonstrated an analgesic effect in the tourniquet test the analgesic action of dexmedetomidine was not clearly dose dependent, an apparent ceiling effect was seen at the 0.5 µg/kg dose of dexmedetomidine.

Patients and Methods

Our current study was aprospective, randomized; double- blinded conducted at Ain - Shams University hospitals between April 2012 and May 2014.

After receiving approval from our hospital ethics committee and written informed consent were signed by 69 patients undergoing elective abdominoplasty. The patients were between 25 to 55 years of age, ASA I - II.

Exclusion criteria includes body mass index ''BMI'' > 35 kg/m^2, allergies to local anesthetic, alcohol or drug abuse, coagulation disorders, mental or physical illness interfere with evaluation of VAS, any patients need liposuction or rectus fundoplication, any patients with organomegaly.

The study was randomized, double blinded divided into 3 groups, 23 patients in dexmedetomidine group "group M", 23 patients in levobupivacaine "group L" and 23 patients in Control "group C".

Patients were assigned to the intervention or control groups by the institutional anesthesiologists by use of a sealed envelope technique. Both the patients and investigators were thus unaware of the study drug.

All patients were assessed preoperatively and familiarized with the use of the VAS, where 0 indicated that there was no pain and 10 indicated the worst pain.

All patients received general anesthesia, they were placed supine position. A standard monitor "ECG, noninvasive arterial pressure, pulse oximeter, capnography". Mean arterial blood pressure, heart rate, and oxygen saturation "SPO_2" were recorded first as a base line, then after induction of anesthesia, before TAP block and every 15 min till the end of operation.

Anesthesia was induced by intravenous fentanyl 1 µg/kg and intravenous propofol 2mg/kg and endotracheal intubation facilitated with atracurium 0.5 mg/kg.

Anesthesia was maintained using 2% sevoflurane in oxygen and air the concentration of agent was adjusted to maintain adequate depth of anesthesia "stable heart rate and blood pressure" within 20% of base line values, adjustment of intraoperative fentanyl was based on clinical signs and haemodynamic measurements as signs of inadequate analgesia and atracurium 0.1 mg/kg and as intermittent doses was required to ensure proper muscle relaxation. Prophylacticanti- emetic was not administered.

The TAP block was performed after induction of anesthesia but before surgical incision using the following technique. Complete sterile technique, with the anesthesiologist wearing sterile gloves and skin prepared with 10% povidone iodine, the bilateral TAP block were performed with 18 G Tuohy needle using mid-axillary land mark technique as described by Mc Donnell and colleagues [8].

With the patient in a supine position and the anesthesiologist standing on the contralateral side, the iliac crest was palpated from anterior to posterior until latissimusdorsi muscle insertion, the triangle of Petit was palpated, the skin over the triangle was pierced with the needle hold at right angle, the needle advanced until resistance indicated that the needle tip reach the fascial extension of the external oblique muscle. Further gentle advancement of the needle resulted in loss of resistance or pop sensation, as the needle entered the plane between the external and internal oblique fascial layers. Further gentle advancement resulted in second increased resistance and its loss indicated entry into TAP. After careful aspiration to exclude vascular puncture, attest dose of 1 ml was injected to identified any resistance indicates the needle is not between fascial planes and repositioned should be done.

TAP block with either 20 ml of 0.375 % levobupivacaine plus 1 ml normal saline bilaterally "L group" or with 20 ml of 0.375 % levobupivacaine plus 100 µg dexmedetomidine in 1 ml; Precedex 100 µg/ml (Hospira, inc, lake forest, USA). "M group" or with 21 ml normal saline bilaterally "C group". The drug solutions were prepared by an anesthesiologist not involved in the study. the anesthesiologist performing the block and observing the patient was blinded to the study group. Data collection was done by the same anesthesiologist who was unaware of the group allocation.

No one of the patients in study groups received any local anesthetics by surgeons as local infiltration or nerve block by agreement with surgeons. We choose abdominoplasty with no rectus plication nor liposuction only P fannenstiel incision used by surgeons who did not used mid - abdominal nor subcostal approach.

At the end of surgery, residual neuromuscular block was antagonized with atropine 0.02 mg /kg and neostigmine 0.04 mg/kg iv after tracheal extubation and awakening from anesthesia patients were transferred to the post anesthesia care unit "PACU" where another anesthesiologist was not one of the anesthesia team recorded the pain score on visual analogue scale "VAS" using a 10 cm ruler where 0= no pain and 10 =worst possible pain just after full recovery and before administration of analgesics.

Meperidine 1 mg /kg for every 4 hours given for postoperative pain relief if pain score > 3 or requested by patients ,the time to first dose of meperidine given was recorded and worst pain score was also noted . The total 24 hours meperidine consumption was estimated.

Post-operative side effects related to meperidine, e.g nausea and vomiting were recorded in the "PACU". Patients nausea and pruritis was rated using a categorical scale "0 = none, 1 = mild, 2 = moderate, and 3 = severe". Number of patients receiving 4 mg ondansetrone was recorded.

