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Dexmedetomidine as Adjuvant for Serratus Anterior Plane Block for Breast Surgery: A pilot study

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Abstract

A novel analgesic method introduced to the clinic by Blanco is called ultrasound-guided serratus anterior plane (SAP) block, a block in which a local anesthetic is injected either superficially or deeply into the serratus anterior muscle at the mid-axillary line. According to certain clinical trials, both superficial and deep SAP effectively blocked pain following modified radical mastectomy for breast cancer. This study aimed to evaluate the efficacy of dexmedetomidine as an adjuvant in SAP block for patients undergoing breast surgery. Ten female patients over the age of eighteen were enrolled in this pilot study, with ASA I–III scheduled for modified radical mastectomy. The primary outcome was when patients should seek an analgesic after surgery. The secondary outcomes were the overall quantity of morphine administered during the first 24 hours post-surgery, resting levels of pain, and successful ipsilateral arm motion. The mean value of total intraoperative fentanyl consumption (± SD) of 130 (±48.3) mcg. Only 3 (30%) patients required postoperative morphine. The mean value of time to first postoperative analgesic requirement (± SD) of 9 (±1) hours. The mean value of postoperative morphine consumption in 1st 24 hours (± SD) of 12.67 (±1.15) mg. VAS at rest and during movement were insignificantly different at 2 hours, 4 hours and 12 hours compared to post operation and was significantly higher at 24h compared to post operation (P value=0.014 and 0.034 respectively). Ramsey scale at postoperative was 2 in 7 (70%) patients and >2 in 3 (30%) patients and after 2h was <2 in all patients. Major decrease in pain is linked to using dexmedetomidine as an adjuvant for SAP Block for individuals having breast surgery in addition to small incidence of complications and hemodynamic stability.

Keywords: serratus anterior plane block, dexmedetomidine, breast cancer, anesthesia

Full length article **Corresponding Author*, e-mail: Khaled201389@hotmail.com

1. Introduction

As the most often diagnosed cancer and the primary cause of cancer-related mortality among women, breast cancer has surpassed lung cancer in this regard [1]. In the recent years, a number of therapies for breast cancer have been developed. Genetic and environmental factors play a role in the heterogeneous nature of breast cancer [2]. In 2020, the incidence of breast cancer was 11.7% of all new cases across all ages and both sexes, even though age-standardized death rates have dropped by 2%–4% annually since the 1990s [3, 4]. Treatment options for breast cancer consist of hormone therapy, targeted therapy, immunotherapy, radiotherapy, chemotherapy, and surgery [5]. For early-stage breast cancer, surgical resection of the tumor is the preferred course of treatment because surgery is the only known cure [6]. After having their mastectomy, between 25 and 40% of the patients experience persistent discomfort syndrome (paraesthesias, intercostobrachial neuralgia, and phantom breast pain) as a result of insufficient treatment of pain, and opioids by themselves can have a number of negative side effects, such as nausea and vomiting. These problems lead to the person's dissatisfaction, extended stays in the post-anesthesia care unit, prolonged hospital stays, and higher hospital expenses. Consequently, in order to effectively manage pain, regional analgesic techniques have become essential [7]. The goal of many regional analgesic methods is to lessen the negative effects of both opioid use and general anesthesia (GA). These methods include intercostal nerve block, thoracic paravertebral block, thoracic epidural analgesia, and local wound infiltration. Several regional or local blocks of nerves are employed in women with breast cancer as crucial components of multimodal pain management and better recuperation after surgery (ERAS). These blocks include thoracic epidural analgesia (TEA), interscalene brachial plexus, paravertebral (PVB), pectoral nerve blocks, and erector spinae plane block (ESPB) [8]. A novel analgesic

method introduced to the clinic by Blanco et al. [9] is called ultrasound-guided serratus anterior plane (SAP) block, a block which involves injecting a local anesthetic into the serratus anterior muscle at the mid-axillary line, either thoroughly or superficially [10]. According to certain clinical trials, both superficial and deep SAP effectively blocked pain following modified radical mastectomy for breast cancer [11, 12]. However, Edwards et al. hypothesized that analgesia may be more enhanced by deep SAP than by superficial SAP [13]. Actually, because anesthesia wears off quickly, even with the administration of long-lasting local anesthetics, the individual's discomfort cannot be completely alleviated. When combined with local anesthetics, dexmedetomidine, a very selective alpha-2 adrenal receptor agonist, can prolong the period of peripheral nerve block [14]. Notably, it has been observed that the use of local anesthetics in conjunction with dexmedetomidine accelerates the onset of action and extends the duration of block [15, 16]. This study aimed to evaluate the efficacy of dexmedetomidine as an adjuvant in SAP block for patients undergoing breast surgery.

