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**“Comparative Evaluation of Postoperative Analgesic Efficacy of Ultrasound-Guided Erector Spinae Block and Ultrasound-Guided Paravertebral Block in Patients Undergoing Lower Abdominal Surgeries under Spinal Anaesthesia: A One-Year Randomized Controlled Study.”**

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**By**

**REG NO. BA0121015**

# **Dissertation**

*Submitted to*

*KAHER, Belagavi, Karnataka,*

*In partial fulfilment of the requirements for the degree of*

**M.D. In ANAESTHESIOLOGY**

**DEPARTMENT OF ANAESTHESIOLOGY,  
JAWAHARLAL NEHRU MEDICAL COLLEGE,  
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**December 2024/ January 2025**

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## **LIST OF ABBREVIATIONS**

1.	ERAS	Enhanced Recovery After Surgery
2.	EA	Epidural Anaesthesia
3.	USG	Ultrasound Guidance
4.	PVB	Paravertebral Block
5.	TPVB	Thoracic Paravertebral Block
6.	LPVB	Lumbar Paravertebral Block
7.	ESPB	Erector Spinae Plane Block
8.	LSCS	Lower Segment Caesarean Section
9.	RCT	Randomized Controlled Trial
10.	VAS	Visual Analog Scale
11.	NRS	Numeric Rating Scale
12.	PCNL	Percutaneous Nephrolithotomy
13.	NSAIDs	Non-Steroidal Anti-Inflammatory Drugs
14.	PCA	Patient-Controlled Analgesia
15.	IV	Intravenous
16.	FDA	Food and Drug Administration
17.	KG	Kilogram
18.	ASA	American Society of Anaesthesiologists
19.	LAST	Local Anaesthetic Systemic Toxicity
20.	LA	Local Anaesthesia

21.	TP	Transverse process
22.	ECG	Electrocardiogram
23.	CNS	Central Nervous System
24.	SD	Standard Deviation
25.	BMI	Body Mass Index
26.	TAH	Total Abdominal Hysterectomy
27.	SpO2	Peripheral Capillary Oxygen Saturation
28.	HR	Heart Rate
29.	SBP	Systolic Blood Pressure
30.	DBP	Diastolic Blood Pressure
31.	MW-U test	Mann-Whitney U test
32.	RAA	Rescue Analgesia
33.	INJ	Injection

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## **ABSTRACT**

**Background:** This study compares the effectiveness of ultrasound-guided erector spinae block (ESP) and paravertebral block (PVB) for postoperative analgesia in patients undergoing lower abdominal surgeries under spinal anaesthesia.

**Aims:** To compare the analgesic efficacy of ESP and PVB by measuring the duration of block and total amount of rescue analgesic utilized in the first 24hours using Visual Analogue scale (VAS).

**Settings and Design:** One Year Randomised Clinical Trail

**Methods and Material:** Sixty patients, ranging between 18 to 65, underwent elective lower abdominal surgery under spinal anaesthesia, with 30 each assigned randomly to Group A (ESP) and Group B (PVB). Under USG supervision, blocks were given to both groups. Postoperative pain was assessed using VAS, and rescue analgesia administered if VAS  $\geq$  4 over 24 hours. Duration of block and total amount of rescue analgesic consumed in the initial 24hours was assessed for each group.

**Statistical Analysis Used:** Data is analysed using statistical software “R version 4.4.0. and Microsoft Excel.

**Results:** Between Groups A and B, there were no significant differences in the mean time to first rescue analgesic ( $10.97 \pm 7.98$  hours vs.  $10.4 \pm 5.59$  hours,  $p=0.7230$ ), VAS scores ( $<4$  in 83.33% vs. 80%), and the total amount of rescue analgesics consumed over a 24-hour period ( $1.63 \pm 1.13$  doses vs.  $1.73 \pm 1.11$  doses,  $p=0.859$ ).

**Conclusion:** In conclusion, ultrasound-assisted paravertebral block (PVB) and erector spinae plane block (ESPB) are equally effective for pain management after lower abdominal surgeries. Both techniques show comparable effectiveness in terms of first rescue analgesia demand and total analgesic consumption in the initial 24 hours post-surgery.

**Key-words:** Erector spinae plane block, Paravertebral block, Ultrasound, Ropivacaine, Dexmedetomidine, Visual Analogue scale.

## **INTRODUCTION**

Acute pain, following surgery is a regular concern for most procedures. Variations in the way people experience pain are dictated by social environment, psychological characteristics, and biological response. Acute postoperative pain has multiple aetiologies. Numerous reactions in the pain matrix are triggered by the surgical injury, including feelings of anxiety, worry, and frustration along with sensitization of the peripheral and central pain pathways<sup>1</sup>. C. Small and H. Laycock conducted a study on acute postoperative pain management and concluded that adequate perioperative pain therapy is critical to patient care and outcomes<sup>2</sup>. Enhanced Recovery After Surgery (ERAS) calls for early mobilization, which limits perioperative opioid usage and promotes regional anaesthesia and blocks in its place.

Opioids have played a significant role in multimodal anaesthesia approach throughout the perioperative period but its effects of reducing central respiratory drive and increased addiction restrict its use. The use of regional anaesthetic or neuraxial blocks (spinal, epidural, or paravertebral) is crucial to the efficacy of Opioid free analgesia. These modalities offer better analgesia and early mobilization.

Epidural anaesthesia (EA) was formerly thought of as an efficient choice for managing pain after lower abdomen surgeries due to its superior analgesic effect. The wide range of applications for EA is, however, restricted by issues such as hypotension, urinary retention, accidental epidural catheter dislodgement and transient neuronal injury.

USG's high-resolution images makes it possible to precisely place the needle next to the targeted nerve, reducing the possibility of problems and guaranteeing the best possible

nerve block outcome. Hence, the ease of performing peripheral nerve blocks has gained popularity.

Of these, Paravertebral block (PVB) has shown to have effects of pain relief that are almost equally effective as EA. By halting nerve signals at the spinal level, PVB effectively alleviates pain whilst preserving motor function by targeting particular dermatomes or areas. On the other hand, Erector spinae plane block (ESPB) essentially acts as an interfascial block. Peripheral nerve and blood vessel injury is greatly lowered and the local anaesthetics disseminate along transverse process plus inner surface of erector spinae muscle<sup>1</sup>. Therefore, in addition to its greatly decreased block procedure difficulties, the ESPB approach also lowers the need for postoperative analgesic medications.

