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Research article

Efficacy of postsurgical ultrasound guided serratus intercostal plane block and wound infiltration on postoperative analgesia after female breast surgeries. A comparative study

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ABSTRACT

Objective: The serratus intercostal plane block is successfully performed for pain management after breast surgeries. To assess the efficacy and safety of serratus intercostals plane block in comparison with local wound infiltration in women under-going breast surgery.

Methods: This prospective study was conducted on 46 female patients undergoing breast surgeries. Patients were divided into two groups: serratus block (SB) group (n = 23): patients received induction with serratus intercostal plane block with 0.4 ml/kg bupivacaine 0.25% plus fentanyl 20 μg, infiltration group (n = 23) received induction with the borders of the surgical wound were infiltrated with 0.4 ml/kg of bupivacaine 0.25% and 20 μg fentanyl at the end of surgery.

VAS pain scores, postoperative patient satisfaction score, time to the first analgesic requirement, total dose of rescue analgesic and the incidence of postoperative complications as vomiting were all recorded.

Results: Intraoperative pain scores and postoperative patient satisfaction scores were significantly lower in group SB compared with infiltration group. Total dose of rescue analgesic was significantly lower in SB group compared with Infiltration group. Significant difference between the study groups regarding the incidence of vomiting. Time to the first analgesic dose was significantly longer in group SB compared to Infiltration group.

Conclusion: There is considerable evidence that serratus intercostal plane block in addition to general anesthesia provide better postoperative pain control with little adverse effects compared with wound infiltration, indicating that a perioperative serratus intercostal plane block is a feasible and effective method for an improved postoperative pain treatment after breast surgery.

1. Introduction

Breast surgery is one of the most common procedures so thousands of patients undergo surgery in the region of the breast and axilla. Breast surgery result in increased incidence of acute and chronic pain in 25–60% of patients and is frequently associated with nausea and vomiting [1]. Regional anesthesia techniques may provide better postoperative analgesia for patients undergoing breast surgery.

Blockade of the lateral cutaneous branches of the thoracic intercostal nerves (T2–T12) will provide analgesia to the anterolateral chest wall in this patient population [2]. Patients undergoing other surgical procedures of the chest wall as anterior thoracotomy, may also benefit from nerve blockade of the anterior chest wall to reduce postoperative pain [1].

This novel technique become popular analgesic alternative to multiple puncture intercostals block, epidural and paravertebral block in breast surgery given decreased incidence of adverse events and has the advantage of simultaneous blockade of multiple dermatomes, it is easy to do and decrease rate of local anesthetic absorption [3].

The aim of this study was to assess the efficacy and safety of serratus intercostal plane block in comparison with local wound infiltration in women undergoing breast surgery.

2. Methods

After the approval of medical ethical committee of Ain Shams University, this prospective parallel group study was conducted

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over 46 female patients between the age of 40–56 years old, ASA physical status I and II, undergoing breast surgeries at Ain Shams University hospitals in 2015–2016, after obtaining written informed consents from all patients. Refusal to participate, Morbid obesity (body mass index >40 kg/m^2), renal insufficiency (creatinine >1.5 mg/dL), current chronic analgesic therapy (daily use >4 weeks), a history of opioid dependence, pregnancy, inability to communicate with the investigators or hospital staff, American Society of Anesthesia (ASA) III-IV were excluded.

Preanesthetic check was done at night of surgery, in the induction room the anesthesiologist secured an 18 gauge cannula and gave midazolam 0.05 mg/kg i.v. to all patients before transfer to the operating room where standard monitoring devices as ECG, Non invasive blood pressure and pulse oximetry were placed.

A conventional balanced general anesthesia was administered. The induction protocol was standard for all patients and consisted of intravenous administration of fentanyl (2 μg/kg), thiopentone sodium (3–5 mg/kg), Atracurium (0.5 mg/kg). Anesthesia was maintained with oxygen 100%, isoflurane and supplements of Atracurium. Volume controlled ventilation (tidal volume 8–10 ml/kg) was adjusted to maintain end-tidal carbon dioxide between 35 and 40 mmHg. At the end of the procedure, those patients who were randomly allocated by sealed envelope method to group SB (n = 23) received induction with serratus intercostal plane block which was performed under ultrasound guidance (S-Nerve; SonoSite Iberica S.L, Madrid, Spain), with a linear ultrasound transducer (10–12 MHz) on the same side of surgery. The patients were placed in the supine position, we counted the ribs inferiorly and laterally till we identified the fifth rib in midaxillary line, the latissimus dorsi (superficial and posterior), teres major (superior) and serrates muscles (deep and inferior) were easily identified by ultrasound at level of fifth rib then we moved the probe in the mid-axillary line to level of the sixth intercostal space. In the upper plane we identified the subcutaneous tissue and serratus muscle and in the intermediate plane the intercostal muscles (external, internal and intimate) and in the deep plane the lung, ribs and pleura could be identified.