A sedation score was measured by using sedation scale " = awake and alert, 2 = slightly drowsy easily roused, 3 = drowsy, sleepy during conversation and 4 = somnolent, minimal or no response to physical stimulation".
We examine all patients in study groups for any abdominal injury

Side effects related to TAP block were recorded.

Statistical Analysis

The sample size for this study was based on a 50% reduction in the PCA mepridine requirement in 24 h from previous audit data (mean 235 mg, SD30.5 mg). This calculation assumed the use of Student's *t*-test, type I error of 0.05, and a power of 80%. A minimum sample size of 22 participants was required and we aimed to recruit 23 patients. The difference between three independent groups was estimated using the one-way analysis of variance test (for numeric nonparametric or discrete variables). Parametric data were tested by Student's *t*-test (two-tailed, unequal variances) or the Mann-Whitney *U*-test for numeric nonparametric or discrete variables. Categorical variables were tested with Chi square test. $P<0.05$ in the primary outcome measure was considered statistically significant.

Results

69 patients were incorporated in the study, each group contains 23 patients. There were no significant differences as regards demographic data in all groups as shown in (Table 1).

No cases of inadvertent traumas or local anesthetic toxicity were reported in any cases

There were significant differences as regards VAS between group L and C the postoperative pain score were significantly lower in group L in comparison to group C, also group M and C were postoperative pain score were significantly lower in group M in comparison to group C, but there was non-significant different between group M and group L done immediately after recovery from anesthesia and just before administration of analgesia as shown in (Table 2).

Also there were significant difference as regards Time to first request meperidine (min) between group L and C, group C needs postoperative meperidine in significant shorter time in comparison to group L, also group M and C, group C needs postoperative meperidine in significant shorter time in comparison to group M, but there were no significant different between group L and group M.

Also there were significant difference between group L and group C as regards total meperidine dose (mg) in 24 hours and total intraoperative fentanyl consumption (µg), also there were significant difference between group M and group C, also there were significant difference between group L and group M as shown in (Table 3 and Figure 1).

There were significant differences as regards side effects, including nausea, vomiting, pruritis and sedation level between group L and C, and group M and C but there were non significant differences between group L and group M, no of patient's needs postoperative antiemetic was significantly high in group C in comparison to groups L and Mas shown in (Table 4).

Table (1) Demographic criteria

	Group L	Group M	Group C
No of patients	23	23	23
Gender male/female	20/3	19/4	21/2
Age	38.8±6.94	41.2±5.62	37.6±7.1
Weight	72.5±9.6	71.3±8.7	74.2±6.8
Procedure time (min)	197±15.8	206±11.2	202±10.4

Table (2): Visual analogue scale taken immediately after recovery from anesthesia and just before administration of analgesia

	Group L	Group M	Group C	P1	P2	P3
Visual analogue scale (VAS)	2(2-4)	2(0-2)	5(2-6)	<0.01	<0.01	>0.05

P1 = difference between group M and group C
P 2 = difference between group L and group C
P3 = difference between group M and group L

Table (3): Analgesic requirements intra and postoperatively in addition to time to first request analgesic

	Group L	Group M	Group C	P1	P2	P3
Time to first request meperidine (min)	181±12.6	205±10.2	26±6.8	<0.001	<0.001	>0.05
Total meperidine dose (mg) in 24 hours	172±15.8	136±13.4	245±23.8	<0.001	<0.001	<0.05
Total intraoperative fentanyl consumption (µg)	135.7±8.2	91.5±7.3	189.9±9.6	<0.001	<0.01	<0.01

P1 = difference between group M and group C
P2 = difference between group L and group C
P3 = difference between group M and group L

Figure(1): Time to first request meperidine (min) and Total meperidine dose (mg) in 24 hours in groups

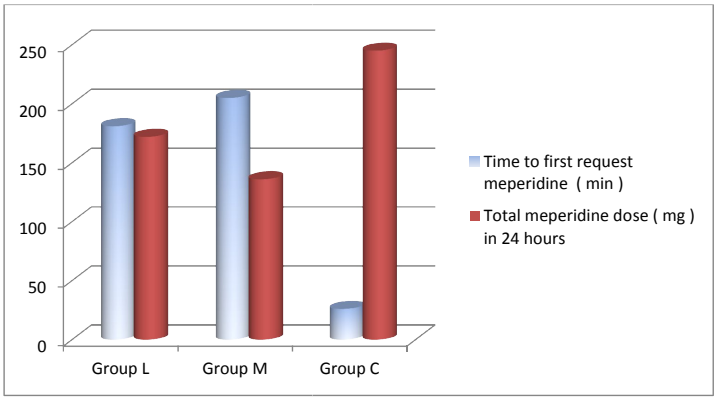

Table (4): Side effects

	Group L	Group M	Group C	P1	P2	P3
Nausea and vomiting (none)						
Mild	18	20	8			
Moderate	4	2	8			
Severe	1	1	5			
Total	0	0	2	<0.001	<0.01	>0.05
	5	3	15			
Pruritis (none)	21	22	15			
Mild	2	1	7			
Moderate	0	0	1			
Severe	0	0	0			
Total	2	1	8	<0.01	<0.01	>0.05
Sedation score (awake)	14	16	8			
(slightly drowsy)	7	6	10			
(drowsy)	2	1	3	<0.05	<0.05	>0.05
(no response)	0	0	2			
NO of patients receiving Ondansetron (4 MG)	1	1	7	<0.01	<0.01	>0.05

P1 = difference between group M and group C
P2 = difference between group L and group C
P3 = difference between group M and group L

Discussion

The optimal analgesic regimen should provide safe, effective analgesia; with minimal side effects. A multi model analgesic regimen is most likely to achieve these goals. The TAP block provides blockade to nociception from the abdominal wall, however there is also nociceptive input from the abdominal organs. Therefore the block is used as part of multimodal approach.