Research contrasting PVB with Quadratus lumborum block<sup>3</sup> and ESP with transversus abdominis plane<sup>4</sup> have shown that PVB and ESPB are more efficient than the others. Additional studies comparing ESPB and PVB are warranted to clarify their relative advantages and optimal use in clinical practice.

The local anaesthetics used in the previous studies have been various formulations of Bupivacaine. Due to its higher potential for cardiac and central nervous system toxicity, bupivacaine is now replaced by Ropivacaine a relatively new drug with lower lipophilicity<sup>5</sup>, it provides similar efficacy in the alleviation of pain and with a reduced risk of adverse effects. Utilized as an adjuvant, Dexmedetomidine is a practical non-opioid alpha agonist medication that helps control pain during surgery<sup>6</sup>. Consequently, in our investigation, Ropivacaine and Dexmedetomidine are utilized for nerve blocks.

Therefore, to ascertain which block strategy is better, a direct comparison between ESPB and PVB was conducted. This randomized control trial is set out to contrast the

analgesic outcomes of PVB and ESPB for those undergoing lower abdominal procedures for which the effectiveness of the block has not been examined.

## **AIMS AND OBJECTIVES**

- **Primary objectives:**

1. To compare the analgesic efficacy of ultrasound guided erector spinae block and ultrasound guided paravertebral block in patients undergoing lower abdominal surgeries using visual analogue scale
2. To measure the length of block, by assessing the moment of obtaining the first rescue analgesic.

- **Secondary objective:**

1. To observe the amount of total rescue analgesic utilised throughout the initial 24 hours of receiving block.

## **REVIEW OF LITERATURE**

After undergoing lower abdominal surgeries, patients often experience extreme pain and discomfort following the surgery. Although opioids and nonsteroidal anti-inflammatory medications are typically used to treat severe pain, their use may be restricted owing to related side effects. Ultrasound-guided regional anaesthesia techniques, such as erector spinae plane block (ESPB) and paravertebral block (PVB), have become more popular to be an alternative method for providing efficient postoperative analgesia in this particular clinical scenario.

According to the results of a randomized control trial conducted by Hamed MA et al., bilateral ESP block significantly reduced Fentanyl use after surgery in individuals having abdominal hysterectomy and offered postoperative analgesia to patients following complete abdominal hysterectomy<sup>7</sup>.

According to a RCT by Melnikov AL et al., both transversus abdominis plane block and thoracic paravertebral block serves as an effective analgesic adjunct in women undergoing major gynecological surgery. While transversus abdomen block under ultrasonography supervision seems to be a more controlled and safer alternative, while thoracic paravertebral block appeared to be more effective.<sup>8</sup>

Research by Swisher MW, et al. compared paravertebral nerve blocks to the Erector spinae plane block for analgesia of non-mastectomy breast surgery, randomized clinical research found that PVBs improved analgesia and decreased the need for opioids.<sup>9</sup>

A meta-analysis study by Chang Xiong et al. found that for thoracic and breast surgery, the surgical location distinguishes the postoperative analgesic outcomes for erector spinae plane block (ESPB) from paravertebral block. PVB had a superior postoperative analgesic

effect over ESPB for thoracic surgery. Whereas both PVB and ESPB had comparable postoperative analgesic effects after surgery on the breast<sup>1</sup>.

A double-blind, randomized trial by Bakshi A et al, on 60 study participants who were administered subarachnoid block for lower segment caesarean section were part of the trial group. Purpose of the trial was assessment of analgesic effectiveness of thoracic erector spinae plane block versus transmuscular quadratus lumborum block among study subjects who had undergone lower segment caesarean section under subarachnoid block. All 60 participants were divided equally into two groups as mentioned above. Assessment was done every 2 hours until 24 hours. The duration of anaesthesia was  $11.90 \pm 2.49$  hours in thoracic erector spinae plane block group and  $12.56 \pm 3.38$  hours in transmuscular quadratus lumborum block group. The study concluded that both the groups were equally efficient in relieving pain in the post operative period following LSCS under subarachnoid block<sup>10</sup>.

To ascertain the impact of ESP block in adults receiving general anaesthesia, Huang J et al, performed a meta-analysis. The Cochrane Library, Embase, and PubMed databases were thoroughly searched in order to locate randomized controlled trials that compared ESPB to a control or placebo. The main result was the use of IV opioids for 24 hours following surgery. Risk ratios and standardized mean differences (SMDs) with 95% confidence intervals (CIs) were determined using a random-effects model. This meta-analysis comprised twelve trials totaling five hundred subjects. 24 hours after the procedure, there was a decrease in the amount of intravenous opioids used when using ultrasound-guided ESPB. According to the study's findings, ESP block works well as a postoperative analgesic for adults following general anaesthesia procedures.<sup>11</sup>

Shilpi Agarwal et al's, RCT on assessing the effectiveness of paravertebral block guided by ultrasonography versus erector spinae plane block for pain relief following modified

radical mastectomy, suggests that ESP block is beneficial, also a better substitute for PVB to an analgesic approach during breast cancer surgery.<sup>12</sup>

A RCT by Joshi R et al, conducted among 124 study participants who were undergoing LSCS were provided with either transmuscular quadratus lumborum block or ESP block. They assessed the requirement of rescue analgesic tramadol, to observe the efficacy of the two blocks for a 48hour period following LSCS. The study also aimed to compare the pain scoring, time for requirement of first analgesic requirement, complications developed related to the block, and patient satisfaction between two groups. The tramadol consumption in first 48 hours of LSCS in ESP block and transmuscular quadratus lumborum block groups were  $47.3 \pm 15.8$  mg and  $50.9 \pm 38.7$  mg respectively. Duration of first rescue analgesic were  $22.8 \pm 15.8$  hours and  $22.7 \pm 15.6$  hours in ESP block and transmuscular quadratus lumborum block groups respectively. In both groups, patient satisfaction was comparable. Initial results showed that the two groups' pain scores were comparable.<sup>13</sup>

