ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES, SCHOOL OF MEDICINE

DEPARTMENT OF ANESTHESIA

COMPARING ANALGESIAEFFECTOF POSTOPERATIVE THORACIC PARAVERTEBRALBLOCK AND INTERCOSTAL NERVE BLOCK FOR UNILATERAL THORACOTOMYAT ADDIS ABEBA PUBLIC HOSPITALS, ETHIOPIA, DECEMBER 25, 2019 TO APRIL 30,2020 GC. A PROSPECTIVE COHORT STUDY

THESISSUBMITTED TO ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCE SCHOOL OF MEDICINE DEPARTMENT OF ANESTHESIA FOR PARTIAL FULFILLMENT OF THEREQUIREMENT FOR THE MASTERS OF SCIENCE DEGREE IN ANESTHESIA.

BY: EMEBET SEYUM

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Declaration

I, the undersigned, declare that this thesis is my original work in partial fulfillment of the requirements for the MSc in Anaesthesia. I understand that plagiarism will not be tolerated and all directly quoted material has been appropriately referenced.

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Date of submission _____

This thesis work has been submitted for examination with our approval of as advisors and tutors on the MSc in Advanced clinical anesthesia course.

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Approval

The undersigned certify that they have read and hereby recommend to Addis Ababa University to accept the thesis submitted by Emebet seyum entitled, Comparing AnalgesiaEffect of Postoperative Thoracic Paravertebral Block and Intercostal Nerve Block for Unilateral Thoracotomy at Addis Ababa Public Hospitals, in partial fulfillment of the requirements forMaster's of science Degree in Anesthesia.

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Acronyms and Abbreviations

AAU- AddisAbaba University

ASA - American Society of Anesthesiologists

CTEDA- Continuous thoracic epidural analgesia

CTPVB- Continuous thoracicparavertebral block

CICNB- Continuous intercostal nerve block

DBP- Diastolic Blood Pressure

DLT- Double lumen tube

ETT- Endotracheal tube

ICNB- Intercostal nerve block

IM- Intramuscular

ICU- Intensive care unit

IV- Intravenous

MAP- Mean arterial pressure

Ml – Milliliter

Mg- Milligram

NMDA- N-Methyl-D-Aspartate

NRS- Numerical Rating Scale

NSAIDs- Nonsteroidal anti-inflammatory drugs

OR- Operation room

PACU- Post anesthesia care unit

PO-Per os.

POD- Postoperative day

PR- Pulse rate

PVB- Paravertebral block

RR- respiratory rate

SBP- Systolic Blood Pressure

SPO2- Arterial oxygen saturation

SPSS- Statistical Package for Social Sciences

T3 - T8 - Thoracic vertebrae 3 to Thoracic vertebrae 8

T4- T7 - Thoracic vertebrae 4 to Thoracic vertebrae 7

TEDB- Thoracic epidural block

TPVB- Thoracic paravertebral block

USG- Ultrasound guide

VAS- Visual Analogue Scale and,

VATS- Video-assisted thoracic surgery

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Abstract

Background: Thoracotomy is one of the most painful operative procedures. Ineffective postoperative pain management practice in this procedure will result in physiological and psychosocial deterioration which increases the risk of morbidity and mortality. This can be reduced by ensuring adequate analgesia using multimodal technique with regional blocks. So far epidural block is the gold standard, intercostal, and paravertebral blocks are the alternatives which results in somatic and sympathetic blockade of multiple dermatomes and reduce pain.

Objective: To assess the postoperative analgesia effect of postoperative thoracic paravertebral nerve block (TPVB) and intercostal nerve block (ICNB) for unilateral thoracotomy in Addis Ababa from December 25, 2019 to April 30, 2020 GC.

Method: A prospective cohort study was conducted on 56 patients who were selected by systematic random sampling technique from December 25, 2019 to April 30, 2020 GC.Patients in the paravertebral group received a block by 0.25% bupivacaine at thoracic vertebral level4-7 and those in the intercostal group received a block by 0.25% bupivacaine at thoracic vertebral level3-8.Data collection was done by perioperative observation and patient interview for 24hour. The analysiswas done by independentt-test, Mann Whitney U test for parametric and nonparametricquantitative variables respectively; Fisher's exact testor chi square test for qualitative variables$P<0.05$ was considered statistically significant.

Result: In this study, the median postoperative pain score at 24hr was lower by a paravertebral group with a significant difference at 6 and 8hr of the block both at rest p=0.036, 0.004and on coughing p=0.024, 0.004 respectively as compared with an intercostal group. The time elapsed to first analgesic request was longer in the paravertebral group 10hr than an intercostal group 6hr with $p<0.001$. Total tramadoland morphine consumption in 24hr was significantly lower in the paravertebral group with p□0.036 and 0.002 respectively.

Conclusion and recommendation: Thoracic paravertebral block done at the end of unilateral thoracotomy decrease postoperative pain, total analgesic consumption and prolong first analgesic request time than an intercostal block. Based on these postoperative thoracic paravertebral block is recommended to be a technique of choice for pain management of unilateral thoracotomy.

Keywords: post-thoracotomy pain and analgesia, intercostal block, paravertebral block

Chapter one: Introduction

1.1 Background

Thoracic surgery is a type of surgical procedure that is performed at the chest wall to accessintrathoracic organs. This procedure can be either thoracoscopy or thoracotomy(1). Thoracoscopy is a minimally invasive surgical procedure done by making a small incision and inserting thoracoscopy camera with surgical instruments to manage Intrathoracic pathology.Whereas, thoracotomy is an invasive open chest surgery with a large incision made to gain access to the thoracic organs which is used in 80% of thoracic surgical procedure(2,3).

There are different skin incision approaches for thoracotomy but posterolateral incision which is associated with intense pain is mostly used for intrathoracic surgical procedures because it has better access to the thoracic cavity(4).This approach is also mostly practiced in Ethiopia.

Overall, thoracotomy is the most painful procedure which produces very severepain postoperatively because of chest wall trauma,manipulation, and potential injury of peripheral nerves by rib retractors compression as well as incisional pain from the skin, muscle, pleural,costovertebral joint disruption, and central nervous system hyperexcitability(5).

The presence of postoperative pain affects the quality of patients recovery and exposed them to postoperative morbidities such as arrhythmia, respiratory failure due to pneumonia and atelectasis following limitation of chest physiotherapy, deep vein thrombosis due to immobilization, restriction in the shoulder and arm movement and facilitation of chronic post-thoracotomy pain syndromewhich overall results poor quality of life(3,6). Therefore,adequate perioperative pain control and maintenance of pulmonary function are the major goals during the postoperative period of thoracotomy(6). Adequate perioperative analgesia gets achieved by using preemptive analgesia, multimodal intraoperative, and postoperative analgesia which should continue even after discharge. Pulmonary complications can be reduced by ensuring adequate analgesia and facilitation of deep breathing, coughing, and clearing secretion(4,7).

Eventhough there is a controversy in its effectivenesspreemptive analgesia can be achieved by using different techniques such as pre incisional regional analgesia, pre-treatment with opioids, NMDA receptor antagonists, paracetamol, and NSAIDs. The timing of

administrationvariesbased on the route, IV/PO acetaminophen30-60 min before surgery, NSAID/PO/IMdiclofenac 1-2hr before surgery, and IV opioids 10-30 min/ IM 30min-2hr before surgery(8–11).

There are different analgesic techniques used to manageacute post-thoracotomy pain those arepatient-controlled analgesia, multimodal systemic analgesia combined with local anesthetics wound site infiltration, intercostal nerve block, thoracic paravertebral block, and thoracic epidural block. Thoracic epidural block is a gold standard techniques of analgesia results in bilateral sensory and motor blockage which further reduces pain intensity as well as opioid consumption(2).

Thoracic paravertebral block is a technique of depositing local anesthetics at the paravertebral space adjacent to the thoracic vertebra and block spinal nerves as they emerge from the thoracicintervertebral foramen.Application of local anesthetics within the unilateral paravertebral space produces sensoryand motor block of multiple thoracic dermatomes at the same side of the block above and below the injection site which results in reduction in pain intensity and used as an option of analgesia for thoracotomy(12,13).

Intercostal nerve block is a technique of blocking intercostal nerves which arise from thoracic spinal nerves and lie adjacent to the caudal border of each rib. It can be blocked subcutaneously by landmark technique and it can also be blocked by direct visualization of the nerves while the chest is open by inserting the needle directly distal to the angle of the ribs and directing it dorsally along caudal border of the rib into internal intercostal muscle then inject local anesthetics intoeach intercostal bundles around the paravertebral line in subpleural plane(14,15). This direct infiltration of intercostal nerves done by the surgeon before the closure of fascia is an easy technique used for thoracotomy(2). Overall, ICNB results in a unilateral somatic and sympathetic block which further reduces postoperativepain severity and dependence on opioids(16).

From all those alternatives thoracic epidural analgesia is considered to be the gold standard method to treat post-thoracotomy pain for many years; however, in the last few years,pieces of evidence have suggested that paravertebral nerve block and intercostal nerve block can be as effective as epidural analgesia for thoracotomy with less incidence of side effects(14,17,18).

1.2 Statement of the problem

The international association for the study of pain defines pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage(19). Post thoracotomy pain is probably the most severe pain experienced by the patient as incision penetrates several layers of muscle tissue, neurovascular bundles, and other structures of the thoracic region. It may be sharp, stabbing, constant shooting neuropathic pain which can be acute (within 30 days of thoracotomy) or chronic (greater than 2 to 6 months after thoracotomy)(6).

Pain following thoracic procedures can occur in >70% of patients and is considered to be one of the most severe types of postoperative pain than surgeries in another body system. Immediate severe postoperative pain stays 72-96hr but can also persist for many months and even years, substantially worsening quality of life(18,20).

Post thoracotomy pain is unique as it isassociated with many postoperative morbidities including respiratory failure, deep vein thrombosis, cardiac instability, infection due to immunosuppression, depression,and limitation in daily living activity due to the development of chronic post-thoracotomy pain syndrome with the incidence of 30% which persists for three or more month(18,21). The overall incidence of post-thoracotomy pulmonary complication (19-59%) is much higher than following upper (16-17%) or lower abdominal surgery (0-5%)(22).

Generally, inadequately treated post-thoracotomy pain has significant morbidity and mortality effect associated with low quality of life due to chronic body pain, depression, decreased physical function, and economic impact due to limitations in working activity as well as unintended expenses on pain associated complications(21).

Postoperative pain management of thoracic surgical patients is mandatory not only for ethical reasons but also because it can modulate stress response, preserve cardiorespiratory function and it is important for patient recovery.

Despite years of advance in pain management, the mostly used postoperative pain management technique in many settings is still full dose opioids howevertheir use is limited by side effects. Specifically in thoracic sugaryopioidsexacerbate postoperative pulmonary complications, therefore, the best approach of pain management requires multimodal analgesia with local anesthetics to block nociceptive inputs from the periphery, low dose opioids administrated

intrathecally and/or parenterally, non-steroidal anti-inflammatory drugs (NSAID)and paracetamolwhich reducessystemic opioid requirements(23).

An epidural block is widely used as an adjuvant to multimodal analgesia in thoracotomy because it provides optimal anesthesia and analgesia, but another technique such as paravertebral and intercostal block is also utilized(18). When an epidural block cannot be done then some studies conclude paravertebral block has a similar degree of analgesic effect with less complication(24), and others find thatintercostal block has comparable analgesia effectiveness with less complication than an epidural(25).On the other hand,another study says the paravertebral block is more effective and superior than an intercostal block(4) and others say ICNB is more effective than TPVB(26).

Eventhough there is a controversy in analgesia effectiveness of TEDB, TPVB, and ICNB, postoperative analgesia is routinely achieved by doing postoperative single-dose TPVB and directinfiltration intercostal nerve block in our setup while TEDB is not routinely practiced due to inadequet availability of epidural kit.But there is no comparative study about single dose multiple site injection TPVB and single-dose direct ICNB analgesia effect for post-thoracotomy pain management. Therefore doing a comparative study having pain intensity as a primary outcome; time elapsed to first analgesicrequest, postoperative analgesic consumption, and incidence of postoperative complications as a secondary outcome is needed. Thus this study has been conducted to compare analgesia effectiveness of postoperative TPVB and ICNB for unilateral thoracotomy based on the above mentioned primary and secondary outcomes.