In this study we have demonstrated that the application of TAP block with 20 ml of levobupivacaine 0.375 %bilaterally in patients undergoing abdominoplasty resulted in reduced pain score just after the operation postoperatively and also significant less intraoperative consumption of fentanyl.

A TAP block reduced overall postoperative meperidine requirement and the interval for meperidine requirement for up to 24 hours after surgery,the TAP block delayed the time to first request for supplemental opioid analgesia.

It was also associated with significantly lower rates of postoperative nausea, vomiting and pruritis, due to higher meperidine consumption in the control "group C" group. A TAP block associated with significantly higher rates of patient satisfaction and lower rate of sedation, with no TAP block related trauma or side effects.

The explanation of the prolonged duration of analgesic effect after TAP block may be related to the fact that transversus abdominis plane is relatively poorly vascularized, and therefore drug clearance may be slow by reduction of absorption in to the blood stream [22].

Our data consistent with previous investigator who reported an analgesic benefit of TAP blockade in patients undergoing lower abdominalsurgery [23]. As a study carried out by Mc Donnell et al. [1] patients undergoing abdominal surgeries were randomized to undergo a TAP block with 20 ml levobupivacaine 0.375 % versus placebo. Patients who received a TAP block had reduced 24 h morphine consumption.

In other study by same team on patients undergoing CS [10] were randomized to a TAP group with 0.75 % ropivacaine versus placebo , they found patients who received TAP block had longer time to first request for morphine and reduced overall morphine requirement over 48 h. The post-operative pain score were significantly lower in the TAP block group; also TAP block significantly reduced the incidence of sedation in comparison with control group.

Also Carney et al. [6] has shown the same result in patients undergoing TAH "trans abdominal hysterectomy", where median time to first request morphine was significantly longer in the TAP block group in comparison with control group , the mean 48 h morphine requirement in that study were significantly lower in the TAP block group. The median postoperative pain score were significantly lower in TAP block group till 36 h postoperatively.

But these data are in contrast with those of Costello and colleagues [24], these investigators found no analgesic benefit from TAP block using ropivacaine 20 ml 0.375 % per side in patients undergoing caesarean section under spinal anesthesia.

In addition Loane et al. [25] found that the use of TAP block did not provide analgesia in comparison with "100 µg morphine" intrathecally in the first 24 h and require higher analgesic consumption due to higher pain score.

Also Mc Morrow and colleagues [26] concluded that TAP block does not provide comparable analgesia and does not provide additional benefit to spinal morphine.

The reason for this difference in outcome between our study and those previously described are unclear, however TAP block in this study was administered at the completion of surgery which explains importance of preemptive analgesia and block before tissue trauma.

Also TAP block was performed as tactile blind procedure and as we and them did not use ultrasound to visualize the anatomy ,we cannot guarantee correct placement of the block , it is therefore possible that portion of block were placed incorrectly either superficially or intraperitoneally [27,28].

Various adjuvants have been used to improve the onset time and quality of local anesthetic action in different peripheral nerves and regional block techniques [29-32].

To prolong and enhance levobupivacaine we add dexmedetomidine and we found that the total dose of postoperative meperidine requirement is significantly lower in this group in comparison with other two groups, this result coincides with Yoshitomi et al. [33], who demonstrated that dexmedetomidine as well as clonidine enhanced the local anesthetic action of lignocaine via peripheral & 2 A adrenoceptors.

Also Shivakumar et al. [34] demonstrated that in patients undergoing peribulbar anaesthesia for cataract surgery, dexmedetomidine added to local anesthetics shortens corneal anesthesia and globe akinesia onset time and extend block duration.

Sandhya et al. [35] found that dexmedetomidine when added to bupivacaine for supraclavicular brachial plexus block shortens the onset times for sensory and motor blocks and prolongs their duration, the significantly prolonged duration of analgesia obviates the need for any additional analgesics.

Masuki et al. [36] suggest that dexmedetomidine induces vasoconstriction via & 2 adrenoceptors in the human forearm possibly also causing vasoconstriction around the site of injection, delaying the absorption of local anesthetic and hence prolonging the effect.

Additional studies using ultrasound and different drug combinations and doses of local anesthetic for TAP block are recommended.

Conclusion

In conclusion, we had proved that addition of dexmedetomidine to the local anesthetic levobupivacaine to a transversus abdominis block improved analgesia and increased time to first analgesic requirements and decreased the need for postoperative analgesics in patients undergoing abdominoplasty with no remarkable side effects.

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