A randomized controlled trial conducted by Yang M et al , on perioperative analgesia in nephrectomised patients via laparoscopic technique using ultrasonic-assisted erector spinae plane block aimed to measure sufentanil consumption during intraoperative period and to measure the pain scores during various time periods after the surgery. The erector spinae plane block group showed lower consumption of sufentanil during the intraoperative period. The study concluded that, Erector spinae block guided by ultrasonography for those who underwent laparoscopic nephrectomy showed a notable decrease in the use of opioids during intraoperative period as well as reduced pain scores post-surgery.<sup>14</sup>

Another prospective randomized controlled open-label trial by Abdelgalil AS et al, sought to determine the effectiveness of the ESP block to alleviate acute pain following surgery in those who underwent open nephrectomy due to renal malignancy. This trial involved 60

patients in all. Intervention group was administered with continuous pre-operative unilateral ESP block and the control group was administered with intravenous patient-controlled analgesia (morphine). Morphine was provided as post-operative analgesia to maintain the VAS score less than 4. The findings demonstrated a statistically significant decrease in intervention group for intake of post-operative morphine in contrast to the control cohort ( $p < 0.001$ ).<sup>15</sup>

Randomized controlled study conducted by Bindra S et al, among those that had an open nephrectomy with the intention of assessment of impact of ESP block in the context of combination analgesia for postoperative pain management. 48 study participants were included in this study. US-guided ESP block was given to the intervention group and the group serving as the control was not given block prior to the reversal of anaesthesia. After undergoing the surgical procedure, they received patient-controlled analgesia which was morphine, intravenously. Moreover, NRS was used to measure pain. Total consumption of morphine was lesser in the intervention group in comparison to the other (11mg versus 17.58 mg with a p value of  $< 0.001$ ). Compared to control group NRS pain scale showed reduction in the intervention group. Average number required for analgesia was more with the control group when analyzed with the intervention group. Overall pain management and overnight sleep was declared good in the group in whom block was administered in contrast to control group. The study concluded ESP block was highly efficient in reducing the pain after surgery, improved recuperation and decreased the need for opioids during the recovery phase following an abdominal procedure such an open nephrectomy.<sup>16</sup>

In a randomized clinical study, Devaram V et al. compared the effectiveness of transmuscular quadratus lumborum block and ultrasound guided single level paravertebral block for postoperative pain management following percutaneous nephrolithotomy surgeries. The study found that USG guided PVB offers better analgesia than Transmuscular Quadratus

lumborum block for pain management following PCNL, which promotes improved postoperative recovery.<sup>3</sup>

## **BASIC SCIENCES**

### ***Definition of pain***

Effective post-operative pain management is vital for every surgical procedure. Inadequate pain management leads to complications like increased hospital stay, increased recovery period and even morbidity.<sup>17</sup> Pain is defined by International Association for study of Pain as “An unpleasant sensory and emotional experience associated with acute or potential tissue damage”<sup>18</sup> . Postoperative pain is a type of acute pain due to the trauma from surgery. The surgery leads to inflammation and initiation of afferent neuronal barrage ..

### ***Types of pain***

There are four types of pain. It includes Nociceptive pain, neuropathic pain, psychogenic pain and mixed category pain.

Nociceptive pain is present when the body sends signals when there is an irritation in the tissue, impending injury or an actual injury. The pain path is as follows: the nociceptors in the affected area gets activated, it transmits the signal (via peripheral nerve and spinal cord) to the brain, this in turn activates the complex spinal reflexes (withdrawal), followed by perception, cognition and affective response, and a voluntary action (possibly). This pain is usually time limited.

Neuropathic pain occurs when an injury or malfunction in the peripheral or central nervous system happens. The pain can stay for a longer duration (months and years) even after the damaged tissues healed. It is a chronic pain.

Psychogenic pain happens due to psychological factors leading to an exaggerated presentation of pain problem.

Mixed category pain is the pain caused by both nociceptive and neuropathic factors. Neurogenic inflammation can result from the release of inflammatory mediators from the brain following an initial nervous system damage or dysfunction. For instance, myofascial pain and migraine headaches.

### ***Types of postoperative pain***

Postoperative pain can be acute or chronic. Acute pain, as the name suggests is experienced right after the surgery for a period of 7 days. Acute pain presence leads to immobilization after surgery. However, when the pain from injury stays more than 3 months it is called as chronic pain. Cutaneous, deep somatic or visceral structures can lead to both acute and chronic pain.

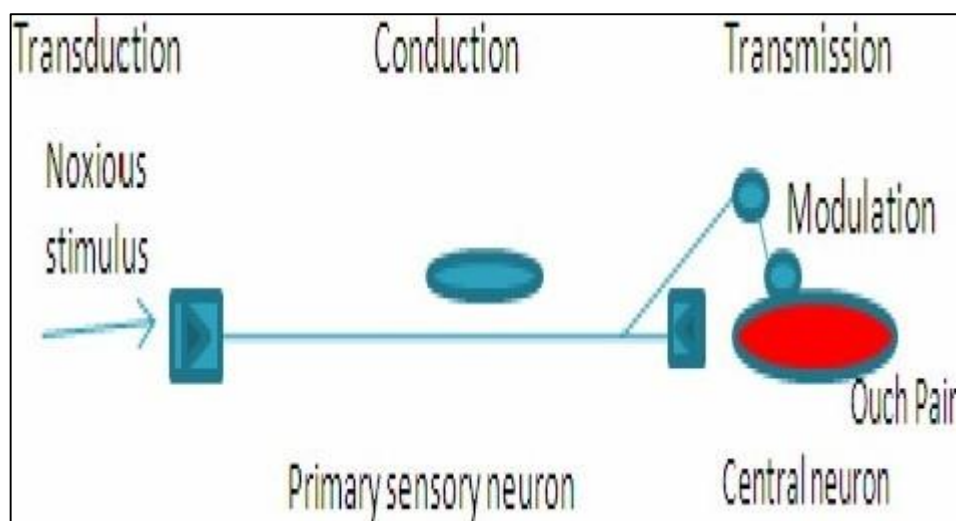
### ***Physiology of pain***

The primary component of the body's central nervous system, the spinal cord, transmits signals from the brain to the nerves that are distributed throughout the body. Along the whole length of the spinal cord, nerves originating in and going to every area of the body enter and exit through the gaps between the vertebrae, 31 pairs of spinal nerves leave the spinal cord. The nerve root is the place where the nerve leaves the spinal cord; peripheral nerves are the many smaller nerves that the nerve branches into, to regulate other body parts. Both motor and sensory nerves are a part of the peripheral nervous system. Nerves that receive sensory stimuli are known as sensory nerves. Movement is stimulated and led to the muscles via motor neurons.