1.3 Significance of the study

Postoperative intense pain resulting from thoracotomy requires adequate analgesia to prevent cardiorespiratory morbidities.In our setup either NSAID or opioid is mostly used for postoperative pain management.Additionally, single-dosemultiple level injectiondirect intercostal blocks and single-dose multiple level injection thoracic paravertebral blocks areroutinely performed.

Eventhough studies are comparing paravertebral block and intercostal block with the gold standard epidural block or CTPVB with CICNB which shows a controversial result, as far as my knowledge, there is no comparative study done on analgesic effect of single-dosemultiple level injectionsTPVB and direct ICNB for thoracotomy. This probably leads to performing the block with less analgesia effectresulting in higher pain score, repetitive analgesic request, and high analgesic consumption which further amplifies postoperative morbidity due to opioids side effects such as nausea, vomiting, respiratory depression, and cardiac instability(23).

There are some studies done on the effectiveness of paravertebral block and intercostal block for minimally invasive VATS, whereas there is insufficient work done to evaluate its effect in thoracotomy. Since conventional posterolateral thoracotomy which has intense pain is performed in our setup, doing a comparative study and identifying the better effective technique is mandatory to improve postoperative outcomes and increase patients' satisfaction by improving comfortand cost-effectiveness. Also studying the incidence of complicationsis important to prefer the technique of block with less complication.

Overall doing this study will help in identifying the more effective type of block for post-thoracotomy pain management and recommend it to be a routine practice as techniques of analgesia for thoracotomy.

Doing this study will also reduce the chance of high dose repetitive opioid administration and reduce the risk of associated side effects which further reduce postoperative morbidities and improve patient satisfaction. On the other hand, it will contribute to improvement of education quality and use as a baseline for further researches.

Chapter two: Literature review

Thoracotomy is an invasive painful surgerymore specificallyposterolateral thoracotomy performed by division of latissimusdorsi and sometimes other chest wall muscles such as the trapezius, rhomboids, and serratus anterior muscle results severepostoperative pain(27).However, a meta-analysis by including 72studies done comparing muscle sparing and posterolateral thoracotomy showed no significant difference in skin incision size and pain score at POD1but higher pain score resulted inposterolateral thoracotomy(28).

Eventhough VATS is a minimally invasive procedure and considered to have less significant pain, recent studies showed no significant difference in the incidence and severity of acute or chronic pain following thoracotomy vs. VATS(21,29).

According to a prospective cohort study done in 2018 at Greece, despite the use of local analgesia or other medications prevalence of pain intensity following thoracic surgery showed 53.33% worst pain and 36.67% strong pain which was significantly associated with the type of diagnosis and procedure performed but shows no significant association with gender while 50% of female and 15% male could not feel pain relief with any medication, age, education level, chest drain, incision type and pain location (internal vs. external)(3).

Overall acute thoracotomy pain does not adequately respond toa single analgesia technique. Successful management requires multimodal analgesia techniques targeting multiple sites along the pain pathwayusing opioids, NSAID, andparacetamol incorporating regional analgesia techniques such as EDA, TPVB, and ICNB(4).

2.1 Analgesia effect of intercostal nerve block

A retrospective cohort study done in 2013 comparing 6level direct ICNB using liposomal bupivacaine with TEDA for thoracotomy showed significantly lower 10cm VAS pain score, 6(3-8) vs.7(7-8) $p<0.04$ by ICNB group but no significant difference in opioid consumption 3mg and 2.1mg for ICNB and TEDArespectively over 24hr(14).

In 2014 a retrospective cohort study was done and showed no significant difference in oxygen saturation and analgesic effect between TEDA and ICNB following thoracoscopic lobectomy but better hemodynamic stability maintained by ICB. The presence of lowest SPO2<90% was 13

(10.4%) in TED, 7 (6.8%) in ICB, P=0.338), postoperative pain using VAS in first day (mean difference: 1.8±1.7 in TED, 1.9±1.2 in ICB, p=0.456(30).

Another retrospective cohort study done in 2015 showed statistically significant lower postoperative pain score by ICNB using standard bupivacaine as compared to liposomal bupivacaine(31)

In 2016,a randomized trial study was done and showed almost equal analgesia effectiveness of direct ICNB with TEDA using 0.2% ropivacaine. In this study analgesic duration without rescue analgesia by EDA and ICNB at rest was 214±10.2 min vs.210 ±8.35 min and on movement was 200±17.89 vs.193±16.76 min respectively with no statistical significant difference p>0.05(25).

Besides, a randomized trial study done in 2017 showed a significant decrease in postoperative pain score and morphine consumption in the5level ICNB group using 0.025% bupivacaine as compared to the IV morphine group in the first 6 hr but no significant difference after 6hr. Mean of 10cm VAS was significantly lower in ICB group (3, 2.6, 2.4, 1.8) when compared to control group (4.1, 3.6, 2.8, 2.5) at 1, 6, 12 and 24 hr respectively with p<0.05 but, from those observation times VAS was not significant at 12thhr with p>0.05(32)

2.2 Analgesia effect of thoracic paravertebral block

A retrospective cohort study done on the efficacy of paravertebral block analgesia for post-thoracotomy pain in 2014 analyzed 132 patients and all received PVB, 68 has intact pleura other 68 has disrupted pleura. In this studypain severity assessed by VAS and showed 4.68 ± 1.26, 2.8 ± 1.28, 2.2 ± 0.86, 2.03 ± 0.77 in PVB with disrupted pleura, 3.67 ± 1.29, 2.3 ± 0.79, 1.3 ± 0.58, 1.09 ± 0.42 in PVB for intact pleura at time interval of 1hr, 6hr, 12hr and 24r respectively. There was a significant difference in post-op analgesia consumption, which was higher in those who have disrupted pleura(33).

Another retrospective cohort study done in Egypt showed the total morphine consumption in 24hr following TPVB for 20 patients as 11 (0.75–8.25)mg and there was nausea vomiting on 3 patients(34).

A randomized trial study done in 2015 on USG TPVB using 0.5% ropivacaine on 33patients undergoing VATS showed high pain score by 10 point NRS at rest 3(2-5), 4(3-5),4(3-5), 4(3-

6),3(2-4), 2(2-3) and on coughing 5(2-6),5(4-7), 6(4-7), 5(4-7), 4(3-5), 3(3-5) at 1hr, 2hr, 4hr, 8hr, 12hr and 24hr respectively. In this study the incidence of nausea was 3(9.1%)(35).

In 2016, a randomized study on effect of preoperative single injection PVB with PCA having IV PCA as the control group was done and result showed a statistically significant decrease in 10cm VRS pain score at 6hr and 24hr with mean 1.75 and 2.25 at rest, 2.5 and 4 on coughing at 6hr and 24hr was respectively with $p<0.05$ at both observation times. In this study, the incidence of nausea and vomiting in the PVB group was2(7.69%)(36).

Besides in 2016 a randomized study was done at Ethiopia and showed statistically significant lower pain score and analgesia consumption by TPVB for cholecystectomy as compared to the control group. the NRS score result presented as median (median±IQR) was 0(0), 1 (1–2), 2 (1–3), 2 (2–3), 4 (3–6) at rest, 1 (0–1.5), 3 (1–4), 4 (4–5), 5 (4–5), 4 (4–7) on coughing at 30min,1hr,2hr,6hr, and 24hr respectively. The time elapsed to first analgesic request was 120 (60–120) min and total morphine consumption was 0 (0–2) mg, total tramadol consumption was 200 (150–250) in 24hr(37).

2.3 Comparison of thoracic paravertebral and intercostal nerve block

A randomized study done in 1995 on unilateral ICB of T3-T7 with 16ml of 0.5% bupivacaine or a paravertebral block with 12ml 0.25% bupivacaine followed by continuous infusion showed lower pain score by ICNB groupthan CTPVB (50cm VAS) both at rest with a median value of 48.1 vs. 57.7, 36.0 vs. 45.6, 27.5 vs. 33.6, 24.1 vs. 31.6, 20.7 vs. 30.7, 22.1 vs. 27.6 and on coughing with median of 83.4 vs. 85.6, 63.0 vs. 78.8, 61.7 vs. 70.8, 60.7 vs. 71.9, 65.1 vs. 68.3, 61.9 vs. 69.6at 1hr, 2hr, 4hr, 6hr, 20 and 24hr respectively. In early 2-3hr ICB has significantly less pain with coughing but there was no significant difference in respiratory parameters including SpO2.This study concludes the presence of no statistically significant difference between groups in terms of pain intensity, morphine consumption, respiratory function, and adverse events(38).

A randomized trial study done in 2008 comparesanalgesic effectiveness of CTPVB and CINB after thoracotomy. In this study, the average VAS score with 101mm measurement at rest was 29± 10mm for paravertebral block and 31.5±11mm for CICB. The average VAS score on

coughing was 36±14mm for CTPVB and 44±14mm for CICNB. Cumulative morphine consumption was lower in the PVB group during the study period but not statistically significant p> 0.05 (35.7 ±17 vs. 41 ±21 mg).The incidence of cardiac instability and pulmonary complications was not significantly different between the groups(39).

In 2014, a randomized trial study has doneon the effectiveness of TPVB against ICB for renal surgery showeda significant decrease in 10 points VAS score by TPVB during rest and on movement with p<0.05. The mean time elapsed before the first analgesia request in the PVB group was 17.37±2.70hr, whereas in the ICB group it was 8.96±1.88hr(p<0.0001)and the total pethidine consumption was significantly lower by PVB compared with the ICB ($P < 0.05$). There was no significant difference in PR, MAP, arterial oxygen pressure, and arterial carbondioxide pressure during postoperative observation in 24hr.The incidence of postoperative complicationwas bradycardia1(2%), 2(4.1%)nausea4(8%), 2(4.1%), vomiting2(4%), 1(2%), hypotension1(2%), 3(6.1%) on ICB and PVBrespectively(40).

A randomized trial study done in 2016 compared analgesia effectiveness of intercostal and TPVBfor thoracotomy and concluded the superiority of PVB block by seeing pain severity as NRSresult at rest for ICB vs. PVB showed 4.5(0-8) vs.1(0-4), 4.5(1-6) vs.2(0-4), 3.5(1-5) vs.1(0-3), 3(1-5) vs. 0(0-3), 3(2-5) vs. 1(0-3), 3(2-6) vs. 2(1-3), and on movement 5(2.5-8) vs. 0.5(0-4), 5 (3.5□7) vs. 3 (0□5), 5 (3□6) vs. 0 (0□3), 3.5 (2□6) vs. 3 (0□5), 5 (3□7.5) vs. 3 (2□5), 5 (3□9) vs. 4.5 (3□5)at 0hr, 1hr, 3hr, 6hr, 12hr, and 24hr respectively. TPVB group had statistically significantlower score(p□0.035, 0.024, 0.0011, 0.01)at 1, 3, 6, and 12hr respectively, it had also lower score on movement with statistical significance seen at 6hr (p=0.028) and 12hr (0.024).Postoperative rescue fentanyl use in theTPVB group was smaller than that in the ICNB group at 3, 6, 12, and 24 hr with p□ 0.023, 0.039, 0.039, and 0.0058 respectively(41).

A randomized trialstudy done in 2016 on the effectiveness of CICB and CTPVB for VATS lobectomy showed no significant differences between the VAS scores of the two groups in the 1st POD, but a lower score was found by the PVB group. Besides no significant differences were detected in the frequency of additional analgesics use and the occurrence of adverse effects(26).

In 2017, a retrospective study comparing USG TPVB performed at space of T4-5 and T7-8 using 20 ml o.37% ropivacaine for VATS and internal ICNB performed at 3rd to 8th intercostal nerve

by 9ml of 0.375% ropivacaine with 1% lidocaine under parietal pleura showed no significant difference pain score(42).