The block was performed with needle (22-G, 50-mm 'Stimuplex A'; BBraun, Melsung, Germany) introduced in-plane with the ultrasound probe, from caudal to cranial till the tip of the needle was placed between serratus anterior muscle and intercostal muscles (IEM) and the local anesthetic (LA) injection was visualized in real-time (Fig. 1), the injection usually consisted of 0.4 ml/kg of bupivacaine 0.25% plus 20 μg fentanyl was injected after negative aspiration then LA injection was visualized in real-time. In infiltration group (n = 23), the borders of the surgical wound were infiltrated with 0.4 ml/kg of bupivacaine 0.25% and 20 μg fentanyl. This was performed by the same surgeon. Anesthesia was discontinued and neuromuscular blockade was reversed with neostigmine (0.05 mg/kg) IV and Glycopyrrolate IV (0.004 mg/kg). Patients were extubated and shifted to the post-anesthesia care unit.

Before induction of anesthesia patients were teached how to use a 100 cm visual analog scale (VAS-0 with end-point labeled "no pain" and 100 to "worst conceivable pain") [4]. The degree of postoperative pain was assessed at 2, 6, 10, 12, 18, 24 h using the

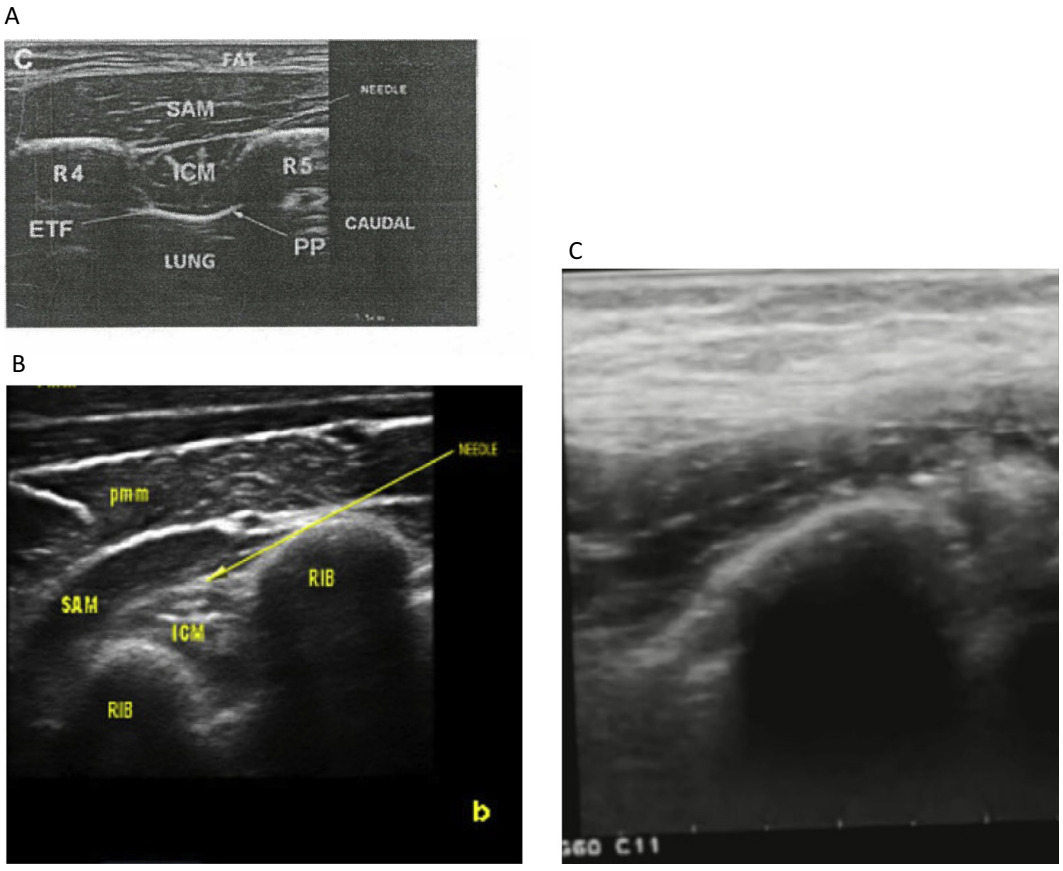

Figure 1. Position of the needle during injection.