Various mechanisms are as follows:

Nociception is the term used to describe how the brain interprets a toxic input and produces the sensation of pain. Transduction, transmission, modulation, and perception are the elements of nociception. Increased sensitivity, or hyper responsiveness, is a defining

characteristic of both acute and chronic pathologic pain. Neuroplasticity, or alterations in the nervous system's reaction at both peripheral and central sites, is the cause of this (Figure 1).

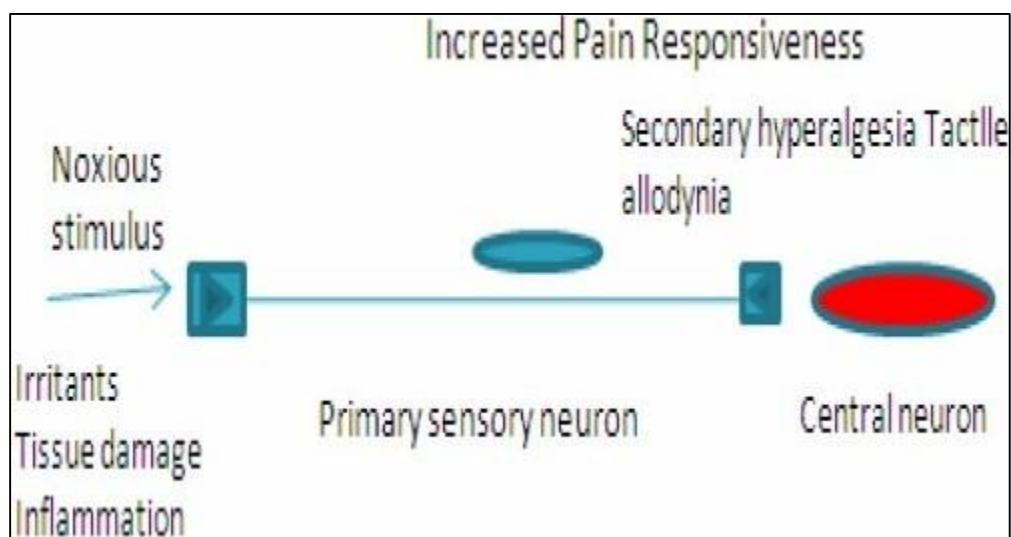


**Figure 1: Process of nociception**

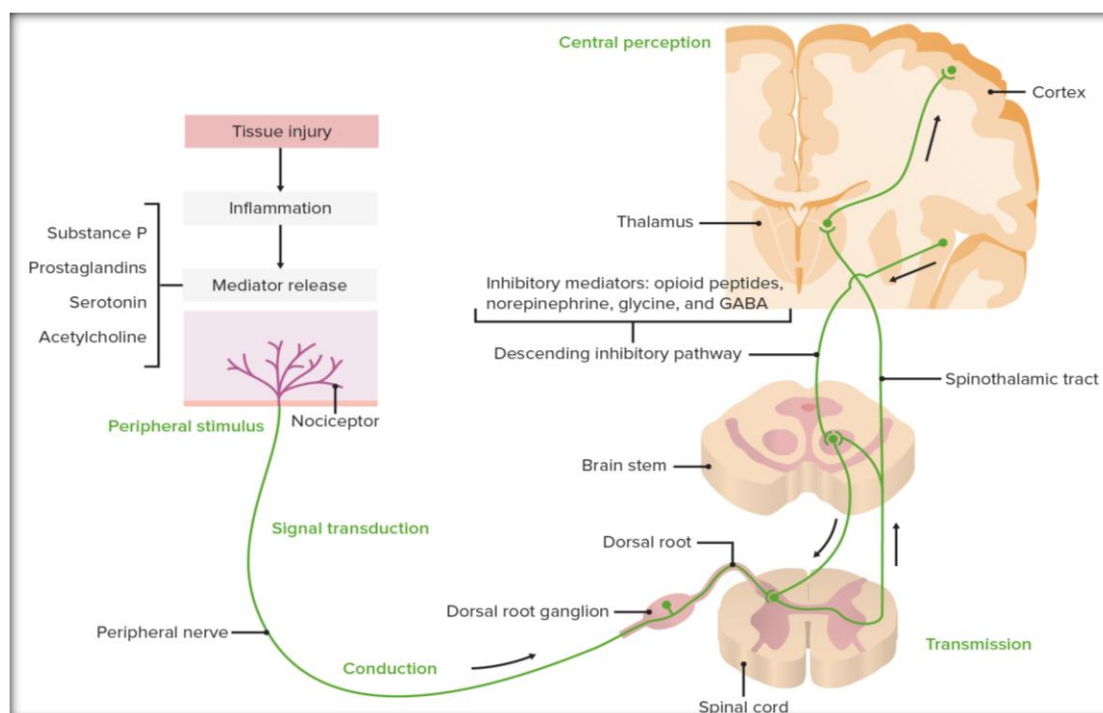
When tissue inflammation triggers the production of a wide range of complex chemical mediators, lowering nociceptor thresholds, peripheral sensitization takes place. Primary hyperalgesia results from an enhanced reaction to painful stimuli.

Central sensitization describes mainly physiological responses in the central nervous system. Central sensitization is a physiological process that will only result in an increase in chronic pain syndromes if C-nociceptors fire continuously over time<sup>32</sup> (Figure 2).

A third-order neurone projects the postcentral gyros (through internal capsule) (Figure 3)<sup>17</sup>.