2. Materials and Methods

Methods

Ten female patients over the age of eighteen were enrolled in this pilot study, with ASA I–III scheduled for modified radical mastectomy. The study was carried out between April 2022 and December 2022 with approval from Cairo University's Ethical Committee National Cancer Institute. Written, informed consent was given by the patient or by the patient's family. Sepsis, previous surgeries in the axillary or above-the-clavicle region, coagulopathy, opioid dependence, alcohol or drug abuse, and mental illnesses that impair adequate pain perception and assessment were the exclusion criteria.

Serratus anterior plane (SAP) block

The infra-clavicular area was the site of the probe insertion. In order to view the serratus anterior muscle as a thin layer on the ribs at the level of the fifth rib, the probe was moved latero-caudally in the direction of the mid-axillary line. Following location determination, aseptic and antiseptic procedures were carried out in the vicinity of the mid-axillary line. The transducer was moved laterally and distally during the scanning process in order to visualize the fourth and fifth ribs. After that, the transducer was turned into the coronal plane and angled posteriorly to identify the latissimus dorsi and serratus anterior muscles [17]. Following a 2-ml local infiltration with 1% lidocaine and aspiration confirmation that there was no intravascular injection, 30 ml of 0.25% bupivacaine (containing 1 ug/kg of dexmedetomidine in a 2-ml volume) was injected into the fascia that separates the latissimus dorsi muscle from the serratus anterior muscle. Patients were given 1% propofol 2 mg/kg with titration, isoflurane 1.5–2.0 vol%, and atracurium 0.1 mg/kg to induce GA. If the baseline values for mean arterial pressure (MAP) or heart rate (HR) increased by more than 20%, 1 μg/kg of fentanyl was given intraoperatively. Before GA was induced, after GA was induced, after endotracheal intubation, prior to surgical incision, and at 30-min intervals until the procedure was completed, the intraoperative MAP and HR were recorded. Fluids and 5 mg of ephedrine were given repeatedly to treat hypotension, which was defined as a drop in MAP of more than 20% of the baseline value and keep it above 70 mmHg. If necessary, repeat the 0.4 atropine treatment for bradycardia, which is defined as heart rate less than 50 beats per minute [18]. Following full recovery of the airway reflexes, the patients were extubated and the residual neuromuscular blockade reversed with neostigmine (0.05 mg/kg) and atropine (0.02 mg/kg). The maintenance liquid was ringer lactate. Following the completion of the surgical procedure, neostigmine 2.5 mg and atropine 1 mg were used to antagonize the residual neuromuscular block, and extubation was performed once the necessary conditions were met. The primary outcome was when patients should seek an analgesic after surgery. The secondary outcomes were the overall quantity of morphine administered during the first 24 hours post-surgery, resting levels of pain, and successful ipsilateral arm motion.

Statistical analysis

Data analysis was done using SPSS v26. Hestograms and the Shapiro-Wilks test were used to determine whether the data distribution was normal. Repeated measures were presented along with the quantitative parametric data's mean and standard deviation (SD). The results were compared using ANOVA. Quantitative non-parametric data were presented using the interquartile range (IQR) and median, and subsequently compared using the Wilcoxon and Friedmann tests. Frequencies and percentages (%) were used to represent qualitative variables.

