

## Dexmedetomidine plus Bupivacaine versus Bupivacaine Alone in Pararectus and Intercostal Blocks in Abdominoplasty: A Randomized Comparative Study

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### ABSTRACT

**Background:** Dexmedetomidine is known for its efficacy as a local anesthetic adjuvant. Herein, we studied the beneficial impact of adding dexmedetomidine to bupivacaine in combined intercostal and pararectus block in patients scheduled for abdominoplasty.

**Patients and methods:** This prospective research enrolled 66 patients allocated into two groups; Group I included 33 patients who received combined intercostal and pararectus blocks using bupivacaine plus dexmedetomidine, and Group II included the remaining participants who received the same blocks using bupivacaine alone.

**Results:** All preoperative patient demographic and clinical criteria expressed no significant difference between the two groups. Group I showed a significant decline in opioid requirements throughout the first postoperative day. The time to the first analgesic request showed a significant delay in Group I (14.73 vs 7.39 hours in Group II). Pain scores showed a significant decline in Group I during rest, cough, and movement, compared to Group II. O<sub>2</sub> saturation, heart rate, and mean arterial pressure showed no significant difference between the two studied groups. Adding dexmedetomidine was not associated with a significant rise in the incidence of postoperative complications.

**Conclusion:** The addition of dexmedetomidine to the local anesthetic agent during intercostal and pararectal blocks is associated with a better analgesic profile. It is associated with lower pain scores and lower morphine consumption without increased associated side effects.

**Keywords:** Dexmedetomidine; Intercostal block; Pararectus block; Abdominoplasty.

### INTRODUCTION

The "abdominal trunk" is a medical term used to describe the region located between the inferior breast aspect and the start of the pelvis. The abdominoplasty is a plastic procedure performed to stretch the abdominal wall muscles and decrease the amount of excess fat in the previously described region <sup>[1]</sup>. With the rising trend of bariatric procedures in Egypt, which offers a durable mean for decreasing excess weight, the need for abdominoplasty subsequently increased to remove the redundant abdominal wall tissues following significant weight loss <sup>[2]</sup>.

Pain management after abdominoplasty is a significant challenge for the surgeon, the anesthetist, and the pain management physician. Proper pain control after surgery is associated with better patient recovery, earlier mobilization and increased patient satisfaction. Nonetheless, excess administration of pain medications like narcotics has its disadvantages, including nausea, pruritus, constipation, and respiratory depression <sup>[3]</sup>.

Regional abdominal wall blocks could provide sufficient analgesia for the majority of patients after such procedures <sup>[3,4]</sup>. The administration of bupivacaine, a long-acting local anesthetic agent, into the proper neurovascular plane blocks voltage-gated ion channels causing decreased pain transmission, which could decrease the need for postoperative opioid analgesia <sup>[5]</sup>.

As an example of abdominal wall blocks, pararectus block or combined ilioinguinal iliohypogastric nerve blocks could provide analgesia for the lower territory of the anterior abdominal wall. However, the upper abdominal wall is not covered by this block. Therefore, it could be combined with other regional block procedures intercostal nerve blocks to provide analgesia to the upper territory of the anterior abdominal wall <sup>[6]</sup>.

Pain physicians also searched for other methods to prolong the action of these blocks to enhance patient recovery and satisfaction. Adding adjuvants to the local anesthetic agents could prolong the period of sensory block <sup>[7]</sup>. Dexmedetomidine is an alpha-2 adrenergic receptor agonist proved to be an effective adjuvant to local anesthesia as its administration significantly prolongs the sensory block in numerous regional and peripheral nerve blocks <sup>[8]</sup>. Its action is mediated through multiple mechanisms, including local vasoconstriction, inhibition of pain transmission through myelinated C fibres, and release of enkephalin-like substances, in addition to its local anesthetic action <sup>[9, 10]</sup>.

After extensive literature research, no previous studies have studied the analgesic efficacy of adding dexmedetomidine to bupivacaine in combined intercostal and pararectus block in patients scheduled for elective abdominoplasty surgery. That is why we conducted the current study. We hypothesized that adding this adjuvant

to bupivacaine would improve the analgesic efficacy and decrease postoperative systemic analgesic need following the abdominoplasty procedures.

## PATIENTS AND METHODS

The study was conducted during the period between January 2021 and January 2022 (a one-year period).