**Figure 2: Process of central sensitization**



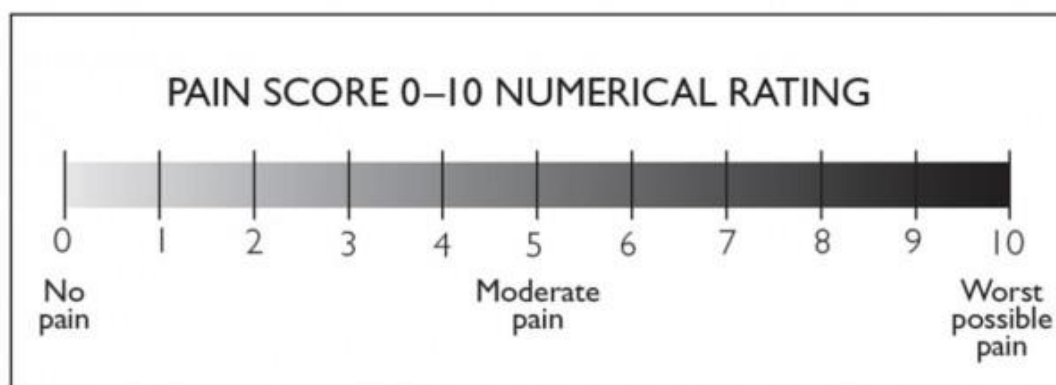
**Figure 3: Pain pathway**

### ***Assessment of acute pain:***

Acute pain frequently has a clear cause, such as after surgery, trauma, or the start of a known illness (Example: cardiac ischaemia, pancreatitis). Neuropathic or nociceptive pain can



**Numerical rating scale:** It is comparable to the visual analogue scale in that the patient rates the two anchors, "no pain" and "worst pain," which range from 0 to 10 (forming an 11-point scale) (Figure 5).



**Figure 5: Numerical rating scale for pain**

**Acceptability:** The pain VAS requires little training to administer and score and has been found to be acceptable to patients. Supervision during completion may minimize these errors.

**Reliability:** Test–retest reliability has been shown to be good, it is highly reliable when it is used for acute abdominal pain and moderate to good reliability for disability in patients with chronic musculoskeletal pain.

### ***Management of postoperative pain***

To lessen and manage postoperative pain, a variety of preoperative, intraoperative, and postoperative treatments and management techniques are available and are constantly changing. The American Society of Regional Anaesthesia and Pain Medicine evaluated and accepted a practice guideline for acute pain management in the perioperative situation released by the American Society of Anaesthesiologists. This includes, systemic pharmacological

therapy; local, intra-articular, or topical techniques; regional anaesthetic techniques; neuraxial anaesthetic techniques, and non-pharmacological therapies.

Systemic pharmacologic therapy:

Oxygen, nonsteroidal anti-inflammatory medicines (NSAIDs), acetaminophen, steroids, gabapentin or pregabalin, intravenous ketamine, and IV lidocaine are frequently prescribed pharmaceuticals for managing postoperative pain. It is not advised to use intramuscular medicines. Opioid medicine should be administered orally rather than intravenously. However, intravenous patient-controlled analgesia (PCA) is advised in situations where a parenteral method of medicine administration is required (such as aspiration risk or ileus).

Local, intra-articular, or topical approaches:

A variety of techniques, such as peripheral nerve blocks, anaesthetic wound infiltration, intra-articular anaesthetic injections, and topical anaesthetics, can be used to target pain control. Even if these techniques are uncommon, their application ought to be supported by useful data.

Neuraxial anaesthetic techniques:

These may include intrathecal (spinal) injection, as well as an epidural injection with local anaesthetics, with or without the addition of IV opioid medication. Both patient-controlled and continuous infusion forms of epidural analgesia are available. Caesarean sections, major thoracic and abdominal procedures, and hip or lower extremity surgeries frequently employ these techniques. Patients who are at risk for cardiac, pulmonary, or prolonged ileus benefit most from them.

Nonpharmacologic therapies:

Mechanical and cognitive modalities, such as transcutaneous electrical nerve stimulation, are examples of non pharmacologic therapies utilised in pain management.

### ***Complications***

Inadequate acute pain treatment can have a number of detrimental implications on a patient's health, such as diminished capacity to carry out everyday tasks, disrupted sleep patterns, depression, and decreased libido. Ineffective acute pain management not only has a detrimental impact on the health of the patient, but it may also raise the possibility of chronic pain.

Opioid drug use can cause pruritus, ileus, respiratory depression, somnolence, drowsiness, and urine retention. Overdosing on opioids can be fatal or severely crippling. Patients who utilise opioid medications may be more susceptible to addiction and drug use disorders. Anxiety, restlessness, lacrimation, runny nose, diaphoresis, sleeplessness, frequent yawning, and muscle aches are some of the initial signs of opiate withdrawal. Diarrhoea, cramping in the abdomen, piloerection, nausea, vomiting, tachycardia, hypertension, pupillary dilatation, and blurred vision are some of the more severe late symptoms of opioid withdrawal. Sedation or vertigo effects may be brought on by gabapentin or pregabalin.<sup>19,20</sup> When creating a proper pain management plan, patients who are at a higher risk of bleeding, such as those who have undergone surgery on highly vascular structures (tonsillectomy) versus those who have not (cholecystectomy), should take the bleeding risk associated with NSAID use into account. NSAID use is also associated with a higher risk of renal impairment and gastrointestinal haemorrhage. Peripheral regional analgesic treatments may cause a temporary motor blockage, which raises the possibility of falls. Patients need to be closely monitored while receiving neuraxial analgesia since it may cause respiratory depression, hypotension, and motor paralysis from spinal cord compression (caused by an infection or hematoma). Patients

undergoing shoulder surgery may be more susceptible to chondrolysis if they receive continuous intra-articular bupivacaine injection.<sup>20</sup>