VAS score which was used as primary outcome measure. Postoperative analgesia regimen was standard in all groups. When the VAS score was greater than 40, patients were given pethidine (50 mg IV). The time to first analgesic and total analgesic requirement during 24-h post-op period were recorded and occurrence of adverse side effects as vomiting was also recorded.

Primary outcome measure included:

Time to the first rescue analgesic dose required in hours.

Secondary outcome measures included:

Rate of patient tolerability to the procedure and ranked their satisfaction as follows:

Satisfaction scores were recorded on a 10-point scale, with zero being very unsatisfied and 10 being completely satisfied [5].

Assessment of the level of pain (on a VAS scale scores) and cumulative dose of rescue analgesic.

The incidence of nausea and any attack of postoperative vomiting was recorded which was controlled by ondansetron 0.1 mg/kg.

Finally patients were considered ready for discharge when they had stable vital signs, oriented, were able to ambulate unassisted, had no vomiting attacks and minimal pain.

2.1. Sample size determination

Based on mean parasthesia for the intercostal nerves 725 ± 21 min, while mean parasthesia for motor nerves 778 ± 43 min. Power of the study 70% and alpha error 5% so the minimal required sample size was 21 patients in each group so the chosen sample size was 23 patients in each group for possible drop out [6].

2.2. Statistical analysis

All statistical calculations were done using SPSS program (Statistical Package for Social Sciences; SPSS Inc., Chicago, IL, USA) software version 17.0. Data were presented as mean ± SD or median (range). Data presented as mean ± SD were compared using independent *t*-test, data presented as percentage were compared using Chi square test. Data presented as median were compared using Mann-Whitney test. P value < 0.05 was considered significant.

3. Results

Forty-six patients were recruited in this study, 23 patients in each group Fig. 2).

Demographic data and surgical factors were presented in Table 1.

No significant difference was found between the 2 study groups regarding demographic data and surgical factors.

Data as age, weight and duration of surgical procedures were presented as mean ± SD while ASA, type of surgical procedures and gender were presented as percentage.

P value < 0.05 considered significant.

Postoperative pain scores were significantly higher in Infiltration group compared to group SB at 6, 10 and 12 h postoperative as shown in Table 2.

Regarding VAS scores, there was no significant difference between the study groups at 2, 18 and 24 h postoperative (Table 2).