### Ethical considerations:

**The study was approved by the Institutional Research Board (IRB) of the Faculty of Medicine, Mansoura University. Code Number (MS 20.07.1182), and an informed written consent was taken from each participant in the study. The study has been executed according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.**

Our sample size was estimated via the PASS software program, based on the previous study of **McDonnell and his colleagues** <sup>[11]</sup>, who reported that postoperative morphine consumption was  $21.9 \pm 6.9$  mg during the first postoperative day when bupivacaine alone was administered. Our null hypothesis considered a 25% difference or less between the bupivacaine and bupivacaine-dexmedetomidine groups regarding postoperative morphine requirements during the initial 24 hours after surgery. Therefore, a minimal of 26 patients in each group was needed to achieve an 80% power and a 5% significance level (with a mean difference of 5.475 and a common standard deviation of 6.9). As seven patients were expected to drop out, the sample was increased up to 33 patients.

The included 66 patients had the following enrollment criteria; age between 18 and 60 years, from either gender and having class I or II according to the American Society of Anesthesiologists (ASA physical status classification) <sup>[12]</sup>. We excluded patients with neuromuscular disorders, hematological disorders, major psychiatric illness, local cutaneous infection at the injection site, and known intolerance to one of the study medications. Patients with chronic hepatic or renal diseases were excluded. All cases received the standard preoperative evaluation, including history taking, examination, and required laboratory investigations. Then, they were admitted to the inpatient ward

night prior to the surgery. The patients were informed about the benefits and possible complications of each approach. They were also informed how to express their pain on an eleven-point scale (visual analogue scale or VAS) which ranges between zero and 10, with zero for no pain and 10 for the most severe one <sup>[13]</sup>.

At the operative room, the standard hemodynamic monitoring (pulse oximetry, noninvasive blood pressure, and electrocardiography) was attached to all patients. A wide bore cannula was inserted into a suitable forearm vein, and 500 ml of 0.9% saline or ringer lactate were infused as a preload. For the induction of general anesthesia, we used IV propofol (2 mg/kg) and fentanyl (1  $\mu$ /kg). IV succinylcholine was administered to facilitate intubation, and when its action faded away, atracurium 0.5 mg/kg was commenced. Maintenance of general anesthesia was done by a minimum alveolar concentration of isoflurane (1.2%) and 45% - 50% air in addition to top-up atracurium doses (0.1 mg/kg).

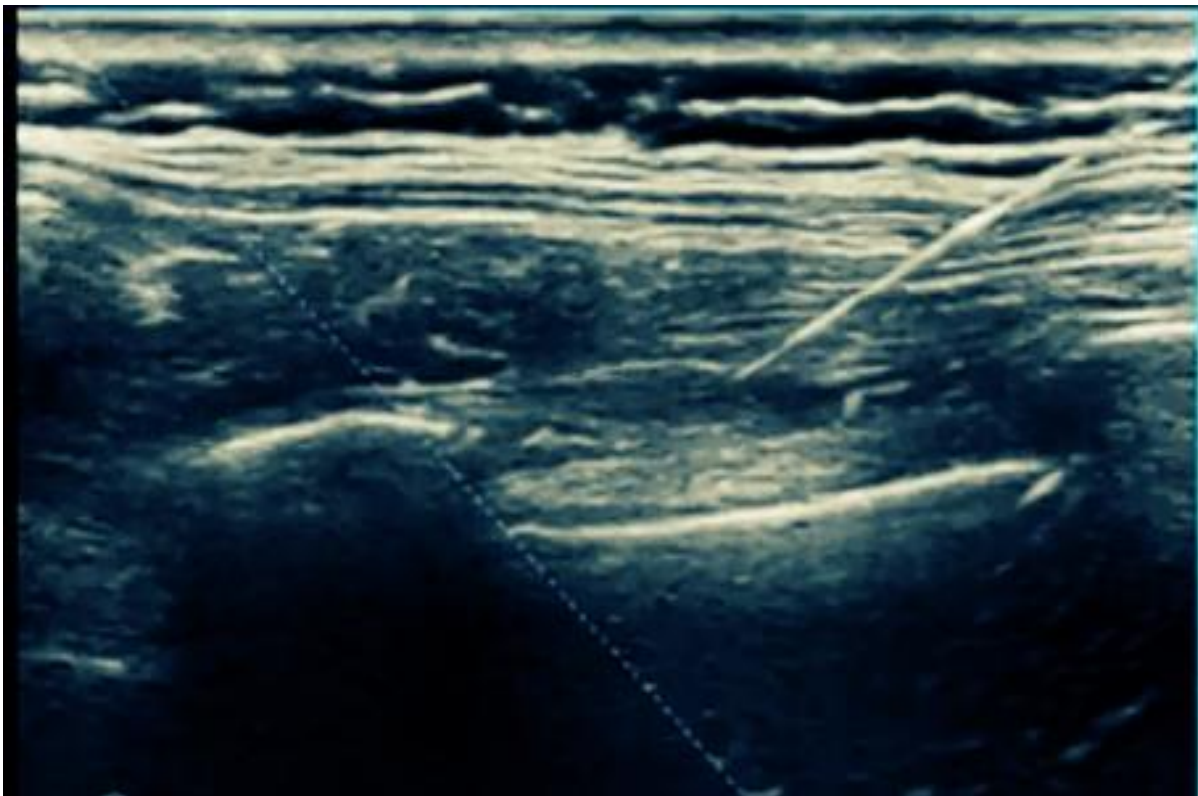
The patients were then randomly assigned into two groups; Group I included 33 patients who received combined intercostal and pararectus blocks using 0.25% bupivacaine (2 mg/kg) plus dexmedetomidine (0.5  $\mu$ g/kg), and Group II included the remaining participants who received the same blocks using bupivacaine 0.25% alone. The total volume (56 ml) was divided into 28 ml in each side as follows, 15 for the intercostal block, 2.5 ml in each space, 10 ml for the pararectus block and 3 ml for combined ilioinguinal iliohypogastric blocks. Each of the previous blocks was done bilaterally under ultrasound guidance using the high-frequency linear probe (SonoScape device, SonoScape CO, Shenzhen, China).