### ***Clinical importance***

Inadequate management of pain following surgery can raise the risk of developing chronic pain syndrome and have negative physiologic effects in the acute postoperative period. Chronic pain may cause a patient's health and well-being to progressively deteriorate. Comprehending the biology of pain, techniques for reducing pain, degree of invasiveness of operations, comorbidities specific to each patient, and social aspects can assist physicians in creating an ideal pain management plan that lowers the possibility of unpleasant results. Furthermore, it has been demonstrated that effective postoperative pain management lessens patient suffering, shortens hospital stays, facilitates early mobilisation and the ability to carry out daily activities, and raises patient satisfaction. While opioid analgesic therapy is still an essential part of postoperative pain management, a patient's potential for substance use disorder or medication misuse must be carefully considered before prescribing and implementing opioid therapy due to the rise in opioid overdose-related injuries and deaths among the general public. Patients should also be informed about safe medicine disposal techniques and safe storage procedures when they are sent home. To minimise opioid demand while maximising pain relief, a multimodal strategy and customised plan for postoperative pain management should be prioritised.<sup>20</sup>

## **ERECTOR SPINAE BLOCK<sup>21</sup>**

The erector spinae plane (ESP) block is a newer regional anaesthetic technique that can be used to provide analgesia for a variety of surgical procedures or to manage acute or chronic pain. The technique is relatively easy to perform on patients, and it is performable with minimal or no sedation in the pre-operative holding area. The ESP block is possible either using a single-injection technique or via catheter placement for continuous infusion.

The first report of the successful use of this procedure was in 2016; the block was used to manage thoracic neuropathic pain in a patient with metastatic disease of the ribs and rib fractures. Since then, the block has been reported to have been used successfully in a multitude of procedures including thoracotomies, percutaneous nephrolithotomies, ventral hernia repairs, and even lumbar fusions.

### ***Indication:***

- It is used to deliver regional analgesia for a wide variety of surgical procedures in the anterior, posterior, and lateral thoracic and abdominal areas.
- Management of acute and chronic pain syndromes.

### ***Contraindications:***

- Absolute contraindications: Infection at the site of injection in the paraspinal region, patient refusal.
- Relative contraindication: Anticoagulation, although the most recent 2018 ASRA consensus statement does not specifically address paraspinal blocks and anticoagulation.

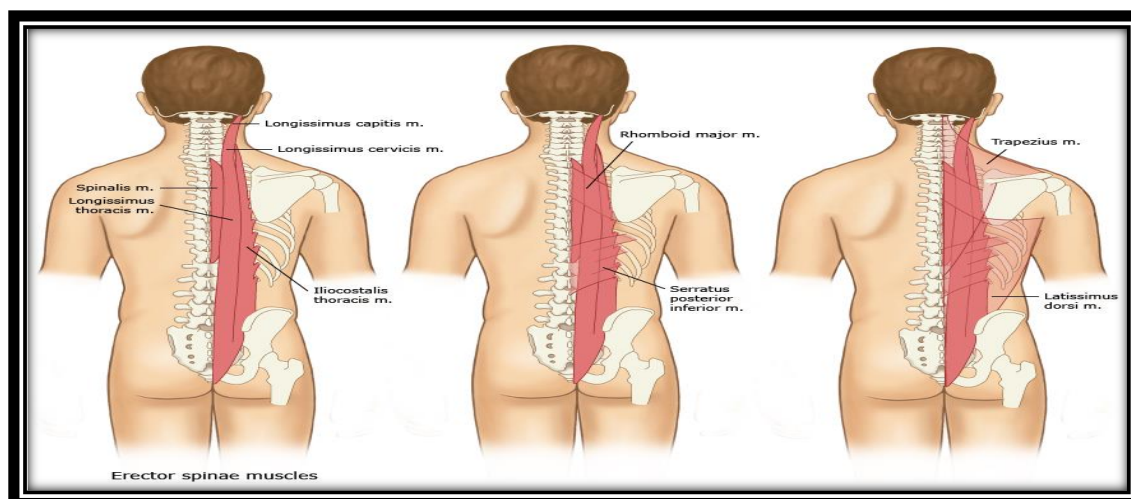
**Anatomy:**

The erector spinae plane lies between the fascia covering the anterior aspect of the erector spinae muscles and the posterior surface of the transverse processes of the vertebrae.

**Muscles, fascia and planes** – The erector spinae muscle complex consists of three muscles - the iliocostalis, longissimus, and spinalis muscles. They run on either side of the spinous processes of the vertebral column from the base of the skull to the pelvis. Their caudal insertions are on the sacrum, iliac crest and lumbar spinous processes. Cranial insertions are at transverse and spinous processes of the thoracic and cervical vertebrae up to C2, as well as attachments to ribs.

In the thoracic region, the erector spinae muscle group is overlaid by the trapezius and rhomboid major muscles. The rhomboid major muscle tapers at approximately T5, so may not be visualized during blocks performed at or below this level.

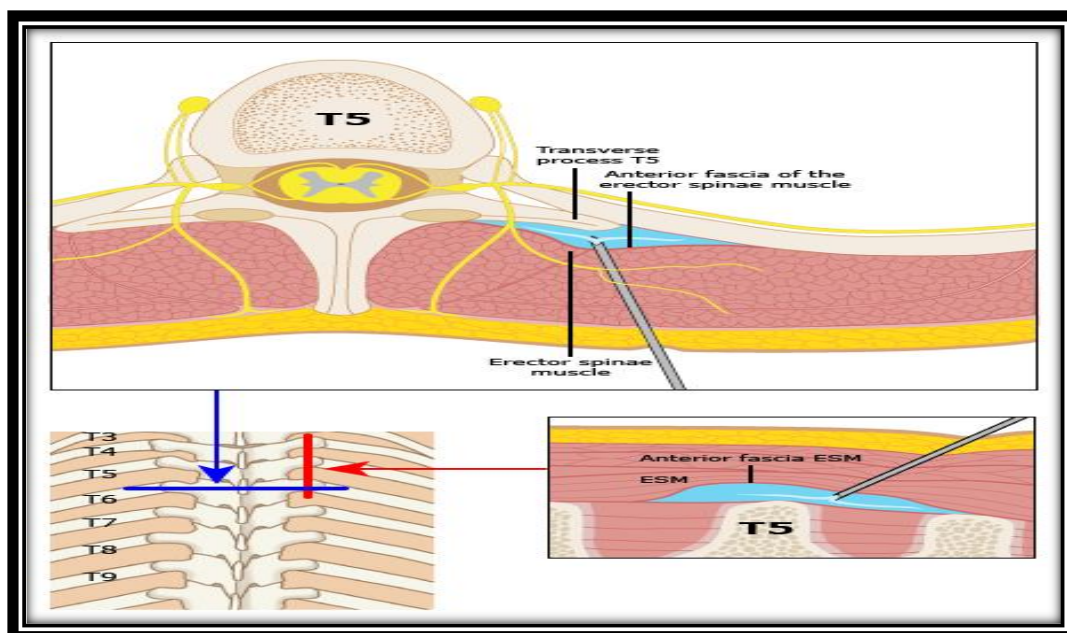
In the lumbar region, they are overlaid by the serratus posterior inferior and latissimus dorsi muscles. The erector spinae plane (ESP) is a fascial plane between the anterior aspect of the erector spinae muscles and the posterior surfaces of the vertebral transverse processes. In the thoracic region, the plane is open to intercostal spaces laterally and is bounded by laminae and interspinous ligaments medially.