In 2018 a prospective cohort study was done at Ethiopia on analgesiaeffectiveness of TPVB and ICB for cholecystectomy. Pain severity at rest by NRSshowed in TPVB and ICB presented as 2(1-2) vs. 2.5(1-4), 1(0-2) vs. 2(1-3), 1(1-2) vs. 2(2-4), 0.5(0-1) vs. 2(0-2), 0(0-1) vs. 1(0-2) and on coughing 3(2-4) vs. 3.5(2-4), 2(1-3) vs. 3(2-4), 2(1-2) vs. 3(3-4), 1(0-2) vs. 3(1-3), 0(0-1) vs. 2(0-3) at 0hr, 6hr, 12hr, 18hr, and 24hr respectively with a stastical significant difference($p<0.5$)on coughing at 12hrand above by superior analgesic effect of TPVB but no significant difference in NRS at rest in all observation times. The median time elapsed to first analgesia request 18(14.59-21.40) hr in TPVB which is significantly longer time as compared to ICNB group with 6(3.7-8.2) hrwith p□ 0.005. The cumulative analgesia consumption of tramadol in mg for TPVB was 0(0-0), 0(0-0), 0(0-50), and 0(0-50), for ICNB was 0(0-50), 0(0-50), 0(0-50) and 50(0-50), inadition total diclofenac consumption in mg on TPVB was 0(0-0), 0(0-19), 0(0-75) and 0(0-75), in ICNB group was 0(0-0), 0(0-75), 75(0-75), and 75(0-75) at 6hr, 12hr, 18hr and 24hr respectively(43).

A randomized control study done on effectiveness of erector spine block, multiple level TPVB and ICNB for thoracoscopic surgery in 2019 showed pain score by 10cm VAS 0(0-1) vs. 0.5(0-2), 0.5(0-1) vs. 1(0-2), 1(0-1) vs. 2(1-2), 1(1-2) vs. 2(1-3), 1(1-1) vs. 1(1-1), for TPVB vs. ICNB at rest; 0.5(0-1) vs. 1.5(0-3), 1(0-2) vs. 2(1-3), 1(1-2) vs. 2(1.5-3), 1(1-2) vs. 2(2-3), 1(1-2) vs. 1(1-2), for TPVB vs. ICNB on coughing at 0hr, 2hr, 4hr, 8hr and 24hr respectively with a statisticallysignificant different resulted at 8hr both at rest with $p< 0.0167$ and on coughing with $p< 0.0167$. There was no statistically significant difference in morphine consumption at 2 and 4 hr, but there was a statistically significant lower analgesia consumption by TPVB at 8 and 24 hr with p□ 0.001(44).

Conceptual framework

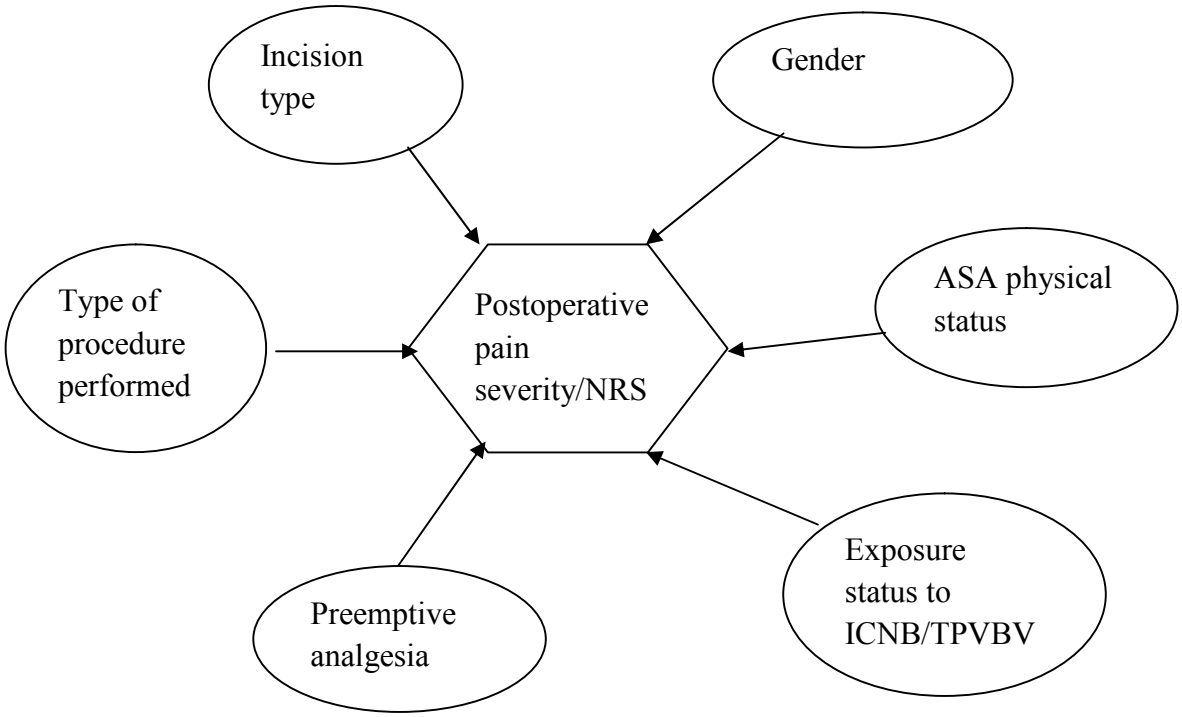

Figure 1: Conceptual framework adapted from different pieces of literature(3,4,45,46)

Research hypothesis

The intensity of pain after thoracotomy in those patients who received intercostal nerve block compared with a thoracic paravertebral nerve block was hypothesized as:-

HO: There is no significant difference in NRS, time to first analgesic request, and total analgesic consumption between groups.

HA: There is a significant difference in NRS, time to first analgesic request, and total analgesic consumption between groups.

Chapter three: Objective of the study

3.1 General objective

To compare analgesic effectof postoperative thoracic paravertebral nerve block (TPVB) and intercostal nerve block (ICNB) for unilateral thoracotomy during at rest and on coughing from December 25, 2019 to April 30, 2020 GC.

3.2 Specific objective

To compare pain severity at rest and on coughing between groups using 11 points NRS in 24hr.

To compare the time elapsed until the first analgesia request time between groups within 24 hr.

To compare the total amount of analgesic drugs consumed between the groups within 24 hr.

Chapter four: Methodology

4.1 Study area

Addis Ababa is the capital city of Ethiopia which has an area of 527 square kilometers and 10 sub-cities. There are around 13 public hospitals at different sub-cities from them TikurAnbesa Specialized Hospital, MinilikII Referral Hospital, and St. Petros Referral Hospitals serve all societies in Ethiopia at different departments; cardiothoracic department is one of them therefore they are selected to be our study area by convenient sampling technique.

TikurAnbesaSpecialized Hospital also called Black Lion Specialized Hospital established in 1872 EC, at Lideta sub-city. This specialized hospital gave surgical health service with a capacity of 9 OR tables, 1 adult and 1 neonatal ICU. It has 1 cardiothoracic OR table and 1 chest ward with 16 beds.

MinilikII Referral Hospital established in 1910 EC at Yeka sub-city. This hospital gave health services with a surgical bed capacity of 135. The surgery department is one of the major departments having 3 major OR tables, 1 ICU, and it has 2 chest wards with separate female and male in each ward.

St. Petros Specialized Hospitalestablished in 1965 EC at Gulele sub-city.They gave health services including surgery with a capacity of 54 surgical beds, 5 major OR tables, and 1 ICU.

Both Minilik II and St. Petros Hospitals schedule thoracic surgeries on two days whereas Black Lion Specialized hospital schedule thoracic surgery on five days a week.

4.2 Study design and period

Multicenter based prospective cohort study was conducted from December 25, 2019 to April 30, 2020 GC.

4.3 Population

4.3.1 Source population

All elective patients admitted for thoracic surgery at Black lion specialized hospital, St. Petros specialized hospital, and Minilik II referral hospital.

4.3.2 Study population

Patients who underwent unilateral thoracotomy and received postoperative TPVB or ICNB at Black lion specialized hospital, St. Petros Hospital,and Minilik II Referral Hospital during the study period.

4.4 Eligibility criteria

4.4.1 Inclusion criteria

From scheduled patients to undergo unilateral thoracotomy under general anesthesia with ETT/DLT in the selected study period, those who were ASA I, II,III, age 18 to 75 years,and received either ICNB or TPVB were included.

4.4.2 Exclusion criteria

Those who don't fulfill inclusion criteria, lack of consent for the study, inability to comprehend or visualize pain scale (psychiatric, dementia, intubated, sedated, delayed recovery, both visual and auditory impairment), hepatic/renal failure,contraindications to regional techniques, those who take epidural anesthesia, chronic opioid use, pre incisional TPVB/ICNB use, combined ICNB and TPVB technique use, rib resection, re-thoracotomy with 24hr, failed block, wound site infiltration before thoracotomy, induction with ketamine and additional skin incision other than thoracotomy.

4.5 Study variables

4.5.1 Dependent variable

The dependent variables of this study were pain severity which was assessed by NRS of patients at rest and with movement; time elapsed to first analgesic request and total analgesic consumption in 24hr during the postoperative period.

4.5.2Independent variable

Independent variables of this study were sociodemographic factors (age, sex, weight, BMI, ASA physical status), type of incision (posterolateral, anterolateral, auxiliary), types of performed procedure, preemptive analgesia, intraoperative analgesia, and exposure status to ICNB or TPVB.

4.6 Operational definitions

Postoperative pain: when a patient has pain and any pain score other than 0 starting from 1hr of the block to 24hr.

Time elapsed to first analgesia request: is the duration of time in minutes from doing block to first analgesia request time in 24hr.

Total postoperative analgesia consumption: total dose and type of medication that will be given in mg within 24hr starting from admission to the post-anesthesia care unit.

Intraoperative analgesic consumption: type of medication that will be given in mg except for fentanyl in microgram after induction of anesthesia to admission to PACU.

Postoperative nausea: when a patient experience at least one episode of nausea within 24hr.

Postoperative vomiting: when a patient experience at least one episode of vomiting in 24hr.

Preemptive analgesia:analgesia initiated 20min to 2h before thestart of surgery incision with the timing for IV opioids and acetaminophen 20-30min beforesurgery whereas 1-2hr before surgery for IM opioids and NSAIDs.

Delayed recovery: when a patient is unable to respond for verbal stimuliand answer a question for greater than 20min after admission to PACU.

Failed block: When thesensation of pinprick pain at any level of dermatome T3-T8 (axilla, nipple, epigastrium, and upper abdomen) in 20 minutes of the block performed on the ipsilateralsite.

Local anesthetic toxicity: when a cardiovascular, neurologic, or respiratory symptom of toxicity is reported after the block to 24hr.

Hypotension/hypertension: If the mean arterial blood pressure is less or greater than 20% of the baseline value.

Bradycardia: when the pulse rate is less than 50 beats per minute in 24hr.

Numerical pain rating scale (NRS): presented by 11 points scale and can be reported graphically or verbally. In this pain assessment tool pain severity is represented as 0=no pain, 1-3= mild pain, 4-6= moderate pain, 7-10=sever pain over 24hr.

Evidence supports NRS to be used to measure acute pain in clinical studies because it has good sensitivity and the responded data can be statistically analyzed(47). Besides high test-retest reliability has been observed in both literate and illiterate patients(48)

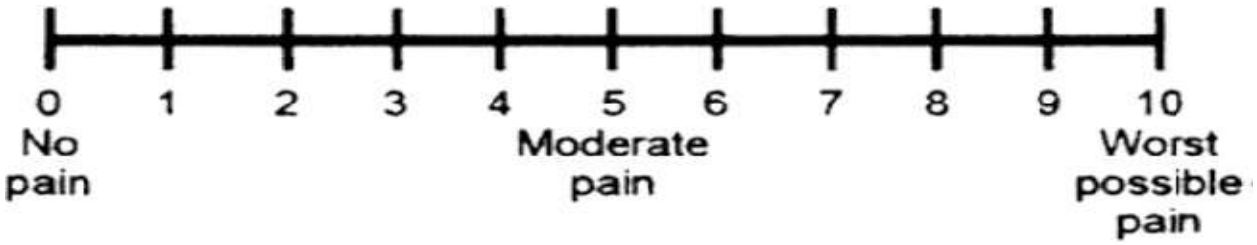

Figure 2: Adopted from the National Initiative on Pain Control (NIPC)

ASA status: is the surgical risk stratification of patients by their physical status as ASA I, II, III, IV, V, VIE which is validated by the American Society of Anesthesiologist(49).