We started with the pararectal block, which was performed when the patient was in the supine position. The probe was positioned in a transverse manner on the abdominal wall lateral to the linea alba along the pararectus plane. After identification of the rectus abdominis muscle, a sonovisible needle was inserted towards the plane between the lateral margin of the rectus muscle and its sheath. The spread of the injectate was noticed when the probe was positioned longitudinally (Figure 1). When the patient was still in spine position, the probe was moved to the region medial to the anterior superior iliac spine, where the ilioinguinal and iliohypogastric nerves were identified (usually within 1 to 3 cm beside it), and a block of both nerves was done.



**Figure (1):** Ultrasound-guided pararectal nerve block.

For the intercostal block, the patient was positioned laterally. The block was performed at the level of the posterior axillary line for T 7 to T 12 nerves. Under ultrasound guidance, the injectate was delivered deep to the internal intercostal muscle, just caudal to the cranial rib (Figure 2). The patient was kept off positive ventilation to decrease the risk of pneumothorax.



**Figure (2):** Ultrasound-guided intercostal nerve block.

During the surgical procedure, IV fluid administration was done according to the maintenance required (based

on lean body weight) and intraoperative blood loss [14]. Hemodynamic parameters were recorded preoperative

and every 30 minutes during the operation. Any intraoperative adverse events were recorded. When the surgery ended, the anesthesia was reversed by IV neostigmine (0.04 mg/kg) and atropine (0.02 mg/kg).

After surgery, the patients were transferred to post-anesthesia care unit (PACU) and then to the internal ward. VAS was assessed at rest, on movement, and during cough at PACU, then 1, 2, 4, 6, 12 and 24 hours following the procedure. If the patient reported breakthrough pain (VAS > 3), IV morphine (0.02 mg/kg) was commenced and repeated every 15 minutes until desirable or undesirable effects occurred. The total morphine consumption throughout the first postoperative day was calculated and recorded.

Any complications including hypotension (20% drop in mean arterial pressure from its nadir value for five minutes <sup>[15]</sup>), bradycardia (heart rate < 60 bpm at two readings five minutes apart <sup>[15]</sup>), vomiting, and delayed recovery (no recovery two hours after surgery, and the patient not correctly responding to verbal commands or other external stimuli <sup>[16]</sup>) were recorded.