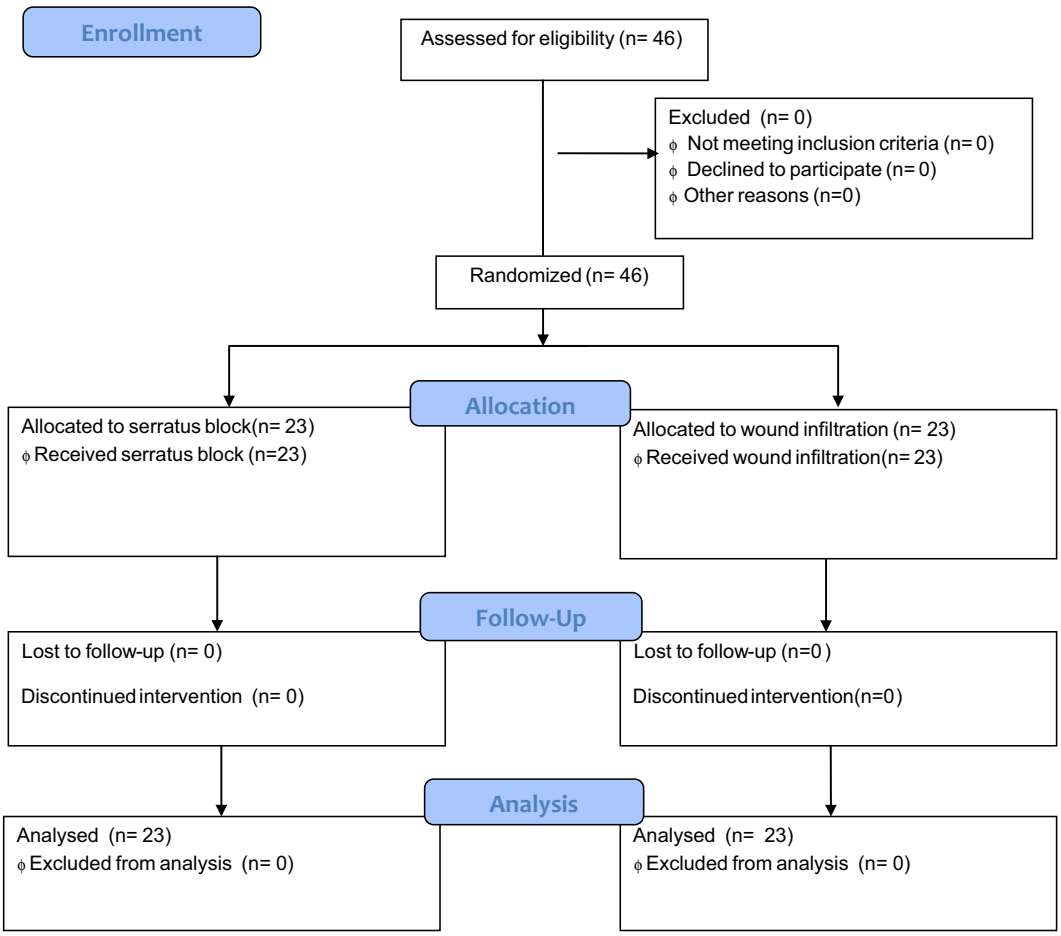

Figure 2. Study flow chart.

Table 1
Demographic data and surgical factors.

Demographic data and surgical factors	Serratus group (n = 23)	Infiltration group (n = 23)	Tests	
			t/X^2	P-value
Age (year)	44.75 ± 3.54	45.27 ± 5.27	0.393	0.696
Weight (kg)	73 ± 16.3	68.6 ± 17.4	0.885	0.381
ASA				
I	7(30.4%)	9(39.1%)	0.383	0.536
II	16(69.6%)	14(60.9%)		
Duration of surgical procedures (min)	50.6 ± 20.4	51.8 ± 16.8	0.218	0.828
Type of surgical procedures				
Wide local excision	5(21.7%)	7(30.4%)	1.472	0.479
Breast ductectesia	7(30.4%)	9(39.1%)		
Simple mastectomy	11(47.8%)	7(30.4%)		

Table 2
Comparison of VAS between the study groups.

VAS	Groups				Mann-Whitney test	
	Serratus group (n = 23)		Infiltration group (n = 23)		Z	P-value
	Range	Median	Range	Median		
T 2	2–4	2	2–4	2	0.000	1.000
T 6	2–3	2	7–10	8	11.357	<0.001*
T 10	3–4	3	7–10	9	12.502	<0.001*
T 12	3–4	4	3–10	7	9.467	<0.001*
T 18	4–5	4	5–6	5	2.654	0.629
T 24	5–6	5	5–6	5	0.000	1.000

Table 3
Comparison of mean arterial blood pressure among study groups.

MBP	Serratus group (n = 23)	Infiltration group (n = 23)	T-test	
	Mean ± SD	Mean ± SD	t	P-value
The end of surgery	60.54 ± 6.53	62.35 ± 5.67	1.004	0.321
After 6 h	64.98 ± 5.40	70.89 ± 6.50	3.354	0.002*
After 12 h	68.28 ± 5.23	74.54 ± 6.67	3.542	<0.001*
After 18 h	70.84 ± 6.57	70.62 ± 7.58	0.105	0.916
After 24 h	72.58 ± 7.68	75.32 ± 6.25	1.327	0.191

Table 4
Comparison of the dose of rescue opioids between the study groups.

Dose of opioids		Groups		T-test	
		Serratus group (n = 23)	Infiltration group (n = 23)	T	P-value
Pethidine dose (mg)	Range	50–75	220–250	34.222	<0.001*
	Mean ± SD	64.45 ± 14.33	238.34 ± 19.71		

T2 = 2 h postoperative T6 = 6 h postoperative T10 = 10 h postoperative T12 = 12 h postoperative T18 = 18 h postoperative T24 = 24 h postoperative.

*P value < 0.001 was considered highly significant.

Postoperative mean arterial blood pressure was significantly higher in group infiltration group compared to group SB at 6, 12 h postoperative as shown in Table 3.

Regarding postoperative mean arterial blood pressure, there was no significant difference between study groups at the end of surgery, 18 and 24 h postoperative (Table 3).

Data presented as mean ± SD.

*P value < 0.05 was considered significant.

Postoperative total dose of rescue analgesic was significantly lower in SB group compared with Infiltration group as shown in Table 4.

Data presented as mean ± SD.

*P value < 0.001 was considered highly significant.

There was significant difference between the study groups regarding incidence of vomiting as shown in Table 5.

None of patients of both groups complained of nausea.

Data presented as percentage.

*P value < 0.05 was considered significant.

The time to first analgesic dose (min) was significantly longer in SB group compared with Infiltration group (see Table 6).

Data presented as mean ± SD.