4.7 Sample size and sampling technique

4.7.1 Sample size

Having no previous published study done in the study area and on the same title, a pilot study was done on November 21 to December 20, 2019at Minilik II referral hospital by taking 10% of the sample size of the previous study done in Tunisia which enrolled 47patientsand had been used to calculate the sample size of our study(50). After getting the sample mean and sample standard deviation of pain score from a pilot study used as representative of the population, the sample size wascalculated manually and using a priori power analysis (G Power version 3.01) by taking 80% power, alpha 5%, and 10% attrition was added.

Sample size estimation was done based on the largest sample size ofequal independent sample size formula for comparison of two means(51) as:-

$$n = \frac{(z_1 + z_2)^2 \times 2 \times (s^2)}{(\mu_2 - \mu_1)^2}$$

$\mathbf{Z_1}$ = 1.96 for α error of 5% (95% confidence level), $\mathbf{Z_2}$ = 0.84 for 80% power

$\boldsymbol{\mu_1}$= 4.8, which is NRS mean of TPVB group, $\boldsymbol{\mu_2}$= 5.6, which is NRS mean of ICB group

S= 1, is pooled standard deviation, **n** = 24.5≈ 25, is the sample size per group

By using a 1:1 ratio for sample size we get 25 patients, adding10% attrition rate each grouphad 28 samples with a total sample size of 56.

4.7.2 Sampling technique

Black lion, Minilik II, and St. Petros hospitals were selected by convenient sampling method. From the situational analysis in those hospitals, a total of 69 patients who fulfill the inclusion criteriawere estimated to undergo thoracotomy during the study period, from those; 56 patients were recruited by systematic random sampling method with the probability of 82%. From this sampling fraction K value was found to be 3/4 thenafter proportionate allocation of the sample size (PAS) to those three hospitals,data collection wasconducted on 3 patients for every 4 patients who undergone unilateral thoracotomywith either multiple injection TPVBor direct ICNB. The first patient to be included in the study was selected by the lottery method and the remaining patients were sorted based on the time sequence they admitted to PACU. The first 3 admitted patients starting from the first patient included for data collection were included in the study based on grouping and the last 4th patient admitted to PACU get excluded. This process of sampling technique continued until the required sample size was reached.

By using the proportionate allocation size (PAS) formula for the sample size, the number of samples required from each hospital was identified as follows:-

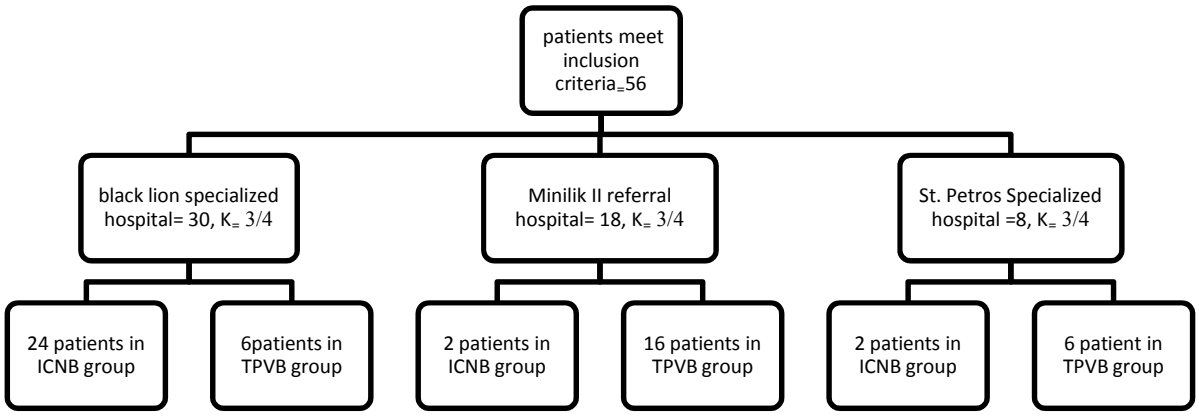

Figure 3: Proportional allocation and enrollment chart for patients scheduled for thoracotomy

4.7.3 Data collection procedure and patients handling technique

Well structured open and close-ended questioner was designed and used to collect data by threedata collectors at each hospital; those are fourBSc nurses at each of Black Lion and Minilikhospitals and two BSc anesthetists at St Petros hospital and one additional BSc anesthetist at each of three hospitals.All data collectors were trained about the objective of this study, their approach to patients, data collection tool and data collection methods.

All patients scheduled for elective thoracotomy who fulfill the inclusion criteria based on information found by chart review and patient interviewduring the preoperative period was requested for their volunteer to involve in our study after explaining them about the objective of the study, their chance of being excluded from the study in the postoperative period based on some seated exclusion criteria, the risk and benefits they get from being involved in the study and then verbalconsent has been taken. Following the voluntary consentdata collector trained each participant about techniques to report the level of pain during at rest and with movement/coughing using verbal NRS (0-10); they also get trained about their right for analgesia request if they need to due to pain.

Data about the confounding factors such as socio-demographic factor, preoperative and intraoperative factors such as preemptive analgesia, anxiolytic premedication, intraoperative analgesia use, incision type, vital sign before doing nerve block and technique used for the block, duration in minutes from doing the block to transfer to recover room and failure/success of the block based on sensory dermatome assessment at 20min of the blockwas filled by anesthetist data collectors in charge. The remaining postoperative data were collected by other responsible data collectors who were unaware of the group allocation. The sources of data for our entire question were primary data.

In all study hospitals, TPVB is usually done with landmark technique single injection and multiple injection technique but ICNB is performed with multiple intercostal nerve infiltration under direct visualization before skin closure. MSc anesthesia trainee and surgery residents have periodic rotation at our study areas and they are well exposed for TPVBand direct ICNB respectively, whereas thoracic anesthesiology residentswho are well exposed forTPVB stay in Black lion. MSc trainee and anesthesiology residents perform multiple levels TPVB and surgery residents perform multiple levels direct ICNB as a routine practice. Sometimes they give combined block but we only include patients who received either landmark technique multiple level TPVB or direct ICNB into our study.

Thoracic paravertebral block for thoracotomy:at the end of thoracotomy closurewith the patient in either left or right lateral position on theipsilateral site of the incision,anesthesia trainee or anesthesiology residents marked the needle injection site 2.5cm distance lateral to the midline of the vertebral body and then following aseptic skin preparation 22 gauge needle inserted on the marked site in search of the transverse process, then at a 15º to 60º angle the needle walk off the transverse process and then advancing 1cm in, 4ml of 0.25% bupivacaine was deposited at each level paravertebral space T4-T8 with a total of 20 ml 0.25% bupivacaine is routinely practiced.

Intercostal nerve block for thoracotomy: at the completion of thoracic procedure with the patient in either left or right lateral position, surgery resident insert a 22gauge needle before thoracotomy closure with direct visualization of intercostal nerves just below the inferior border of the rib along with internal intercostal muscle then injected3 ml of 0.25% bupivacaine at each levelofT3-T8above partial pleura withatotalof18ml0.25%bupivacaineis routinely practiced.

Postoperative follow-up and data collectionon pain intensity, analgesia request, total analgesic consumption, cardiopulmonary and other complications were done at PACU, ICU, and surgical ward for 24 hr. Data collectionstarts at 1hr of block performed, then continued in 3^{rd}hr,6^{th}hr,8^{th}hr,12^{th}hr,18^{th}hr,and 24^{th}hr.

Postoperative pain was assessed in all groups using an NRS pain assessment method.Each patient asked to report their pain verbally based on 11 points NRS score. The pain score had been assessed during a quiet breathing period or at rest and after voluntary cough/ movement. The time to the first request for analgesia requirement and total analgesic consumption of each patient was also recorded.

4.7.4 Data quality control and assurance

Before starting the actual data collection, the reliability and validity of the data collection tool was checked by pretesting at Minilik II referral hospital on 10% of the sample size. Data collection had been done by trained personnel under regular supervision and follow up by the principal investigator. The collected data was checked by the principal investigator for completeness, accuracy, and clarity every day. Data quality assurance by cleanup and cross-checking of entered data on SPSS V 20 was alsodone before analysis.

4.7.5 Data analysis and interpretation

The collected study data wereentered into SPSS V 20 for analysis. The data weretested for normality using the Shapiro-Wilk normality test. Normally distributed homogeneity of the variable was tested by Levene's test for equality of variance. Numerical data were presented as mean± standard deviation for parametric data and median± interquartile range for nonparametric data. Frequency and percentage were used to describe qualitative variables and statistical difference between groups was tested by Fisher's exact test or chi square test as indicated. Comparisons of quantitative variables between two groups were by using independent sample t-test for parametric and Mann Whitney U test for nonparametric numerical data. $P< 0.05$ was considered as statistically significant.

4.7.6 Ethical consideration

Before the start of the study, an ethical clearance was obtained from the departmental research and ethical review committee of AAU. An official support letter was requested to be written for responsible authorityto get permission for data collection. The purpose of the study, risk, and

benefits of participation was explained to the study participants to get voluntary based informed verbal consent. Their right to not participate in the study and to quite their participation at any stage was allowed. Confidentiality was maintained by avoiding the identifier and using codes to identify the patient.

4.7. 7 Dissemination plan

This study on the completion will be presented for the department of anesthesia staff, at the annual research conference and the Ethiopian association of anesthesia annual meeting. It will serve as a reference to experts for this the paper will be submitted to the school of medicine and department of anesthesia. Besides, a copy of this material will be given to Black lion, St. Petros, Minilik II hospital, and Addis Ababa University student research office. The result will also be submitted to journals, disseminated through publication in peer-reviewed local and international journals.

Chapter Five: Result

5.1Sociodemographic and Perioperative characteristics

A collected data from 56 patients who received either ICNB or TPVB at the end of surgery were entered into SPSS V20 software and it gets analyzed.

The result shows no statistically significantdifference between two groups in both sociodemographic and perioperative characteristics with p value>0.05 except the time taken from doing the block to admission to recovery owing to the time taken for thoracotomy closure in intercostal groups. All the characteristics result and their corresponding P-value is demonstrated bellow.

Table 1:Sociodemographic characteristics of patients who underwent thoracotomy

Characteristics		**TPVB group n=28**	**ICNB group n=28**	**P-value**
Age in year		40.79±15.06	37.39±12.93	0.370
Gender n(%)	Male	18 (64.3%)	14 (50%)	0.280
	Female	10 (35.7%)	14 (50%)	
ASA physical	I	15 (53.6%)	17 (60.7%)	0.589
Statusn(%)	II	11 (39.3%)	10(35.7%)	0.783
	III	2 (7.1%)	1 (3.6%)	1.000
BMI in kg/cm^2		23.29±2.53	23.58±2.24	0.653

Hint:Values are presented as mean± SD tested by independent sample t-testand Number (proportion) tested by chi square test and fisher exact test.