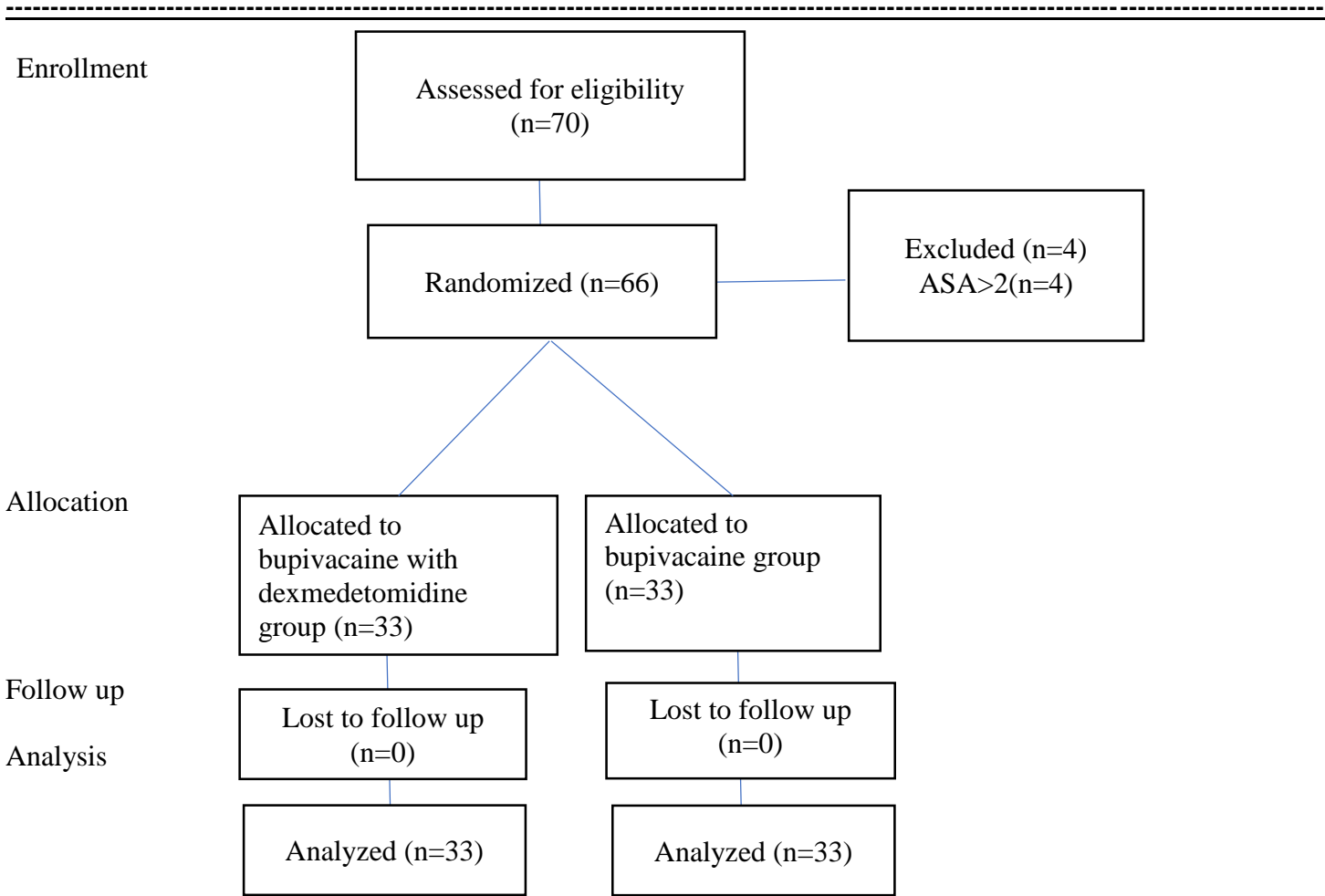
Our primary outcome was morphine consumption during the first postoperative day. Secondary outcomes included time to the first analgesic request, postoperative pain scores intraoperative hemodynamic changes and the incidence of postoperative complications.

**Statistical methods:**

Using the SPSS software for macOS, the acquired data were tabulated and analysed. Numerical data were expressed as mean and standard deviation, while categorical ones were expressed as numbers and percentages. To compare the former data, the Student-t-test was used, while the latter was compared via the Chi-square test or Fisher’s exact test. Any p-value < 0.05 was considered significant.

**RESULTS**

Seventy patients were assessed for eligibility. Four patients were excluded, the remaining sixty six patients fulfilling the criteria completed the study.



**Figure (3):** Consort flow chart

The two study groups expressed no significant differences regarding age, gender, body mass index (BMI), and ASA classification (Table 1).

**Table (1):** Demographic characteristics and ASA classification of the study groups

		<b>Group I (n= 33)</b>	<b>Group II (n= 33)</b>	<b>P</b>
<b>Age (year)</b>		44.18 ± 10.448	39.61 ± 10.093	<b>0.471</b>
<b>Gender</b>	<b>Male</b>	51.5% (17)	36.4% (12)	0.215
	<b>Female</b>	48.5% (16)	63.6% (21)	
<b>BMI (kg/m2)</b>		43.48 ± 7.985	40.97 ± 2.921	0.094
<b>Height (cm)</b>		158.18 ± 15.094	161.21 ± 8.200	0.315
<b>Weight (kg)</b>		111.36 ± 11.199	106.03 ± 11.488	0.061
<b>ASA</b>	<b>I</b>	57.6% (19)	66.7% (22)	0.447
	<b>II</b>	42.4% (14)	33.3% (11)	

The total dose of morphine consumption was significantly higher in group II (bupivacaine alone) than group I (dexmedetomidine with bupivacaine) at 4, 6, 12, and 24 hour postoperatively (Table 2).