*P value < 0.001 was considered highly significant.

Regarding postoperative patient satisfaction it was significantly higher in group SB compared with Infiltration group as shown in Table 7.

*Data presented as median.

*P value < 0.004 was considered highly significant, *IQR: Interquartile range*.

Table 5
Incidence of postoperative vomiting.

Vomiting		Serratus group (n = 23)		Infiltration group (n = 23)	
		N	%	N	%
Yes		0	0.0	4	17.4
No		23	100.0	20	82.6
Chi-square	X^2	4.381			
	P-value	0.036*			

Table 6
Time to the first analgesic dose.

		Groups		T-test	
		Serratus group (n = 23)	Infiltration group (n = 23)	T	P-value
First analgesic dose (min)	Range	480–600	90–180	26.980	<0.001*
	Mean ± SD	527.4 ± 57	135 ± 40.2		

Table 7
Comparison of pain satisfaction scores among study groups.

Satisfaction score	Serratus group Median (IQR)	Infiltration group Median (IQR)	z-test	p-value	Sig.
Patients satisfaction Scores	8 (7–10)	3 (3–4)	5.267	<0.001*	S

4. Discussion

This study showed that serratus intercostal plane block resulted in significant analgesia, less total dose of rescue analgesic, longer time to the first analgesic requirement, less incidence of vomiting and higher satisfaction scores than did the use of local wound infiltration according to this study.

In a report by Fajardo showed that this block injection done throughout three years in a total of 115 patients known as Serratus-intercostal plane block (SIFP). These techniques are easy to perform, and may be associated with decreased risk of complications [3].

In a study by Blanco et al. showed that four volunteers receiving serratus plane block reported an effective block that provided long-lasting paraesthesia (750–840 min). There were no side-effects recorded in this initial descriptive study [6].

A case study on morbidly obese patient planned for wide local excision of benign radical scar using serratus plane block showed good analgesia for the whole breast, the patient did not require any more intraoperative analgesia or any rescue analgesic requirements in the postoperative period [7].

A prospective, randomized, double-blinded, parallel group placebo-controlled study in which 236 patients undergoing breast cancer surgery received ropivacaine wound and intercostal space infiltration reported decreased postoperative pain for 90 min compared to placebo [8].

Similarly, a randomized, double-blinded, placebo-controlled study in which 120 patients undergoing segmental mastectomy showed that pre- and post-incision bupivacaine lacked preemptive analgesic effects, although they noted initially decreased PACU pain score [9].

Similarly, in a recent review of ten trials investigating wound infiltration in various breast surgeries as simple mastectomy, segmental mastectomy, and benign lumpectomy, only six trials showed small changes in pain scores after wound infiltration, while four trials found unremarkable reduction in opioid consumption [10].

The authors noted that the reductions for both pain scores and opioid consumption were clinically insignificant and only lasted a couple hours postoperatively.

Breast surgery have a reported PONV incidence of 48–72% with general inhalation anesthesia and use of total intravenous anesthesia only decreases this to 43.8%. However, opioids are also a significant contributor to PONV so decreased usage of opioid often results in decreased adverse reactions [11].

Serratus plane block may have similarities to wound infiltration techniques, which can provide adequate postoperative analgesia, particularly after ambulatory surgery [12,13]. Wound infiltration has also been used as the sole technique for major breast surgery [14] but larger volumes of local anesthetic are usually used, but apart from the risk of toxicity, the limited duration and the discomfort associated with wound infiltration, there are other few disadvantages [15] so subcutaneous catheters can be placed for continuous infusion [16].

A study by Ohgoshi et al. done on female patients undergoing partial mastectomy and serrates intercostal plane block was used for analgesia of breast surgery where the area of sensory loss obtained by skin prick in the midaxillary line at level of fifth rib was extended from five to six as the number of intercostal spaces. Analgesic effect was obtained for 12–24 h. The cephalad dermatomal paresthesia was T2 [17].

Fajardo showed that serratus intercostal plane block became an effective alternative to paravertebral blocks or thoracic epidurals, safe resulting in a low complication rate [18].

There is a need for a prospective controlled randomized trial to assess the effect of serratus plane block for postoperative pain control in breast surgeries as we found no previous randomized trials or precisely they are not yet completed.

The main limitation of our trial was the small sample size and lack of blinding which gave chance for bias.

5. Conclusion

Serratus intercostal plane block in addition to general anesthesia provide better postoperative pain control with little adverse effects compared with local infiltration, indicating that a perioperative SB is a feasible and effective method for an improved postoperative pain treatment after breast surgery.

Conflict of interest

Not declared.

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