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Original Research Article

A Comparison of the Effectiveness of Serratus Anterior Block Vs Intercostal Block as Analgesia for the Management of Post-Thoracotomy Pain

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Abstract: *Post-thoracotomy pain is a significant clinical challenge that can affect patient recovery and increase the risk of chronic pain. Regional nerve blocks such as intercostal nerve block (ICNB) and serratus anterior plane block (SAPB) are increasingly utilized for postoperative analgesia in thoracic surgery, yet comparative data on their safety and efficacy remain limited.* ***Objective:*** *To compare the effectiveness and safety of intercostal nerve block and serratus anterior plane block for the management of post-thoracotomy pain.* ***Methods:*** *This prospective study was conducted in the Thoracic Surgery Department of Mayo Hospital, Lahore, from February 2024 to February 2025. A total of 100 patients undergoing thoracotomy with an ASA physical status I or II were included. Patients were consecutively assigned to two groups: Group A (n=50) received intercostal nerve block, and Group B (n=50) received serratus anterior plane block. The primary outcome was the assessment of pain intensity using the Visual Analogue Scale (VAS) at rest and during coughing up to 48 hours postoperatively and at 3 months post-surgery. Secondary outcomes included analgesic requirements and identification of predictors for chronic postoperative pain. Statistical analysis was performed using SPSS version 25. Independent t-tests and chi-square tests were applied, and a p-value <0.05 was considered statistically significant.* ***Results:*** *Group B demonstrated significantly lower VAS scores at 48 hours at rest (p=0.001) and at 24 hours during coughing (p<0.001) compared to Group A, although VAS at rest was higher at 6 hours postoperatively in Group B (p=0.020). Group A required significantly higher doses of nalbuphine (p<0.001), ketorolac (p=0.006), and flurbiprofen (p=0.004). No adverse effects related to nerve blocks were reported in either group. Risk factors significantly associated with chronic postoperative pain included VAS at rest at 12 hours (p=0.049), surgical duration (p=0.050), and chest tube duration (p=0.032).* ***Conclusion:*** *Both intercostal nerve block and serratus anterior plane block are safe and effective for managing post-thoracotomy pain. However, SAPB may offer superior analgesia in the immediate postoperative period. Pain intensity at 12 hours postoperatively, surgical duration, and chest tube duration are significant predictors of chronic postoperative pain.*

Keywords: Analgesics, Nerve block, Safety, Thoracotomy

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Introduction

Video-assisted thoracoscopic surgery is a surgical technique used to diagnose and treat conditions in the chest cavity, including the lungs. Although it is a safer and minimally invasive procedure than thoracotomy, 29% of the patients experience post-surgical pain due to inflammation, trauma, ectopic neural activity, and chest tube irritation. (1) To avoid further complications, multimodal analgesia is essential to ensure smooth recovery. (2)

Common analgesics used in thoracic surgery to manage postoperative pain are thoracic epidural analgesia, pecs block, intercostal nerve block, thoracic paravertebral block, serratus anterior plane block, and erector spinae plane block. (3,4) Among these options, intercostal nerve block and serratus nerve block are best suited anesthetics that are fast-acting, safe, have limited adverse effects, reduce the need for opioids, and speed up recovery.

Intercostal nerve block is injected near the intercostal nerves towards the end of the surgery to relieve pain within 6 hours after surgery, which becomes more effective with time, completely disappearing after 1-2 days. Serratus anterior block is injected in the anterolateral chest wall to provide significant pain relief within 12-14 hours after the surgery. Both these techniques have been shown to maintain hemodynamic stability and sympathetic nervous system function due to distant puncture sites. (5,6)

This study was conducted to compare the effectiveness and safety of intercostal nerve block and serratus anterior block for the management of post-thoracotomy pain.

Methodology

A prospective analysis was conducted in the Thoracic Surgery Department of Mayo Hospital, Lahore, from February 2024 to February 2025. A total of 100 patients scheduled for video-assisted thoracoscopic surgery with an ASA score of I or II were selected for the study. Patients allergic to local anesthesia, a BMI greater than 30, a history of opioid abuse, chronic chest pain, syncope, liver or kidney disorder, or those with severe cardiopulmonary diseases were excluded. Informed consent was obtained from all patients for research. The ethical review board approved the study.