**Table (2):** Postoperative morphine requirements in the study groups

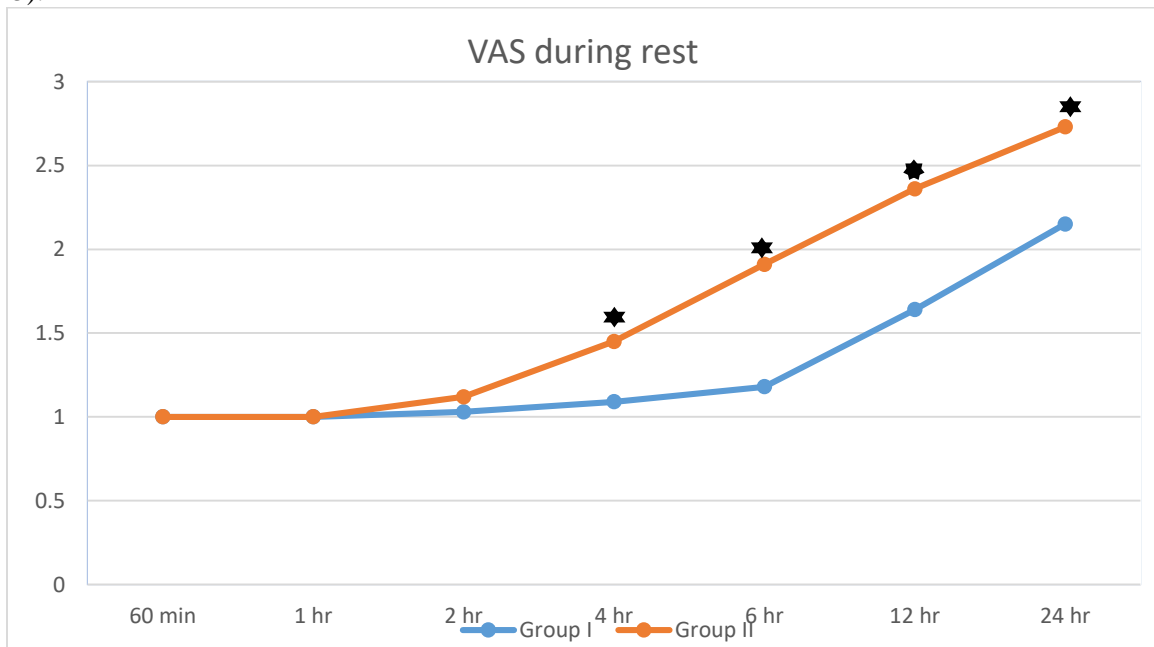
<b>Postoperative morphine requirements</b>	<b>Group I (n= 33)</b>	<b>Group II (n= 33)</b>	<b>P</b>
<b>1 hour</b>	0.00 ± 0.0	0.00 ± 0.0	-
<b>2 hours</b>	0.00 ± 0.0	0.00 ± 0.0	-
<b>4 hours</b>	0.00 ± 0.0	0.36 ± 0.994	<b>0.040</b>
<b>6 hours</b>	0.00 ± 0.0	2.55 ± 1.092	<b>&lt; 0.001</b>
<b>12 hours</b>	1.09 ± 1.809	3.18 ± 1.044	<b>&lt; 0.001</b>
<b>24 hours</b>	2.09 ± 1.756	3.36 ± 1.454	<b>0.002</b>
<b>Total</b>	3.18 ± 3.264	9.55 ± 3.133	<b>&lt; 0.001</b>

The time interval to the first analgesic request showed significant delay in group I (Table 3).