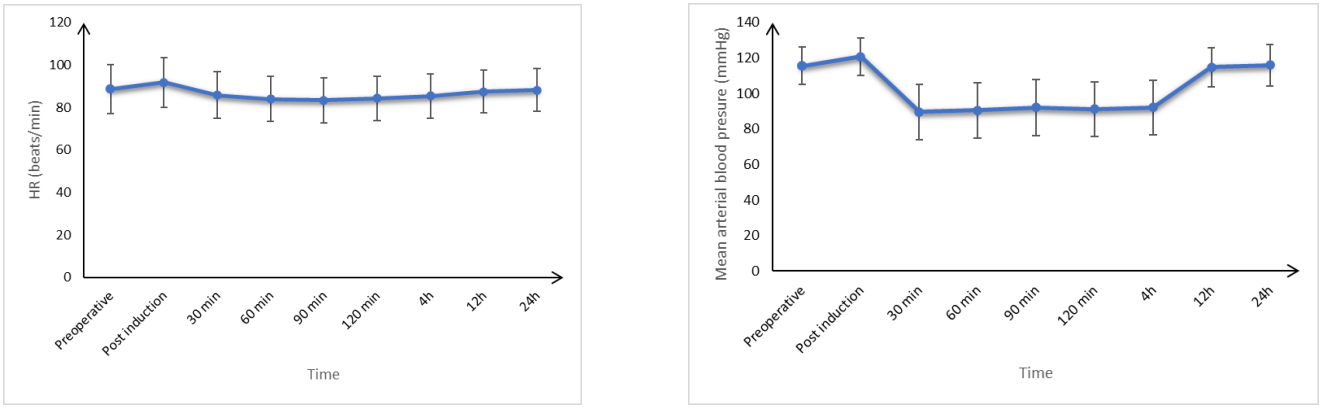
3. Results and discussion

The mean value of age (± SD) of 45.9 (±7.29) years. The mean value of weight (± SD) of 78.85 (±15.46) kg. The mean value of height (± SD) of 164.4 (±5.17) cm. The mean value of BMI (± SD) of 29.03 (±4.59) Kg/m2. ASA physical status was II in 7 (70%) patients and III in 3 (30%). Side of surgery was right side in 4 (40%) patients and left side in 6 (60%) patients. HR and MAP were significantly higher at post induction (P value <0.05), was significantly lower at 30 min, 60 min, 90 min, 120 min and 4 h (P value <0.05) and was insignificantly different at 12h and 24h compared to preoperative. The mean value of total intraoperative fentanyl consumption (± SD) of 130 (±48.3) mcg. Only 3 (30%) patients required postoperative morphine. The mean value of time to first postoperative analgesic requirement (± SD) of 9 (±1) h. The mean value of postoperative morphine consumption in 1st 24 hours (± SD) of 12.67 (±1.15) mg. VAS at rest and during movement were insignificantly different at 2h, 4h and 12h compared to post operation and was significantly higher at 24h compared to post operation (P value=0.014 and 0.034 respectively). Ramsey scale at postoperative was 2 in 7 (70%) patients and >2 in 3 (30%) patients and after 2h was <2 in all patients.

Table 1: Demographic data, ASA physical status and side of surgery of the studied groups

		(n=10)
Age (years)		45.9 ± 7.29
Weight (Kg)		78.85 ± 15.46
Height (cm)		164.4 ± 5.17
BMI (Kg/m^2)		29.03 ± 4.59
ASA physical status	II	7 (70%)
	III	3 (30%)
Side of surgery	Right	4 (40%)
	Left	6 (60%)

Data are presented as Mean ±SD or frequency (%), BMI: body mass index.



(A) **(B)**

Figure 1: Heart rate (A) and mean arterial blood pressure (B) of the studied groups

Table 2: Total intraoperative fentanyl consumption, time to first postoperative analgesic requirement and postoperative morphine consumption of the studied groups

	(n=10)
Total intraoperative fentanyl consumption (mcg)	130 ± 48.3
Need for postoperative morphine	3 (30%)
	(n=3)
Time to first postoperative analgesic requirement (h)	9 ± 1
Postoperative morphine consumption in 1st 24 hours (mg)	12.67 ± 1.15

Data are presented as Mean ±SD, or frequency (%)

Table 3: VAS measurements at rest and during movement and Ramsey sedation scale of the studied groups

		(n=10)	P value
VAS at rest			
Post operation		0 (0 – 1)	0.083
2h		0 (0 – 1.75)	
4h		0 (0 – 1.75)	0.157
12h		0 (0 – 1.75)	0.102
24h		1 (1 – 2.5)	**0.014***
VAS at movement			
Post operation		1 (0.25 – 1)	0.564
2h		1 (0.25 – 1.75)	
4h		1 (1 – 1.75)	0.317
12h		1 (1 – 1.75)	0.083
24h		1.5 (1 – 2)	**0.034***
Ramsey scale			
Postoperative	**2**	7 (70%)	
	>2	3 (30%)	
After 2h	**<2**	10 (100%)	

*Significant as P value≤0.05, Data are presented as median (IQR) or frequency (%), VAS: visual analogue scale

Table 5: Postoperative adverse events of the studied groups

		(n=10)
Hallucination		1 (10%)
Neuropathic pain		1 (10%)
PONV	**Mild**	3 (30%)
	Moderate	2 (20%)
	No	5 (50%)