Patients were consecutively assigned to an analgesic group; Group A included 50 patients who received ICNB, and Group B included 50 patients who received SNPB. In Group A, anesthesia was administered by a surgeon in a single shot at the surgical incision, surgical tube site, and intercostal space above and below these regions after completion of surgery. A 22-gauge nerve block needle was used to inject 20 mL of 0.5% Bupivacaine in the intercostal bundle area under thoracoscope guidance. It targeted the intercostal nerves and was localized to the rib spaces.

In Group B, a 22-gauge nerve block needle was used to inject 20mL of 0.5% Bupivacaine in a single site at the fascial plane between intercostal muscles under ultrasound guidance, performed by an anesthesiologist. It

targeted the lateral cutaneous branches of the intercostal nerves and dispersed along the fascial plane through palm or gauge massage.

During surgery, 2mg/kg propofol, 0.4µg/kg, and 5mg dexamethasone were given as local anesthetics. 3mL 2% lidocaine was administered as throat anesthesia. 4-5 mg propofol, 0.7% sevoflurane, and 0.1µg remifentanil were given to maintain anesthesia. Vasopressors like epinephrine or deoxyepinephrine were used to lower blood pressure, and atropine was used to keep a low heart rate. 50 mg of flurbiprofen ester as an NSAID and 5mg tropisetron were given as anti-nausea, 30 minutes before completion of surgery.

The primary endpoint was evaluation of VAS score at rest and while coughing up to 48 hours after surgery, perioperative medications, and VAS score after 3 months of surgery. Secondary endpoints were recognizing predictors of chronic postoperative pain and the adverse effects of nerve blocks. Patients were followed up after 3 months of surgery, and pain was measured by the Brief Pain Inventory, including its position, characteristics, and impact on quality of life.

All data analysis was done by SPSS version 26. Descriptive statistics were used to present categorical and continuous data. Intragroup data were compared by t-tests for constant data and Fisher's exact test for categorical data. Chronic pain was taken as a dependent variable, and variables with $p<0.01$ in comparison between pain groups were taken as independent variables in multivariate analysis. Independent risk factors of chronic pain were assessed by stepwise regression. Statistical significance was set at $p<0.05$.

Results

A total of 100 patients were included in the analysis, with 50 patients in each group. Patients in both groups did not differ significantly concerning age, gender, BMI, smoking, history of surgery, or physical status, as shown in Table I.

Regarding postoperative pain scores, there was no significant difference between both groups except that Group B had lower pain scores at 48 hours (rest)($p=0.001$) and 24 hours (coughing)($p<0.001$) than Group A, but had higher scores at 6 hours (rest) ($p=0.020$) (Table II). Group A had a significantly higher dose of sufentanil ($p<0.001$), remifentanil ($p=0.006$), and flurbiprofen ($p=0.004$) as compared to Group B. None of the patients in the study reported adverse effects.

A total of 20 patients (20%) experienced chronic pain, among whom 9 (45%) were from Group A and 11 (55%) were from Group B; the difference was insignificant. The average chronic pain score was 1 (mild). 7 (35%) patients experienced sharp pain, and 10 (50%) patients experienced dull pain. Most patients reported no impact on pain on their daily lives.

Development of chronic pain was significantly associated with the incidence of diabetes ($p=0.042$), surgical duration ($p=0.050$), pain score at 12 hours in resting ($p=0.007$), and pain score at 48 hours while coughing ($p=0.020$) in the univariate analysis (Table III). Stepwise regression analysis showed pain score at 12 hours at rest ($p=0.049$), surgical duration ($p=0.050$), and chest tube duration ($p=0.032$) remained significant risk factors of chronic pain.

Table I: Baseline data of study groups

	Group A (n=50)	Group B (n=50)	95% CI	P
Mean age	59.31 ± 9.42	60.58 ± 8.87	-3.259,5.073	0.568
Female gender	30 (60%)	31 (62%)	0.539,1.566	0.809
Mean BMI	26.82 ± 3.05	26.05 ± 3.18	-1.223, 1.564	0.756
Smokers	22 (44%)	22 (44%)	0.530, 1.5	1
History of previous surgery	30 (60%)	27 (54%)	0.763, 2.148	0.645
Hypertension	19 (38%)	16 (32%)	0.82,2.11	0.632
Diabetes	10 (20%)	10 (20%)	0.571,1.763	1
CHD	8 (16%)	8 (16%)	0.349,2.724	1
ASA score				
I	14 (28%)	16 (32%)	0.459,1.396	0.610
II	36 (72%)	34 (68%)		