**Table (3):** The time to first analgesic request of the study groups

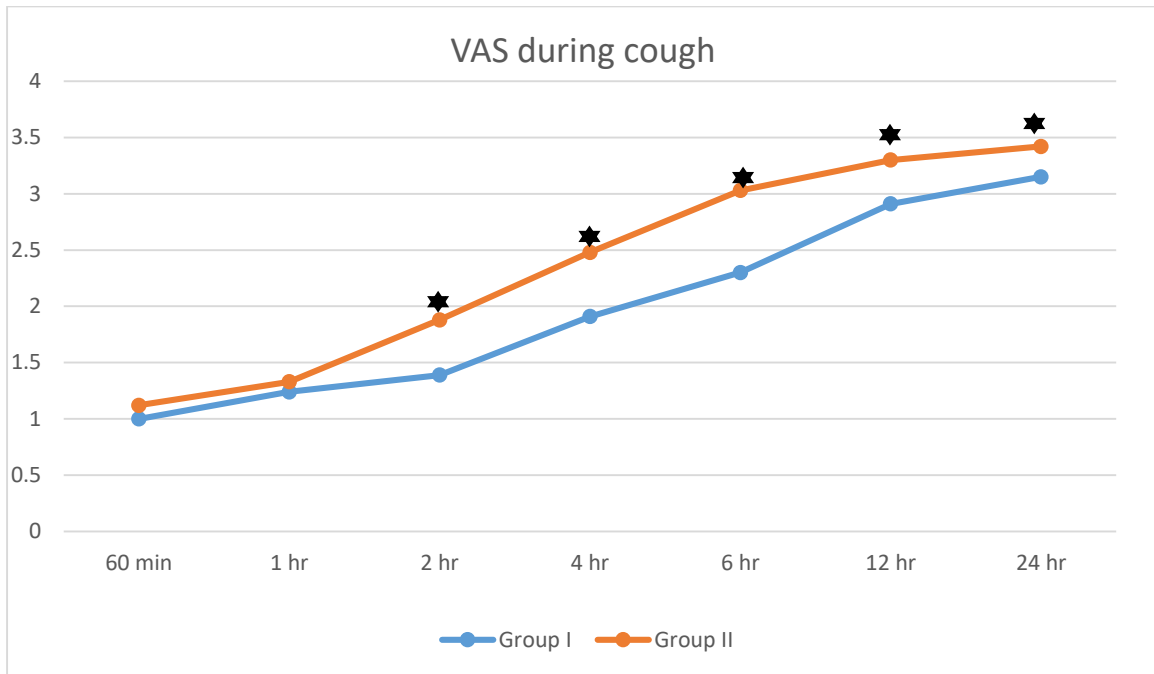
	<b>Group I (n= 33)</b>	<b>Group II (n= 33)</b>	<b>P</b>
<b>Time of the first request for analgesia (Hours)</b>	14.73± 6.23	7.39 ± 5.58	<b>&lt; 0.001</b>

VAS was significant lower in group I than group II at 4, 6, 12, and 24 hours postoperatively at rest, cough, and movement (Figures 3 – 5).



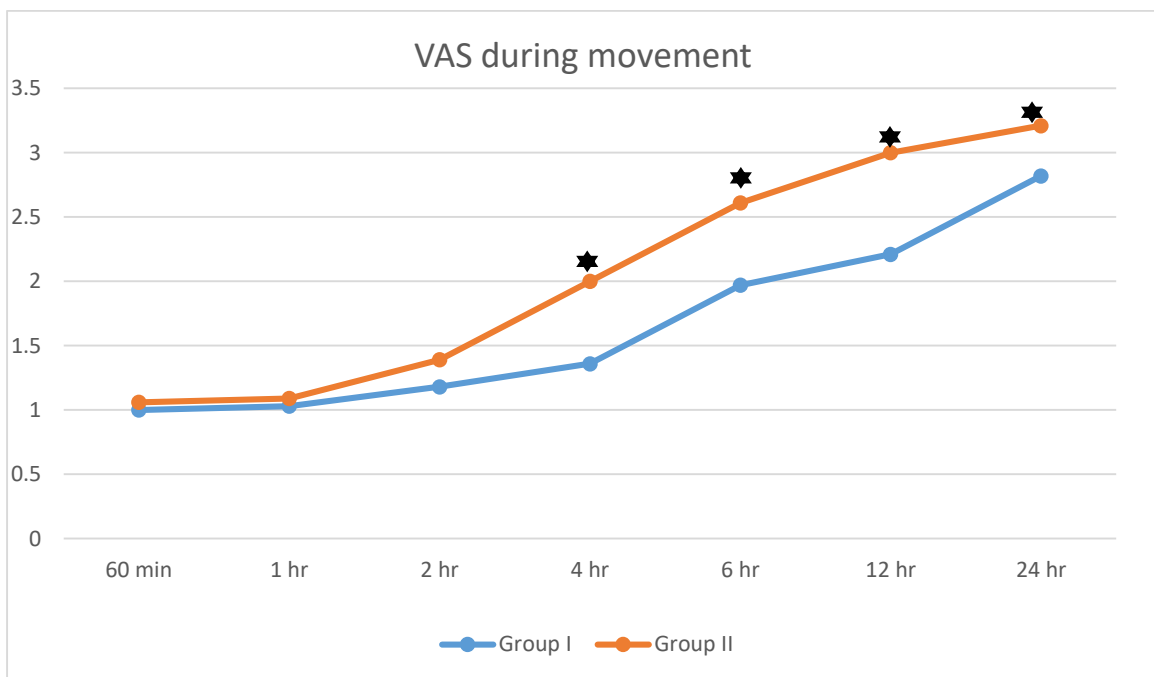
**Figure (4):** VAS score changes during rest in the studied groups