Table 2: Perioperative characteristics of patients who underwent thoracotomy

Characteristics	**PVB group n=28**	**ICB group n=28**	**P- value**
Preoperative PR in beat/min	79.25±9.999	78.36±8.941	0.726
Preoperative MAPin mmHg	87.86±6.905	87.11±6.414	0.675
Preoperative RRbreath/ min	19.07±1.044	18.86±1.215	0.482
Preoperative SPo2in %	94.50±1.319	94.21±1.750	0.493

Preemptive analgesia	Given	22(78.6%)	21(25%)	0.752
	Not given	6(21.4%)	7(25%)	
Performed procedure	Wedge resection	2 (7.1%)	4 (14.3%)	0.669
	Cyst excision	4 (14.3%)	2 (7.1%)	0.669
	Lobectomy	5 (17.9%)	6 (21.4%)	0.737
	Decortications	8 (28.6%)	9 (32.1%)	0.771
	Mass excision	4 (14.3%)	4 (14.3%)	1.000
	Pneumonectomy	3 (10.7%)	1(3.6%)	0.611
	Bullectomy	2 (7.1%)	2 (7.1%)	1.000
Intraoperative analgesia in middle of procedure	Fentanyl	2 (7.1%)	1(3.6%)	1.000
	Diclofenac	3 (10.7%)	5 (17.9%)	0.705
	Morphine	5 (17.9%)	5 (17.9%)	1.000
	Pethidine	5 (17.9%)	4(14.3%)	1.000
	Tramadol	4 (14.3%)	2 (7.1%)	0.669
	Not given	9 (32.1%)	11 (39.3%)	0.577
Duration of surgery in minutes		181.79±48.1	177.68±42.74	0.737
Duration from doing block to admission to recovery		18.21±2.409	48.57±4.095	0.023*

Hint: Values are presented as mean± SD tested by independent sample t-test, Number (proportion) tested by Fisher exact test and chi square test, $p<0.05$ was taken as statistically significant showed by*.PR- pulse rate, RR- respiratory rate, MAP- mean arterial pressure, SPO2- oxygen saturation, mmHg- millimeter of mercury, %-percent, beat/min- bet per minute, breath/min- breath per minute.

All patients were anxious during the preoperative period but none of them take anxiolytic premedication. Posterolateral thoracotomy at the level of 5th ICS was performed and adequate fluid balance was maintained for all group members. At the end of the procedure immediately before skin closure ICNB group members received 3ml of 0.25% bupivacaine into the intercostal nerves at each level of T3-T8 under direct vision before skin closure and TPVB group membersreceived 4ml of 0.25% bupivacaine at each level of T4-T8 after skin closure by landmark technique.

There were no significant difference inthe presence of preemptive analgesia, preoperative PR, MAP, RR, and SPO2 with p>0.05 for all. There were also no significant difference in type of procedure,intraoperative analgesia consumption, and vital sign (MAP, PR) immediately before doing the block with p-value of>0.05.

5.2 Comparison of postoperative vital sign and pain severity score

During the postoperative follow up pain severity was reported by 11 point NRS and cardiorespiratory status was evaluated by MAP, PR, RR, and SPO2. The result of vital sign comparison by independent t-test shows p>0.05.

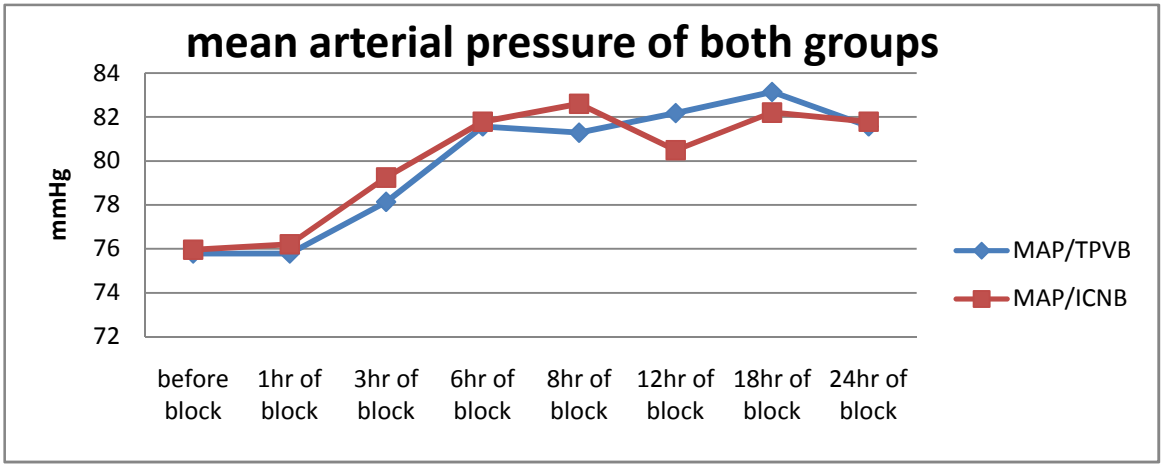

Figure 4: Comparison of mean arterial blood pressure between groups before the block and during observations after the block.

Hint: There was no significant difference in mean of MAP (mean arterial pressure) in mmHg (millimeter of mercury). TPVB- Thoracic paravertebral block group, ICNB- Intercostal nerve block group.

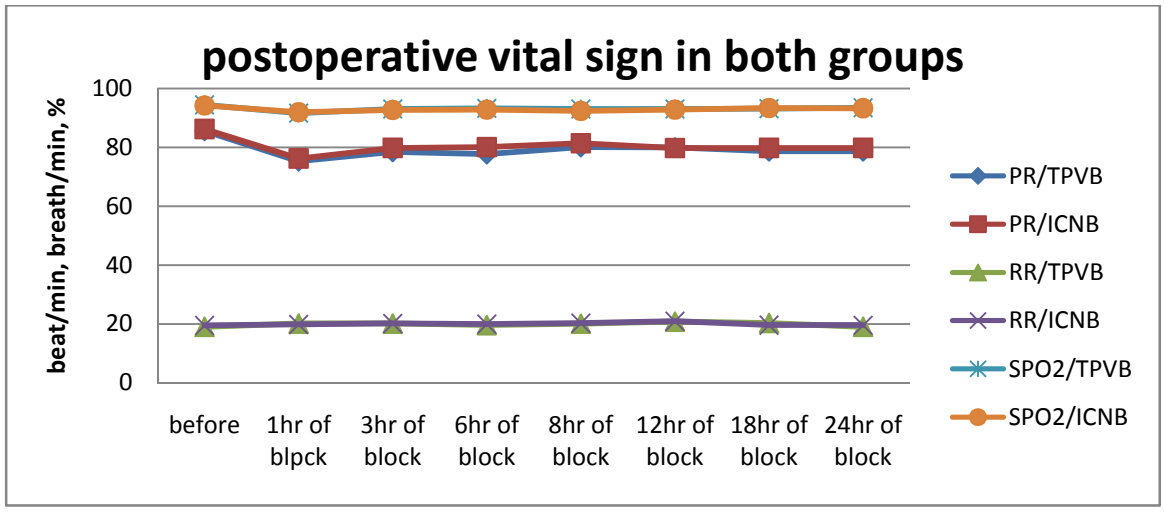

Figure 5: Comparison of vital signs between groups before the block and during observations after the block.

Hint: There was no significant difference in mean of PR (pulse rate) in beat per minute (beat/min), RR (respiratory rate) in breath per minute (breath/min), and SPO2 (Oxygen saturation) in percent (%) between groups. TPVB- thoracic paravertebral block group, ICNB- intercostal nerve block group.

Result from comparison of postoperative cardiorespiratory status demonstrates no significant difference of MAP, PR, RR, and SPO2 between groups. But there was a slight increasment of MAP in ICNB groups at 6hr to 8 hr then it gets decreased with P□ 0.088, 0.28, 0.593 at 6 hr, 8 hr, and 12 hr respectively. Whereas in the TPVB a slight increasment has seen at 12 to 18hr then it gets decreased.

The distribution of postoperative pain scored data wasasymmetric therefore comparison was done by Mann Whitney U test.

Table 3: Comparison of postoperative pain severity at rest and on coughing by 11point NRS

Variables median (IQR)	PVB group at rest	ICB group at rest	P-value	PVB group with cough	ICB group with cough	P-value
1st hr of the block	2(1-2)	1(1-2)	0.285	2(2-3)	2(2-3)	0.582
3rd hr of the block	2(1-2)	2(1.25-2.75)	0.085	2.5(2-3)	3(2-3.75)	0.101
6th hr of the block	2(2-3)	3(2-4)	0.036*	3(3-4)	4.5(3-5)	0.024*

8thhr of the block	3(2-3)	4(3-5)	0.004*	3.5(3-5)	5(3.25-6)	0.004*
12thhr of the block	4(3-4)	3.5(2-5)	0.813	5(3.25-6)	4(3-6)	0.838
18thhr of the block	3(2-4)	3(2-4)	0.338	3.5(3-5)	3.5(3-5)	0.791
24thhr of the block	2(2-3)	2(2-3)	0.586	3(3-4)	3(2.25-3.75)	0.582

Hint:- Value presented as median (interquartile range), PVB: Paravertebral block, ICB: Intercostal nerve block, *represents a significant difference in pain score between groups.

The median NRS score showed a significant statistical difference at6th and 8thhourwith higher pain score by ICNB both at rest and on coughing. The finding of NRS pain score was presented in box plot at figure 6 and figure7.

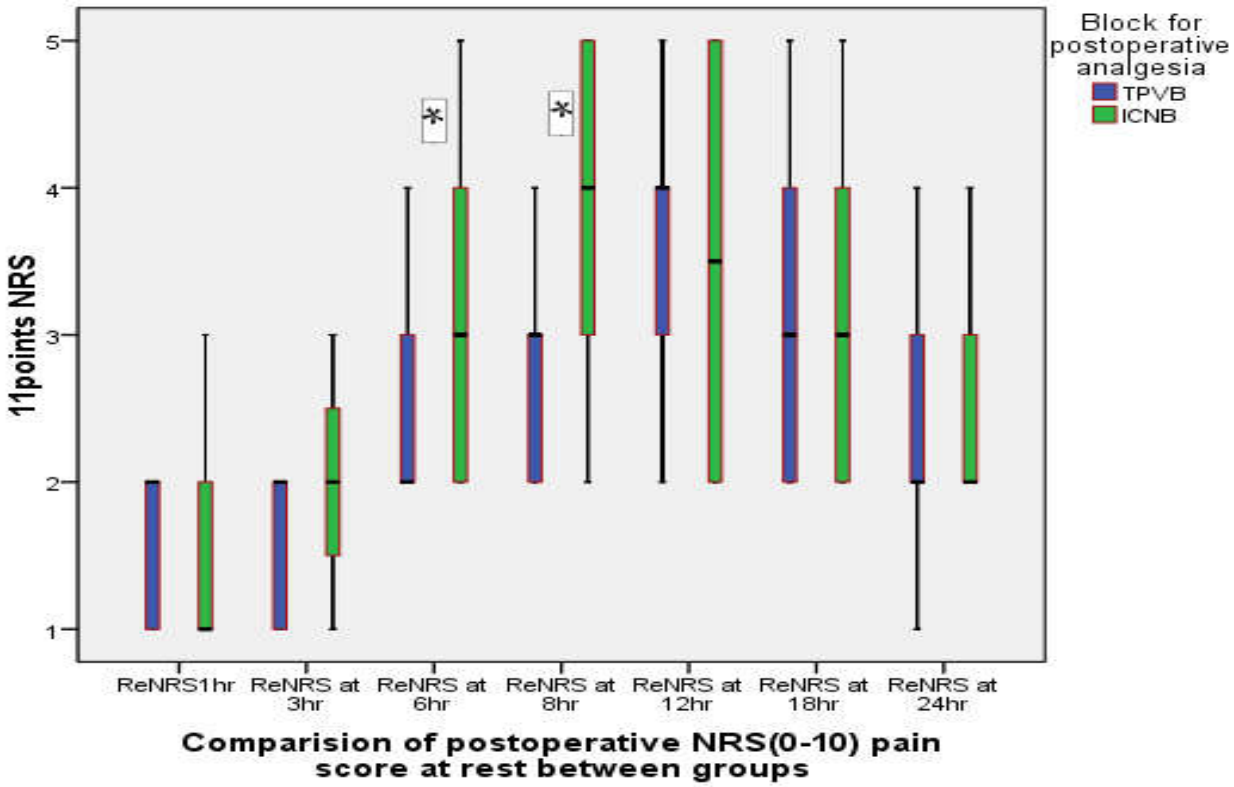

Figure 6: Comparison of postoperative 11point NRS pain score of patients at rest

Hint: NRS: Numerical rating scale, ReNRS: NRS at rest, TPVB: Thoracic paravertebral block and ICNB: Intercostal nerve block.