**Figure 6: The erector spinae muscle complex consists of the iliocostalis, longissimus, and spinalis muscles.**

**Communications** - The erector spinae plane communicates with the thoracic paravertebral and epidural spaces through the intertransverse connective tissue. The superior costotransverse ligament that forms most of the dorsal border of the thoracic paravertebral space has fenestrations which may allow spread of local Anaesthetic (LA) into the paravertebral space from more superficial injection within the ESP. The ESP also communicates with intercostal spaces laterally.

**Nerves** – In the thoracic spine, spinal nerves exit the vertebral canal and continue as ventral and dorsal rami within the ESP . In the lumbar region, the ventral rami of L1 to L4 form the lumbar plexus, and the dorsal rami split into medial, intermediate, and lateral branches.



**Figure 7:** This schematic shows placement of the block needle and hydro dissection for erector spinae plane block, in both transverse and sagittal planes. Correct needle placement is confirmed by visualizing the anterior fascia of the erector spinae muscle separating from the tip of the transverse process.

**Technique:**

**Landmark-guided ESPB** can be performed with the patient in prone, lateral, or sitting position. The sitting position allows easy identification of landmarks and greater comfort to the patient. Local anaesthetic (LA) is deposited into the fascial plane deep to erector spinae muscle which blocks the dorsal and ventral rami of the spinal nerve depending on the level of injection and the amount of local anaesthetic injected.

The spinous process of the vertebra and a point, 3 cm lateral to it are marked at the appropriate level before performing the block. Under aseptic precautions, the needle (23-gauge, Quinickes spinal needle) is inserted and advanced perpendicular to the skin in all planes to contact the transverse process of the vertebra. The transverse process of the thoracic vertebra

lies at a variable depth of 2–4 cm from the skin depending on the build of the individual. At this point, the needle tip lies between the erector spinae muscle and transverse process. After negative aspiration, local anaesthetic is injected. The drug injected in this plane spreads in the longitudinal axis to both cephalad and caudal direction over several levels as the erector spinae fascia extends from nuchal fascia to the sacrum.

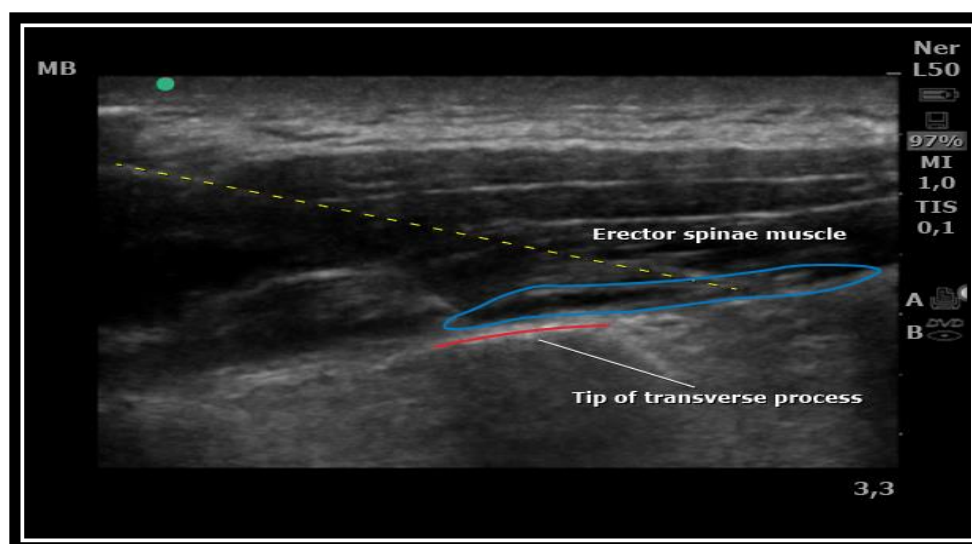
### ***Ultrasound Guided Block:***

- **Ultrasound equipment** — For most patients we use a high frequency (10 to 15 MHz) linear array transducer, with the depth set to 3 to 5 cm. For patients with obesity, we use a low frequency (2 to 5 MHz) curvilinear transducer, and adjust the depth as necessary.
- **Patient positioning** — Thoracic ESP block is commonly performed in the sitting position. Lateral and prone positions may be used, particularly if the block is performed after induction of anaesthesia.
- **Performing thoracic block** — ESP block is most commonly performed with the ultrasound transducer in a parasagittal orientation, which has routinely been used in trials involving this block, and which we describe here. Transverse orientation has been described in case reports.

**Identify the correct block level** – To identify the target transverse process (TP), either count ribs or count spinous processes.

- **Count ribs** – We count ribs with ultrasound rather than surface landmarks to more accurately identify the desired TP level, particularly when spinous processes (SPs) are not clearly palpable.
- Place the transducer in sagittal orientation approximately 6 cm from midline. Start cranially to identify the first rib, or caudally to identify the 12<sup>th</sup> rib.