★ Significant difference



**Figure (5):** VAS changes during cough in the two studied groups

★ Significant difference



**Figure (6):** VAS changes during movement in the two studied groups

★ Significant difference

Heart rate showed no significant difference between the studied groups (Table 4). In addition, mean arterial blood pressure measurements showed no significant difference between the two groups (Table 5). Furthermore, oxygen saturation showed no significant difference between the two studied groups (Table 6).

**Table (4):** Heart rate readings in the studied groups

Heart Rate (bpm)	Group (n= 33)	I Group (n= 33)	II P
<b>Basal</b>	88.06 ± 6.21	90.12 ± 7.578	0.232
<b>Intraoperative</b>			
<b>30 minutes</b>	84.39 ± 8.898	87.76 ± 8.408	0.119
<b>60 minutes</b>	79.94 ± 10.825	84.36 ± 9.297	0.080
<b>90 minutes</b>	77.94 ± 6.343	81.45 ± 7.255	0.040
<b>120 minutes</b>	77 ± 8.18	78.42 ± 7.366	0.461
<b>150 minutes</b>	73.9 ± 5.926	76.20 ± 7.251	0.163
<b>180 minutes</b>	72.76 ± 6.394	77.38 ± 11.77	0.052

**Table (5):** Mean arterial blood pressure readings in the studied groups

MAP (mmHg)	Group (n= 33)	I Group (n= 33)	II P
<b>Basal</b>	86.91 ± 11.651	87.91 ± 6.242	0.665
<b>Intraoperative</b>			
<b>30 minutes</b>	80.94 ± 11.7	84.24 ± 5.948	0.254
<b>60 minutes</b>	78.30 ± 10.61	81.79 ± 5.561	0.099
<b>90 minutes</b>	77.45 ± 10.2	81.03 ± 7.02	0.102
<b>120 minutes</b>	77.09 ± 9.62	80.12 ± 7.04	0.149
<b>150 minutes</b>	76.34 ± 10.47	79.13 ± 7.01	0.208
<b>180 minutes</b>	77 ± 11.02	81.87 ± 9.33	0.057

**Table (6):** O<sub>2</sub> saturation readings in the studied groups

O <sub>2</sub> Saturation (%)	Group (n= 33)	I Group (n= 33)	II P
<b>Basal</b>	98.64 ± 1.055	98.91 ± 0.843	0.884
<b>Intraoperative</b>			
<b>30 minutes</b>	98.64 ± 1.055	98.91 ± 0.843	0.884
<b>60 minutes</b>	98.64 ± 1.055	98.91 ± 0.843	0.884
<b>90 minutes</b>	98.64 ± 1.055	98.91 ± 0.843	0.884
<b>120 minutes</b>	98.67 ± 1.080	98.61 ± 1.919	0.875
<b>150 minutes</b>	98.62 ± 1.115	98.88 ± 0.927	0.362
<b>180 minutes</b>	98.33 ± 1.345	98.71 ± 1.254	0.240

The incidence of postoperative complications did not significantly differ between the two groups (Table 7).

**Table (7):** Postoperative complications of the study groups

Complication	Group (n= 33)	I Group (n= 33)	II P
<b>Bradycardia</b>	6.1% (2)	3.0% (1)	1
<b>Hypotension</b>	6.1% (2)	3.0% (1)	1
<b>Vomiting</b>	6.1% (2)	3.0% (1)	1
<b>Delayed recovery</b>	15.2% (6)	9.1% (3)	0.475

## DISCUSSION

This is the first study to evaluate the beneficial effect of adding dexmedetomidine to local anesthesia used in combined intercostal and pararectus blocks during abdominoplasty procedures. On looking at our preoperative data, the reader could notice no significant difference regarding all of these parameters. This denotes our proper randomization, and this should also deny any bias skewing our findings in favour of one group rather than the other.

The main finding of this study is that adding dexmedetomidine to bupivacaine in combined intercostal and pararectus block in patients scheduled for elective abdominoplasty surgery showed a decrease in pain levels and opioid consumption.