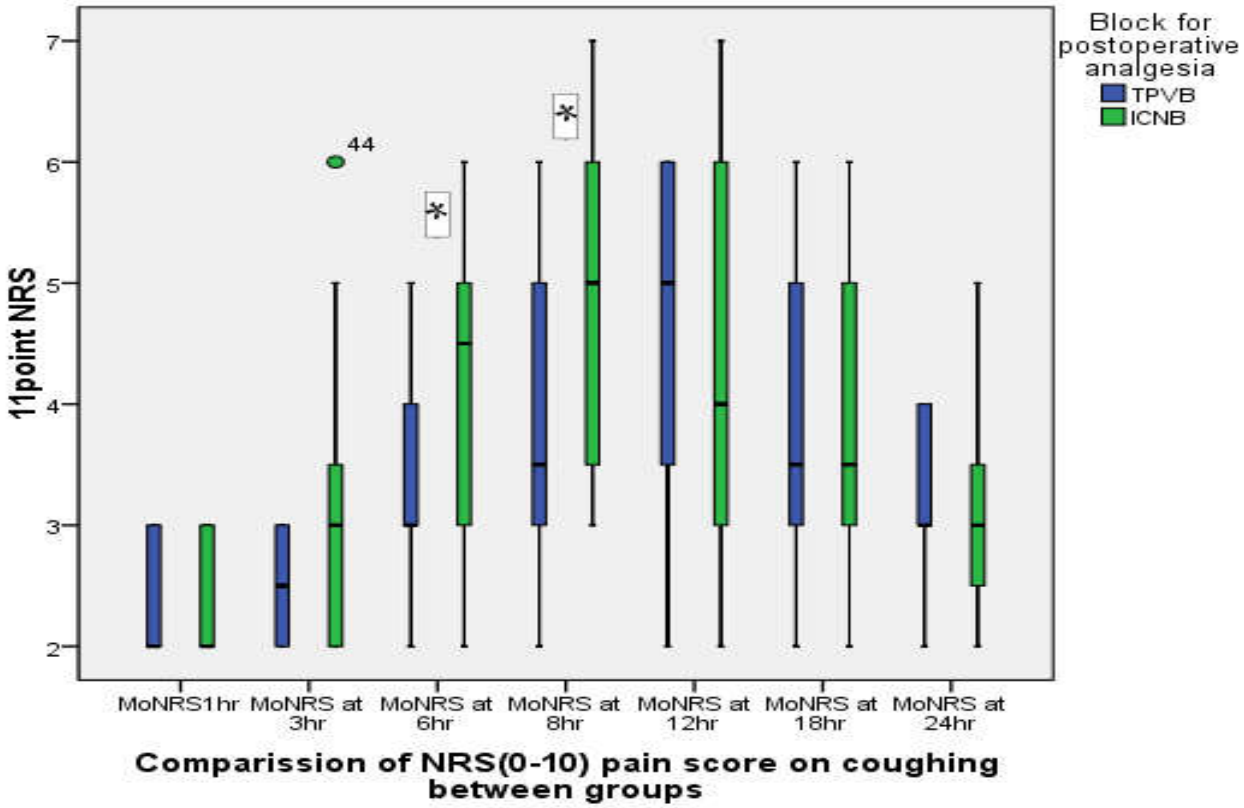

Figure 7: Comparison of postoperative 11point NRS pain score of patients on coughing

Hint: NRS: Numerical rating scale, MoNRS represent Numerical rating scale pain score on coughing of both groups, TPVB: Thoracic paravertebral block, ICNB: Intercostal nerve block.

Hint for figure 6 and 7**:***shows significant difference($p<0.05$), bold black box inside the box shows median, lower and upper border of the box shows interquartile range, and whisker/lower and upper end of vertical lines represent the minimum and maximum pain score.

5.3 Comparison of time elapsed to first analgesic request and total analgesic consumption

The distribution of analgesia consumption at each observation time was asymmetric and the Mann Whitney U test was used to detect the difference. According to the result, there was a significantly higher opioid and diclofenac consumption at 6 and 8hr on ICNB group than TPVB group which showed significantly higher diclofenac consumption at 12 hr.

Table 4: **Comparison of cumulative median diclofenac, tramadol, and morphine consumption at each postoperative observation time**

	Time interval	3hr	6hr	8hr	12hr	18hr	24hr
Diclofenac consumption(mg)	TPVB	0(0)	0(0)	0(0)	0(75)	0(0)	0(0)
	ICNB	0(0)	0(0)	37.5(75)	0(0)	0(0)	0(0)
	P value	0.111	0.352	0.009*	0.04*	0. 469	0.669
Tramadol consumption(mg)	TPVB	0(0)	0(0)	0(50)	0(0)	0(37.5)	0(0)
	ICNB	0(0)	0(50)	0(0)	0(0)	0(50)	0(0)
	P value	0.419	0.014*	0.329	0.739	0.768	0.193
Morphine consumption(mg)	TPVB	0(0)	0(0)	0(0)	0(4)	0(0)	-
	ICNB	0(0)	0(0)	0(5)	0(3)	0(0)	-
	P value	>0.05	0.491	<0.001*	0.198	0.901	-

hint: Analgesic consumption tested by Mann Whitney test and presented: =Median (IQR), *representssignificant difference in analgesic consumption between groups with p<0.05.

The distribution of time elapsed to first analgesic request is symmetric and according to independent sample t-test there were a highly significant difference with p-value of 0.001. Whereas the distribution for total analgesic consumption of diclofenac, tramadol, and morphine was asymmetric therefore Mann Whitney test was used to detect the significant difference. There was a significant difference in total tramadol and morphine consumption with higher consumption by the ICNB group within 24hr.

Table 5: **Time elapsed to first analgesic request in minutes and total analgesic consumption between groups in 24 hr.**

		TPVB group	ICNB group	P-value
Time to first analgesic request (min) mean± standard deviation		608.571±161.63	370.18±97.64	<0.001
Total analgesic consumption within	Diclofenac	75(75-75)	75(75-75)	0.211
	Tramadol	50(0-87.5)	50(50-100)	0.025*

24 hour(mg) Median (IQR)	Morphine	4(0-4)	5(3.25-5)	0.003*

Hint:*shows a significant difference between groups ($p<0.05$), analgesia consumption tested by Mann Whitney and presented as median (interquartile range), request time tested by Independent sample t-test represented as mean± standard deviation.

5.4 Incidence of postoperative complications between groups

The incidence of postoperative complications by fisher exact test was resulted as desaturation42.8%, nausea (21.4%), vomiting (10.7%), hypotension(3.6%), and LA toxicity (3.6%). The proportion of desaturated patients did not differ between groups (21.4%) in eachbut there were higher proportion patients with nausea (14.3%) and with vomiting (7.1%) in the ICNB group as compared to TPVB group. The proportion of patients with hypotension were (3.6%) in the TPVB.

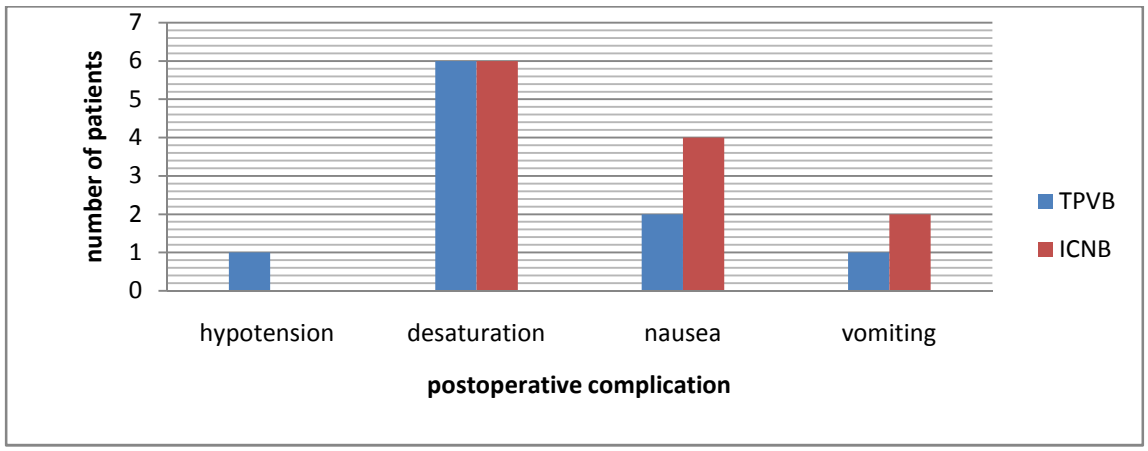

Figure 8: Incidence of postoperative complications in TPVB (Thoracic paravertebral block) and ICNB (intercostal nerve block) groups.

The incidence of complications between groups was comparable with no significant difference with p= 1.000 for all but p=0.669 for nausea.

The overall result of this study demonstrates the presence of statistically significant difference in duration of time elapsed to first analgesic request, total analgesic consumption, and pain score both at rest and on coughing.

Chapter six: Discussion

The severity of postoperative pain and cardiorespiratory instability gets affected by various confounding factors such as age, gender, ASA status, presence of anxiety, preemptive analgesia use, intraoperative analgesia consumption, type of skin incision, types of procedure performed and surgical duration(3,4,45,46)

All those confounding factors in our study were comparable between groups with p> 0.05. Therefore the difference in pain severity, time to first analgesic request, and analgesic consumption between groups was likely due to TPVB or ICNB. Patients who are chronic opioid users were excluded. The thoracic level of ICNB (T3-T8) and TPVB (T4-T7) is supported by other study(19).

Our study demonstrates no significant difference in the median (IQR) of pain score in TPVB and ICNB both at rest and on coughing at 1hr, 3hr, 12hr, 18hr and 24hr of the block with p-value > 0.05 with the lower score resulted by TPVB except at 12hr; but at 6 and 8hrthere was a significant difference both at rest and on coughing with pat rest=0.036 and 0.004, p on coughing=0.024 and 0.0004 at 6 and 8hr respectively. The presence of significantly higher pain score by ICNB group at 6 and 8hr might be explained by the presence of high absorption of local anesthetics from vascularized intercostal bundles which further reduces intercostal nerve block density and results in intense visceral pain perception(52).

Our study result was comparable to a randomized study done in France comparing USG block for mastectomy which showed NRS 2.25(0.5-4) vs. 2(0.25-3.75), 1.75(0.75-3) vs. 2.5(0.75-4.25)at rest, 3(1-5) vs. 2(0.75-5.25), 3(1.75-4.5) vs. 4(2-6) on coughing for TPVB vs. ICNB at 1 and 24hr respectively with p= 0.597 at 1hr and 0.46 at 24hr(53).The possible explanation for this similarity might be that local anesthetics are injected at the proximal thoracic level in both studies. Deposition of LA under direct visualization into proximal thoracic level intercostal nerves results spread of LA into paravertebral space(54). But our study demonstrates a significant decrease in pain intensity at 6 and 8 hr both at rest and on coughing by TPVB with p< 0.05 while it is not assessed on those times in their study.

Eventhough the type of thoracotomy performed in our study is invasive the lower pain score result at 3hr was comparable to a retrospective cohort study done at

ChinacomparingTPVB(T4/5- T7/8) on 2level injection and ICNB (T3-8)for VATS with VAS of 2.75±0.70, 3.16±1.17 for TPVB and ICNB respectively with p 0.097(42).

In line with our study, a randomized trial study done in 2016 at Japan showed a significant decrease in pain intensity by TPVB than ICNB following thoracotomy with p=0.001 and 0.01 at rest, 0.028 and 0.024 on movement at 6 and 12 hr respectively(41). Our study result is also comparable with a randomized trial study done in Chine for thoracoscopy.The result in this study showed statistically significant higher painscore both at rest and on coughing by the ICNB groupat 8hr with p<0.0167(44). The slight difference in this study is thetype of thoracic surgery. They undergo minimally invasivethoracoscopy while it was invasive thoracotomy in ours, but a meta-analysis study showed no significant difference in pain intensity between invasive and minimally invasive thoracotomy in POD 1 but on POD7(28).