Data are presented as frequency (%). PONV: Postoperative nausea and vomiting

Hallucination was present in 1 (10%) patient. Neuropathic pain was present in 1 (10%) patient. PONV was mild in 3 (30%) patients and moderate in 2 (20%) patients. Both peripheral and central actions are present in dexmedetomidine. It works centrally to produce analgesia by blocking the nociceptive pathway's substance P being released from the dorsal root neuron and the locus coeruleus's alpha-2 receptors being activated. This alpha-2 agonist acts peripherally by inhibiting norepinephrine release, which results in analgesia [19]. The current study showed that HR and MAP were significantly higher at post induction (P value <0.05), were significantly lower at 30 min, 60 min, 90 min, 120 min and 4 hours (P value <0.05) and were insignificantly different at 12 hours and 24 hours compared to preoperative. Different from the current findings, Menshawi and Fahim. [20] showed no significant change of HR, and MAP measured at difference times compared to baseline values in patients within GA for video-assisted thoracoscopic surgeries (VATS) and receiving dexmedetomidine added to bupivacaine in ultrasound-guided SAP block. This could be because the study populations in the two studies differed, and our study had a smaller sample size. First, the thoracic sympathetic fiber innervations were not affected when using SAP block for thoracic wall analgesia as opposed to unilateral and bilateral autonomic block that is associated with PVB and TEA [21]. The second is the interfacial SAP plane's relatively low vascularity [9], which leads to less hemodynamic affection and slower study drug systemic absorption. Third, Santosh and Mehandale. [22] also investigated the impact of adding dexmedetomidine (0.5 μg/kg) as an adjunct to ropivacine in superficial cervical plexus block for thyroid surgery, using the same small dose of the drug. They observed perioperative hemodynamic balance and no appreciable variation in MAP and HR readings among the research groups. The present study showed that the mean value of total intraoperative fentanyl consumption (± SD) of 130 (±48.3) mcg. Only 3 (30%) patients required postoperative morphine. The mean value of time to first postoperative analgesic requirement (± SD) of 9 (±1) hours. The mean value of postoperative morphine consumption in 1st 24 hours (± SD) of 12.67 (±1.15) mg. Menshawi and Fahim. [20] showed comparable intraoperative fentanyl consumption which was slightly lower than our study 114.87 ± 12.28 mcg. However, patients took longer time for first rescue analgesia postoperatively which was 22.6 ± 4.77 hours. On the other hand, this study showed higher postoperative nalbuphine consumption compared to our study (23.66 ± 2.33 mg). Abdelzaam and Abd Alazeem. [23] assessed the dexmedetomidine effect as an adjuvant to bupivacaine on the quality of the ultra-sound SAP block after modified radical mastectomy surgery. They showed longer time for postoperative analgesia 19 ± 3 hours, and less morphine consumption in the 24 hours following operation compared to our study (6 ± 2 mg). VAS at rest and during movement were insignificantly different at 2 hours, 4 hours and 12 hours compared to post operation and was significantly higher at 24h compared to post operation. Ramsey scale at postoperative was 2 in 7 (70%) patients and >2 in 3 (30%) patients and after 2h was <2 in all patients. Similarly, Abdelzaam and Abd Alazeem. [23] showed significant rise in VAS during rest and measurement after 24 hours of operation compared to baseline values. However, it was found that VAS measurements were lower at 12 and 14 hours in the dexmedetomidine group in comparison with the control group at rest and during movement. In addition, Menshawy and Fahim. [20] showed that VAS was lower in the dexmedetomidine group compared to the control group at 8 and 12 hours post-operatively. According to this study, there was no significant difference in the sedation scores between the control group and the dexmedetomidine-treated patients during the first hour following operations.

Moreover, Wu et al. [24] showed significant decrease in VAS score in patients taking dexmedetomidine as an adjuvant to ropivacaine in SAP block while undergoing modified radical mastectomy compared to control group at 12 and 24 hours of movement, and at 12 hours of rest. The current study showed that hallucination was present in 1 (10%) patient. Neuropathic pain was present in 1 (10%) patient. PONV was mild in 3 (30%) patients and moderate in 2 (20%) patients. Menshawy and Fahim. [20] found that no respiratory depression occurred, tachycardia was present in one (3.84%) patient, nausea and vomiting in two (7.69%) patients, and shivering in one (3.84%) patient. Wu et al. [24] showed that PONV occurred in 6 (16.2%) patients at 24 hours of operation, bradycardia in one patient (3.7%), and dizziness in three (8.1%) patients. The study had some limitations including small sample size, absence of comparison control group, and being a single-center study. Therefore, we recommend further mutli-center randomized controlled trials with larger sample size.

4. Conclusions

In conclusion, this study provided a detailed overview of various aspects related to sports participation in the study population. The results revealed a predominance of the male gender over the female gender among the participants.

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