Table II: Pain scores at rest and coughing state

	Group A	Group B	95% CI	P
Resting score				
6 hours	4 (4,4)	4 (4,5)	-0.6,0.6	0.020
12 hours	4 (3,4)	4 (3.5,4)	-0.6,0.6	0.518
24 hours	3 (2,3)	2 (2,3)	-2,2	0.098
48 hours	2 (1,2)	1 (1,1)	0.5,1	0.001
Coughing pain score				
6 hours	5 (4.5,5)	5 (4.5,5)	0,0	1
12 hours	4 (4,4)	4 (3.5,4.5)	-0.6,0.6	0.148
24 hours	4 (3.5,4)	3 (3,3.5)	0.6,1	<0.001
48 hours	3 (2,3)	3 (2.5,3)	-0.6,0.6	0.209

Table III: Risk factors of chronic postoperative pain

	Patients with chronic pain (n=20)	Patients without chronic pain (n=80)	95% CI	P
Diabetes	9 (45%)	12 (15%)	2.30,7.98	0.042
Median chest tube drainage	3 (3,4)	4 (3,4)	-2,2	0.057
Surgical duration	90 (68.5,134.25)		1.5,42.1	0.050

Perioperative and postoperative medications				
Sufentanil	26 (26,31)	31 (26,31)	-4.0,9.1	0.271
Remifentanil	0.75 (0.51,1)	0.8 (0.5,0.9)	-0.3,0.5	0.363
Flurbiprofen	51 (51,51)	51 (51,100)	-49,0	0.1
Dezocine	23.4 (11,38.3)	9 (0,31)	-6,21	0.065
Resting pain				
6 hours	4 (4,4.2)	4 (4,4)	0.32,0.6	0.831
12 hours	4 (4,4)	4 (3,4)	1,2	0.007
24 hours	3 (2,3)	2.5 (2,3)	-0.6,1	0.1
48 hours	2 (1,2)	1 (1,2)	-0.6,1	0.166
Coughing pain score				
6 hours	5 (5,5)	5 (4,5)	1,2	0.035
12 hours	4 (4,4.1)	4 (4,4)	-0.34,0.6	0.555
24 hours	4 (3,4)	3 (3,4)	-2,2	0.581
48 hours	3 (3,3)	3 (2,3)	1,2	0.020
Nerve block				
Intercostal	8 (40%)	40 (50%)	0.409, 1.280	0.568
Serratus	12 (60%)	40 (50%)		

Discussion

This study was conducted to compare the efficacy and safety of intercostal and serratus nerve blocks for alleviating post-thoracotomy pain. The results showed that both analgesics were similarly effective for the management of pain, where the intercostal block had lower pain scores till 6 hours, and the serratus block had better coughing scores at 24 hours and resting scores at 48 hours. Baytar et al, Kim et al, Chen et al, and Zeng et al reported similar results.(7,8,9,10)

There was a significant difference between the need for postoperative analgesics between both groups, with patients administered serratus block having fewer requirements. This may be because SAPB is fast acting preoperatively, which prevents nociceptive stimuli transmission later, but ICNB is administered intraoperatively. SAPB group had lower pain score at 48 hours (rest)($p=0.001$) and 24 hours (coughing)($p<0.001$) than the ICNB group, but had a higher score at 6 hours (rest) ($p=0.020$) because the latter has a faster short-term pain relief mechanism. These findings are in agreement with previous literature. (11,12)

At follow-up, 20% patients had chronic postoperative pain after management with analgesics, NSAIDs, and opioids. There was no significant difference between the incidence of chronic pain after the use of either nerve block. In Rayed et al, patients with chronic postoperative pain had a high 12-hour score at rest and 6 and 48 hours while coughing, suggesting that pain scores may be a predictor of pain severity. (13) The surgery was also longer in chronic pain patients in our study, similar to Chen et al and Qui et al.(14,15). Diabetes was also a significant determinant of chronic pain, consistent with Lee et al.(16)

Multivariate analysis revealed pain score at 12 hours at rest ($p=0.049$), surgical duration ($p=0.050$), and chest tube duration ($p=0.032$) as independent predictors of chronic pain. Previous literature has reported similar factors. (17,18)

Conclusion

Intercostal nerve block and serratus anterior nerve block are equally safe and effective for managing postoperative pain of thoracotomy. Duration of procedure, chest tube duration, and resting pain score at 12 hours are significant risk factors for the development of chronic pain.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC -24)

Consent for publication
Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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