Even though liposomal bupivacaine was used in a retrospective cohort study done in 2013 at Texas, pain score by ICNB was higher with 10 cm VAS 6(3-8) at 24hr as compared to our result which shows 2(2-3) using 11point NRS (14). The difference might be due to differences in study design, pain assessment tools, and due to differences in local anesthetics used standard bupivacaine which results in significantly lower pain intensity as compared to liposomal bupivacaine(31).

According to a study done in Tunisia, the average mean of 101mm VAS score as converted to 10cm at rest was 2.9cm for continuous paravertebral block and 3.15cm for continuous intercostal nerve block. The average mean VAS score on coughing was 3.6cm for the first one and 4.0 cm for the second group. There was no significant difference between groups until 24hr but the pain score on coughing was lower in the paravertebral group(39).Which is in contrary to our study result with a difference of significantly higher score by an intercostal group at 6 and 8hrand a higher score by a paravertebral group at 12hr but lower score both at rest and on coughing with no significant difference on other times which is more likely to be explained by the single-injection technique of block we used(55).

Incontrary to our study a randomized trial study done in Helsinkishows minimal pain scoreby ICNB both at rest and on coughingin all observation times at 1hr, 2hr, 4hr, 6hr, 20hr, and 24hr as compared to CTPVB(38). Their study also shows no significant difference in cumulative morphine consumption in 24hr whereas there was a significant difference in ours. This difference in result is likely to be due to the difference in study methodology they used 5 levels ICNB with 16ml 0.5% bupivacaine and we used six levels with 0.025% bupivacaine, they used 50cm VASpain assessmentand we use 11 point NRS. Our study result is also different from a randomized trial study done in 2017 comparing CICNB with TPVB for thoracotomy since it shows no significant decrease in pain intensity and analgesic consumption by TPVB(26).The difference might be due to the use of continuous block techniquesin their study and difference in study design.

In this study, the mean duration of time elapsed to first analgesia request was 10hr inTPVB and 6hr in ICNB with $p<0.001$. There was a significant difference in total analgesia consumption of tramadoland morphine but not diclofenacbetween TPVB and ICNBwith $p=0.025$, 0.003, and 0.211 respectively. The dominancy of analgesic effect by TPVB in this study can be explained by the longer stay of LA deposited in less vascularized paravertebral space than on intercostal nerve bundles. The shorter time elapsed to first analgesia request in both groups was likely tobe due the progressive decrease in density of blocked nerve in contrary to the intense pain resulted in thoracotomy.

In line with our study result,a randomized trial study done for renal surgery in Egypt showed a result of a significantly longer time elapsed to the first analgesia request by ultrasound guided TPVB as compared to USG ICNB with $p< 0.0001$. The time elapsed by ICNB was 8.96 hr which is slightly comparable but has a difference of 2 and half hr as compared with our result which could be due to difference in type surgery(40). Our study result is also comparable with a retrospective cohort study done for cholecystectomy in Ethiopia which showed significantly longer time elapsed to first analgesia request by landmark technique TPVB as compared to subcutaneous ICNB with $p=0.005$. This study also showeda comparable duration of analgesia 6hr by ICNB with ours (43). But they both have longer duration by TPVB 17.37hr and 18hr respectively. The difference might be due to the technique of blockand the type surgery(40,43).

The maximum duration of bupivacaine we used for the single injection of a peripheral block is likely to stay for 11-12hr which supports our higher pain score result at 12hr and the duration of time elapsed to first analgesia request (10hr) by TPVB group.The maximum duration of bupivacaine for ICNB stays 4-8hr which also explains the duration time elapsed to first analgesia request result in our study (6hr) and the presence of higher pain score results at6 and 8hr in our ICNB group(56).

The duration of time to the first analgesia request in ICNB according to a study done in 2016 in India was 210min, which is too early as compared to our result which might be due to the difference in methodology and drug used(25). They used 0.2% ropivacaine which is 40% less effective than bupivacaine, we used 0.25% bupivacaine which had better myelin sheath penetration and block potency with a little longer duration of effect(57,58).Besides, they used VAS for pain assessment and we used NRS.

The duration of time elapsed to the first analgesia request in TPVB is different from a randomized study done in Ethiopia which showed a result of 2hr shorter than our result 10hr(37). This difference can be explained by differences in study design and surgery type.

In line with our study, a randomized trial study done in 2019 at China showeda significant decrease in morphine consumption at 8hr by multiple level injections TPVB than USG ICNB with p=0.001. It also showed significant opioid consumption decreased in 24 hr with a median morphine dose of 10.5mg vs. 18mg in TPVB vs. ICNB with p=0.001(44). A slightly lower morphine dose in our study is due to the use of other adjuvant drugs diclofenac and tramadol.

According to a randomized control trial study done in 2016 at Japan,postoperative analgesia consumption was significantly decreased by CTPVB at 3, 6, 12 and 24hr than CINB with p=0.023, 0.039, 0.039, and 0.0058 respectively which is comparable with our result at 6 and 8hr(41). But our result shows a significantly higher analgesia consumption at 12hr and no significant decrease at 24 hr by TPVB which might be due to the use of single-dose TPVB since single-dose ICNB and CICNB doesn’t have a significant difference in reducing pain intensity at postoperative day 1 but on POD 2 and 3(55); this might also be due to higher opioid use before 12hr in our ICNB group.

The result of diclofenac and tramadol consumption on both TPVB and ICNB is comparable with a study done in Ethiopia(43).

Postoperative total morphine consumption in 24 hr on ICNB was comparable to a retrospective study done at Texas in 2013 which showed 3mg(14). Morphine consumption in 24hr on TPVB wasalso comparable with a study done in Egypt which shows 9mg median consumption(13). Additionally, it was comparable with a study done in Ethiopia which had lower consumption 0(0-2) mg while it was 4(0-4)mg in our(37). The slight difference in median of morphine consumption which was higher in our study is probably due to the lower tramadol consumption 50mg while it was 200mg in their study.

In contrary to our study some studies demonstrate the presence of no significant difference in postoperative analgesia consumption between TPVB and ICNB. The difference in result might be due to 0.5% bupivacaine concentration was used while it was 0.25% in our study(38), due to the use of continuous block technique while it was single dose in ours(26,39), and due to the difference in the type of thoracic surgery they used VATS while it was thoracotomy in ours(42).

Our study demonstrates no significant difference in cardiorespiratory parameters such as MAP, PR, SPO2, and RR between groups which is comparable with other studies(38–40).

Regarding the incidence of nausea, vomiting, and hypotension in TPVB and ICNB in our study is comparable with other studies done on the effectiveness of TPVB and ICNB with no significant difference between groups but the higher incidence in ICNB group(26,36,39,40,43). The higher incidence in ICNB can be explained by higher pain score and opioid consumption than the TPVB group.

Strength and limitation

Strength: There was homogeneity of variables such as sociodemographic factors, preoperative, and intraoperative status.

Limitation: This study had certain limitations such as the absence of comparative single dose multiple injection TPVB and direct ICNB studies for thoracotomy to compare with, inability to use ultrasound-guided blockage for TPVB, inadequate timeto control confounding factors such as incision size, presence of chronic pain, type of performed procedure,personnel who perform the block, and data collectors. Absence of standard perioperative pain management protocol in the study hospital was also another limitation.

Conclusion and recommendation

Conclusion:according to this study the conclusion was that postoperativethoracic paravertebral block was more effective analgesic techniquewith lower pain score both at rest and on coughing, longer postoperative analgesia duration, and lower postoperative analgesia consumption than an intercostal block. But there was no significant difference in postoperative cardiorespiratory status and incidence of complication between groups. Therefore, we conclude that postoperative TPVB should be used for pain management of unilateral thoracotomy unless the patients are contraindicated.

Recommendation: Based on this study we recommend the use of postoperative TPVB with an experienced hand for pain management of unilateral thoracotomy as part of multimodal analgesia.

We recommend anesthesia professionals to improve their practice of TPVBand integrate it to postoperative pain management protocol for unilateral thoracotomy.

We also recommend researchers to do a randomized control trial study with adequate sample size and prolonged follow up time for 72hr or even months to see the effect in alleviating post-thoracotomy pain syndrome.

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Annex one: Information sheet to get permission for the research

Introduction

This information sheet is prepared to explain the research project that you are asked to join by research investigators.

The research team includes MSc students, two senior advisors from AAU, oneanesthetist, and four nurses for data collection from Black lion specialized hospital, Minilik II referral hospital, and St. Petros hospital.

Name of Principal investigator: - EmebetSeyum, MSc anesthesia student

Advisor's name:-Mr**.** LeulayehuAkalu:- Assistant Professor in anesthesia.

Ms. MeronAbrar:-MSc in anesthesia

Name of sponsor: - AAU

Name of organization: - AAU, College of Health Sciences, department of anesthesia

This information sheet is prepared by the above investigators.

Risk

There is no risk or harm that you will face by participating in this research. Any personal information recorded will not be copied and transferred to other bodies. No need for writing participant name but by a code. Every piece of information will be kept confidential.

Benefits

There is no incentive or payment to be gained by taking part in this project but your pain status and presence of adverse events will be followed and get treated early. The information collected from this research project will be kept confidential and only accessed by the researcher and research assistants. This research project was reviewed and approved by the ethical committee of the department. If you want to know more information, you can contact the committee through the address below.

EmebetSeyum- principal investigator

Department of anesthesia, Addis Ababa University

Email: emutiseyum@gmail.com

Assist. Professor LeulayehuAkalu – advisor

Department of anesthesia, Addis Ababa University

Email: leulayehu_akalu@yahoo.com

Annex Two: Consent form

Dear participant:

My name is EmebetSeyum, I have been attending a postgraduate program in the field of anesthesia at Addis Ababa University. I am doing a research to compare analgesia effectiveness of intercostal and paravertebral block for unilateral thoracotomy. Data collection will be done for 24hr. To conduct our study, I would like to ask you some questions which may take about 10 minutes in 7 different times until 24hr of postoperative time which is at 1hr of the block, at 3hr, 6hr, 8hr,12hr,18hr and 24hr. As your participation is very important to the outcome of the study andfor you in helping you to get treatment by recognizing your complications and pain intensity early, we kindly request you to give us your sincere and truthful answer. All the information that you and other patients going to provide us will remain confidential and you don't need to mention your name.

Are you willing to participate in the study, please? YES/NO (please encircle your response)

If your answer is no, you don't have to continue to the following questions. Thank you!

If your answer is yes, please continue your response to the following questions.

Thank you for taking part in the study!

Signature of the interviewer certifying that consent has been obtained verbally.