One could also see that both intercostal and pararectus block using the local anesthesia alone were effective in pain control, and this was evident by comparable heart rate and arterial blood pressure between the two groups, controlled pain scores below 4 in most readings, as well as an accepted incidence of postoperative complications, that were not significantly different from the adjuvant group.

In fact, there is a real paucity of studies studying the efficacy of combined intercostal and pararectus block in abdominoplasty procedures. After intensive literature research, we only found three studies [17-19] that evaluated the same block techniques in abdominoplasty procedures but without the application of dexmedetomidine.

In the study conducted by **Feng**, which evaluated the efficacy of intercostal, pararectus, ilioinguinal and iliohypogastric blocks in abdominoplasty procedures, the author applied the blocks using bupivacaine, tetracaine, and methylprednisolone. Patients in the block group showed a significant reduction in postoperative morphine requirements (3.099 mg vs 12.836 mg in the control group). The intervention group also expressed lower pain scores, shorter recovery time, and earlier return to normal daily activities compared to controls. The author concluded that the combination of these blocks was safe and efficacious in providing postoperative analgesia for

surgeries involving the upper and lower abdominal territories [18].

In 2015 **Fiala** conducted his study, which included 32 abdominoplasty patients who were allocated into two equal groups; the first group included 16 patients who received transversus abdominis plane block (TAP), while the second group (including the remaining cases) received pararectus, combined ilioinguinal and iliohypogastric nerve blockade in addition to bupivacaine administration in the rectal plication in both groups. The latter group showed a significant increase in postoperative hydromorphone consumption (4.31 vs 2.63 mg in the first group) and a significantly earlier first analgesic request (87 vs 191 minutes in the first group) [17].

The previous study showed the superiority of the TAP block procedure, and this was compensated by adding the intercostal nerve block in our study for better coverage of the upper abdominal wall territory.

**Michaels and Eko** evaluated the analgesic efficacy of intercostal nerve block alone in abdominoplasty procedures. They divided their patients into two groups; the first one was operated on under general anesthesia, while the second one was operated on under IV sedation along with the intercostal block. Although the previous authors did not perform the pararectal block, they reported a significant decline in postoperative pain scores and opioid consumption, as well as a lower incidence of nausea and vomiting. No major complications were encountered [19].

Our findings showed a significant decline in postoperative pain scores in association with dexmedetomidine administration. This was also reflected in opioid consumption, which was significantly decreased in the same group, which received the adjuvant with local anesthesia.

Although the analgesic effect of dexmedetomidine is not clearly understood, multiple mechanisms have been proposed for its action. It has a peripheral analgesic action mediated by inhibition of pain transmission through A $\delta$  and C fibres. Moreover, it has a local analgesic action mediated by its agonistic action on alpha-2 receptors, which results in proper modulation of postoperative hyperalgesia. Furthermore, it has a central mechanism of action by inhibition of presynaptic substance P and other nociceptive peptides released in the spinal cord leading to inhibition of nociceptive impulse transmission [20,21].

Similar to our findings, **Mahmoud et al.** also reported that the addition of dexmedetomidine to local anesthesia administered during intercostal block was associated with a significant increase in the duration of analgesia following thoracotomy procedures [22].

In our study, Group I expressed lower heart rate and arterial pressure readings compared to Group II. Yet, that difference was statistically and clinically insignificant. This is in line with previous studies which reported that dexmedetomidine administration could induce cardiovascular depression like bradycardia and hypotension, which are caused by decreased sympathetic firing caused by its central alpha-2 receptor stimulation [10,23,24].

The incidence of vomiting was statistically comparable between our two study groups, and that indicates proper pain management in both groups, despite the different efficacies of both blocks.

We noticed a delay in recovery time in Group I but it was statistically insignificant. This could be explained by the sedative effect of dexmedetomidine, which is mediated through central pre- and postsynaptic alpha-2 receptor stimulation in the locus coeruleus [25]. Although we administered dexmedetomidine in regional blocks, its systemic absorption could explain the previous findings, and that was previously reported in previous studies [8].

Although our trial handled a unique perspective that was never discussed before, it has some limitations, including the small sample size and the absence of a control group. Therefore, more studies, including more cases from different plastic centres, should be conducted in the near future.

## CONCLUSION

Based on the previous findings, adding dexmedetomidine to the local anesthetic agent during intercostal and pararectal blocks is associated with a better analgesic profile. It is associated with lower pain scores and lower morphine consumption without increased associated side effects. It is recommended to use it as an adjuvant to local anesthetics to enhance postoperative analgesic outcomes.

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