Signature _____ Date _____

For further question ask investigator EmebetSeyum

Tel: - +251970414285

E-mail: emutiseyum@gmail.com

የመጠይቅፈቃድበአማረኛ

የተከበራችሁየጥናቱተካፋዮች

የዚህጥናትዋናአላማበአድስአበባበሚገኙትሚንልክ፣ጥቁርአንበሳ፣ፓውሎስሆስፒታልኦፕራሲዮንክፍ ልለደረትቀዶህክምናለሚደረግላቸዉህሙማንከጠቅላላአነስቴዝያበኋላጀርባላይለብቻመድሀኒትከመሰ ጠትናአፕራሲዮንየተሰራበትቦታላይመድሀኒትከመሰጠትከአፕራሲዮንበኋላህመምንበመቀነስየሚበል ጠውንለማወቅነዉ፡፡

በአጋጣሚእርስዎምበዚህጥናትእንዲሳተፉተመርጠዋል፡፡የዚህጥናትጥቅምእርስዎበሚሰጡትምላሽ መሰረትመረጃዎችንበማማላትበሚገኘዉዉጤትመሰረትመረጃዎችንበማጠናቀርውጤቱንእየተሰራበ ትካለውጋርለማገናዘብእንዲቻልነዉ፡፡እርስዎምበጥናቱሲሳተፉየህመምዎንመጠንበ 24
ሰዐትዉስጥለ7ጊዚእየታየእንዲቀንስእንዲታከሙይረዳወታል፡፡ለኛምጥናቱበትክክልአላማውንእንዲ መታየእርሶዎንድጋፉእንጠይቃለን፡፡የማንኛውምግለሰብስምአይመዘገብምእንዲሁምሀሳቡብቻውንይ ፋእንዲዎጣአይደረግምሙሉበሙሉበሚስጥርየተጠበቀነው፡፡በጥናቱመሳተፍአለመሳተፍየራስዎመ ብትብቻነዉ፡፡ግልፅየሆነምላሽንናከልብየመነጨተሳትፎዎንእንዲሰጡንበአክብሮትእንጠይቃለን፡፡
ለመሳተፍፈቃደኛነዎትሀ/ አዎ፡ከሆኑየሚቀጥሉትንጥያቄዎችይመልሱልንለ/ አይደለሁም ለመሳተፍፈቃደኛስለሆኑእናመሰግናለን፡፡

ለጥያቄዎችመልሰለመስጠትእርስዎየቃልፈቃድመስጠትዎንለማርጋገጥመረጃሰብሳቢባለሙያይፈር ሙልን፡፡

የሰብሳቢዉየማረጋገጫፊርማ----------፣ቀን----------

Annex three: patient data

Section I: Sociodemographic data (chart review)

Card number:		Bed no:	Code
S.no	Question	Response	
1.1	Hospital card number	--------	
1.2	Age	--------	
1.3	ASA (I, II, III)	A. ASA I B. ASA II C. ASA III	
1.4	Sex	A. Male B. Female	
1.5	Weight	--------	
1.6	Height	--------	
1.7	BMI	--------	

Section II: Data during the preoperative period

S.no	Question	Response	
2.1	Base line Heart rate, blood pressure	____bpm ____/____mmhg	
2.2	Base line RR & spo2	_____bpm&_____%	
2.3	Diagnosis	_____	
2.4	Does the patient take preemptive analgesia medications orally or intramuscularly within 1 –3hr before surgery?	1. Yes 2, No	If no skip No 2.5
2.5	If yes, specify the drug, and duration of time from administration to skin incision?	_____, ___ hr _____, _ _hr	

Section III: Questions related to anesthetic and surgical interventions

S.no	Question	Response	
3.1	Does the patient receive analgesics as a premedication for 20- 30 min before skin incision?	1. Yes 2. No	If no skip No 3.2
3.2	If YES specify type, route, and duration of time from administration to skin incision.	_____, ___, __min _____, ___, ___min	
3.3	Does the patient haveanxiety before surgery?	1. Yes 2. No	
3.4	Does the patient receive any anxiolytic premedication? If yes what drug, route?	2. Yes 2. No _____, ____	If no continue to 3.5
3.5	Type of skin incision	A. Anterolateral incision B. posterolateral incision C.----------	
3.6	Specify the performed procedure after thoracotomy	----------	
3.7	Does the patient took intraoperative analgesic? If yes which drug, route?	A. No B. Fentanyl _____ C. Morphine_____ D. Pethidine_____ E. Tramadol_____ F. Diclofenac_____ G. Paracitamol _____	If no skip No 3.8
3.8	If the patient took one of the above. When?	A. After induction/ as incision started B. during intraoperative period C. At the end of surgery before transferred to recovery room	
3.9	Does the preoperative and	1. Yes 2. No	

	intraoperative fluid and blood loss adequately replaced?		
3.10	What was duration of surgery?	_____minute	
3.11	Where was the level of incision?	1. T4, 2. T5 3. T6 4 T5-T6	
3.12	Vital sign immediately before block	SBP------- DBP------- PR--------	
3.13	Type of post op pain management, procedure performed time?	1. Landmark TPVB ------- 2. Direct infiltration INB -------	
3.14	Level of injection, type, concentration, and dose of local anesthetics administered?	1, T3, ____,__ml 4, T6, ___,__ml 2, T4, _____,__ml 5, T7, ____,__ml 3, T5, ____,__ml 6, T8, ____,__ml	

Section IV: Hemodynamic parameters in postoperative period at 1st hr of the block, 3rd hr, 6th hr, 8th hr, 12th hr, 18th hr and 24th hr.

Questions to be answered during the begninng of follow up at the recovery room or ICU

S.no	A Question to be answered at recovery	Response
4.1	Time from TPVB or INB to admission to recovery?	_____min
4.2	Dermatome level of blockage using pin prick test	1. T2- T83. T4- T9 2. T3-T8 4. Other level_____

S.no	V/S	1st hr post op.	3rd hr post op.	6th hr post op.	8th hr Post op.	12th hr Post op.	18th hr post op.	24th hr Post op.
4.3	Time (local)							
4.4	BP(mmHg) SBP/DBP							

	(MAP)								
4.5	HR (bpm)								
4.6	Respiratory rate								
4.7	SPO2 (%)								
4.8	NRS	At rest							
		With coughing							
4.9	Analgesia given Type and dose								

4.10. Duration in minutes till Initial analgesic requirement time after the block

A. Nerve block given at _____ PM/AM time per 24hr in local time.
B. First analgesic required time _____PM/AM time per24hr in local time
C. Duration from time of doing block to first analgesic request _____

4.11. Total dose and type of analgesic consumption within 24 hours after the block

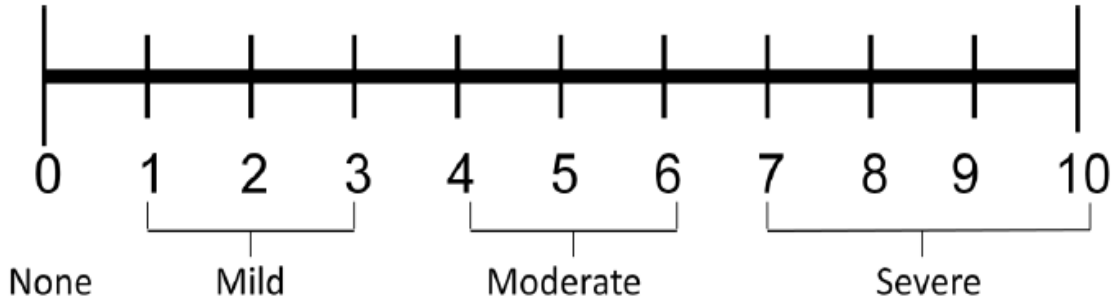
A. tramadol ----------mg
B. diclofenac ----------mg
C. morphine ----------mg
D. Pethidine ----------mg
E. paracitamol----------mg

Section V: Complications during the postoperative period

s.no	Type of complication	Score /response	Remark
5.1	Hypotension/ BP decrease by 20 % from baseline	1. Yes 2.No	
5.2	Bradycardia HR<50bpm	1. Yes 2. No	
5.3	Desaturation without Oxygen	1. >90% 2.<90%	
5.4	Nausea	1. Yes 2. No	
5.5	Vomiting	1. Yes 2. No	
5.6	Local anesthetics toxicity	1. Yes 2. No	
5.7	Failed block confirmed after 1hr of block.	1. Yes 2. No	

Annex four: The numeric rating scale (NRS)

English version: The numeric Rating scale (NRS)



A. The scale will be taken 7 times within 24 hours. Patients will be asked to rate their pain.

B. The patient will be asked one of the following questions:

1. What number on a 0 to 10 scale would you give your pain right now?
2. When the explanation suggested above is not sufficient for the patient, further explanation or conceptualization of the scale will be done:

   0 = No Pain

   1-3 = Mild Pain (nagging, annoying, interfering little with activity)

   4–6 = Moderate Pain (interferes significantly with activity)

   7-10= Severe Pain (disabling; unable to perform activity)

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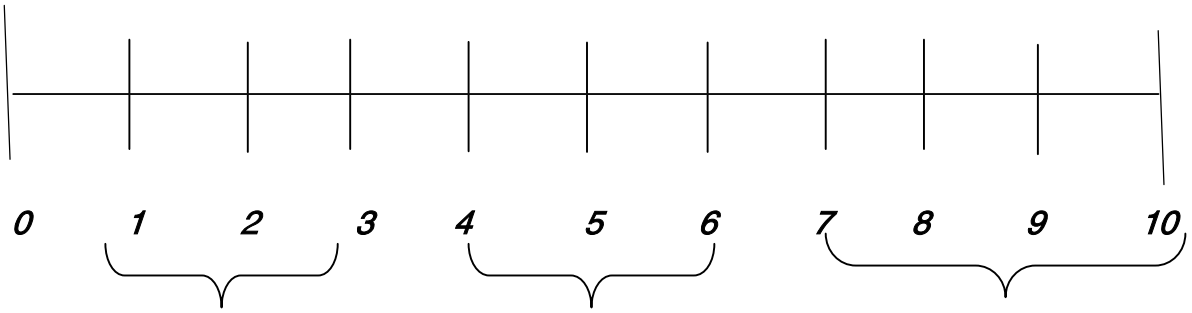

የለምመካከለኛከፍተኛበጣምከፍተኛ

መለኪያዉበ24ሰአትዉስጥ

7ጊዜየሚለካሲሆንታካሚዎችየሚሰማቸዉየህመምመጠንእንዲያሳዩንእንጠይቃለን

ታካሚዎችየሚከተሉትንጥያቄዎችይጠየቃሉ፡-

ሀ . አሁንከተገለጹትቁጥሮችማለትም (0-10) ባሉትውስጥየእርስዎየህመምመጠንስንትላይነው

ለ. ከላይየተገለጸዉበቂካልሆነተጨማሪማብራሪያይሰጥታል፡

0 ህመምየለም

1-3 መካከለኛህመም (መነጫነጭ፣መረበሽ፣ወ.ዘ.ተ)

4-6 ከፍተኛህመም (ከህመሙ.ጋርበተያያዘቀላልስራዎችንለማከናወንመቸገር)

7-10 በጣምከፍተኛህመም (ከህመሙ.ጋርበተያያዘቀላልተግባራትንማከናወንአለመቻል)

Annex five: - Dermatome level of blockage, Local anesthetics toxicity and ASA classification

Ask the patient to close their eyes and give the therapist feedback regarding the various stimuli and then check for pin prick sensation(59).

Areas to be checked:-	**Dermatome Level**
Infraclavicular fossa, Inner aspect of arm and forearm	T1-T2
Apex of axilla	T2-T3
Nipple- inferior nipple	T4-T5
Bottom of xiphoid process	T7
Upper abdomen and mid back	T9
Umbilicus, and below umbilicus	T10, and T11 respectively

If the patient feels pin prick at all dermatome levels after 30minutes of block; then we can say bock is failed.

Local anesthetic toxicity systemic clinical manifestations

Cardiac system	**Bradycardia, hypotension, cardiovascular collapse, prolonged QRS and PR interval on ECG, atrio-ventricular block**
Central nervous system	Light headedness, dizziness, drowsiness, tingling around the lip, metallic test, tinnitus, blurred vision, incoherent speech, tremor/ twitch, seizure, coma
Respiratory system	Dyspnea, desaturation, apnea/ respiratory arrest

ASA status classification

ASA I: a healthy patient with no organic/physiological/pyschtric problems

ASA II: controlled medical conditions with mild systemic effect and no limitation of functional ability

ASA III: medical condition with severe systemic effect, limitation in functional capacity

ASA IV: poorly controlled medical conditions associated with significant impairment in functional ability that is potential threat to life

ASA V: critical condition, little chance of survival without surgical procedure

ASA VI: brain dead patient undergoing organ donation

Annex six: Data accuracy check sheet

S.No	Tools	Yes	No
1	Are the Inclusion criteria /exclusion criteria done appropriately?		
2	Are all questions on Socio-demographic data filed appropriately?		
3	Are all questions on preoperative period data filled appropriately?		
4	Are all questions on intraoperative period data filled appropriately?		
5	Are all questions on postoperative period data filled appropriately?		
6	Did the postoperative analgesic drugs filled based on request time,type and dose?		
7	Did the pain assessment follow standard operating procedure strictly on time?		
8	Did the presence of complications assessed?		