- Slide the transducer cranially or caudally parallel to the spine, counting the ribs until the desired level is reached. Centre the rib on the ultrasound screen.
- Slide the transducer medially to visualize the tip of the TP, typically approximately 3 cm lateral to the midline.
- **Count spinous processes** – Palpate the spinous prominens (C7) and counting caudally to the desired level. At the levels T4 to T8, the spinous process of the vertebral body above correlates with the TP of the vertebral body one below. Place the transducer over the target spinous process and slide laterally along the lamina to find the TP.
- **Identify the TP** – Scan from lateral to medial, looking for the transition from rib to TP . Ribs appear round, thin, and surrounded by visible pleura. In contrast, TPs appear as flat, with squared off acoustic shadows and with less visible surrounding pleura. At the point of transition from rib to TP (the costo-transverse angle), the TP is more superficial than the rib. Mark the desired TP and center it on the ultrasound screen.
- Insert the block needle in plane to the transducer at either end and advance the needle to contact the tip of the transverse process, visualizing the needle tip throughout .
- After negative aspiration, inject 1 to 3 mL of saline, visualizing elevation of the fascia of the erector spinae muscle off the TP . Adjust the tip of the needle as necessary to clearly visualize separation of the erector spinae muscle (ESM) from the TP.
- After negative aspiration, inject 10 mL of local anaesthetic in 5 mL increments, with gentle aspiration between injections, while visualizing the hypoechoic pocket of local anaesthetic (LA) lifting the ESM on either side.
- Scan cranially and caudally to visualize spread of LA within the ESP.



**Figure 8: This image shows hydro dissection with a small volume of saline prior to injecting local anaesthetic during ESP block. The pocket of saline (outlined in blue) lifts the erector spinae muscle off the transverse process.**

**LUMBAR BLOCK** — Lumbar ESP block is technically more challenging than thoracic block as the muscle layers are deeper and thicker than in the thoracic region, and the tips of the TPs are deeper and more lateral.

- Ultrasound equipment — For lumbar ESP block we use a low frequency (2 to 5 MHz) curvilinear transducer, with the depth set to 4 cm, adjusted as necessary.
- Patient positioning — Lumbar ESP block is usually performed in the prone position. It can also be performed in the lateral position, which can be useful if the block is placed in an Anaesthetized patient.

***Performing lumbar block:***

- **Identify the correct block level** – Identify the target TP by counting them either caudal to cranial from the sacrum or cranial to caudal from T12. Note that the T12 TP

is shorter than other thoracic and lumbar TPs. The author scans cranially from the sacrum.

- **Identify the tip of the TP** – Obtain a parasagittal oblique interlaminar view to identify laminae. At the desired level, slide the transducer laterally to visualize the TPs, which cause acoustic shadows separated by psoas muscle. Move the transducer laterally beyond the tip of the TP (until the acoustic shadows disappear) and then move it slowly back until the shadows reappear. This is the tip of the TP, which is the needle target.
- Visualize the erector spinae muscle overlying the TP.
- Insert the block needle in plane to the transducer at either end and advance the needle to contact the tip of the transverse process, visualizing the needle tip throughout.
- After negative aspiration, inject 1 to 3 mL of [saline](#), visualizing elevation of the fascia of the erector spinae muscle off the TP. Adjust the tip of the needle as necessary to clearly visualize separation of the ESM from the TP.
- After negative aspiration, inject 10 mL of local anaesthetic in 5 mL increments, with gentle aspiration between injections, while visualizing the hypoechoic pocket of LA lifting the ESM. Cranial-caudal spread of LA is not as apparent in the lumbar level as it is during thoracic ESP block.

***Side effects and complications:***

The incidence of complications specific to erector spinae plane (ESP) blocks is unknown, but they are likely rare.

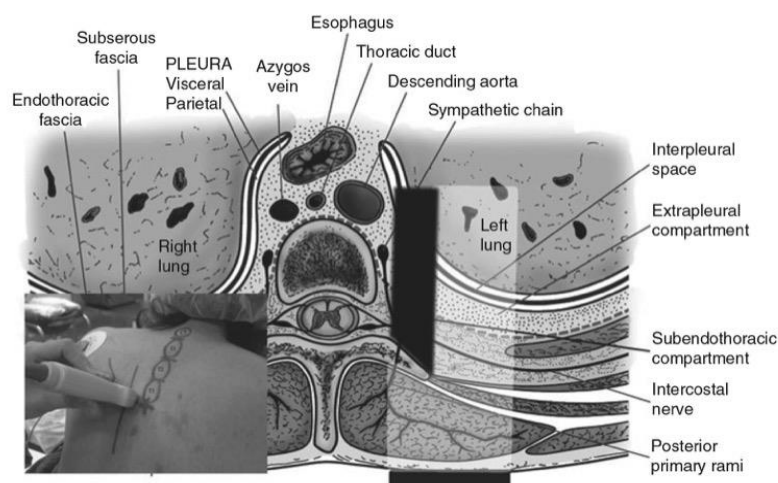
- Local anaesthetic systemic toxicity (LAST), because of the high vascularity of the erector spinae muscle, close proximity of the block to the intercostal spaces in the thoracic region, the large area of tissue contact with local anaesthetic (LA), and the high volumes used for the block.
- Pneumothorax from mid-thoracic blocks
- Motor block after low thoracic and lumbar blocks.
- There are also reports of sympathectomy presumably due to paravertebral spread.

## PARAVERTEBRAL PLANE BLOCK<sup>22</sup>

Paravertebral block (PVB) is the technique of injecting local anaesthetic alongside the vertebra close to where the spinal nerves emerge from the intervertebral foramen. This produces unilateral, segmental, somatic, and sympathetic nerve block, which is effective for anaesthesia and in treating acute and chronic pain of unilateral origin from the chest and abdomen. Currently, it is used not only for analgesia but also for surgical anaesthesia, and its application has been extended to children. Introduction of ultrasound to the practice of regional anaesthesia led to the renewed efforts to increase safety and consistency of PVBs.

### **Anatomy:**

Each thoracic paravertebral space (TPVS) is a wedge shaped compartment that lies alongside vertebral column, in between the heads and necks of the ribs above and below. The anterior boundary of the TPVS is the pleura. The posterior border consists of ribs, transverse processes, superior costotransverse ligament, and internal intercostal membrane.



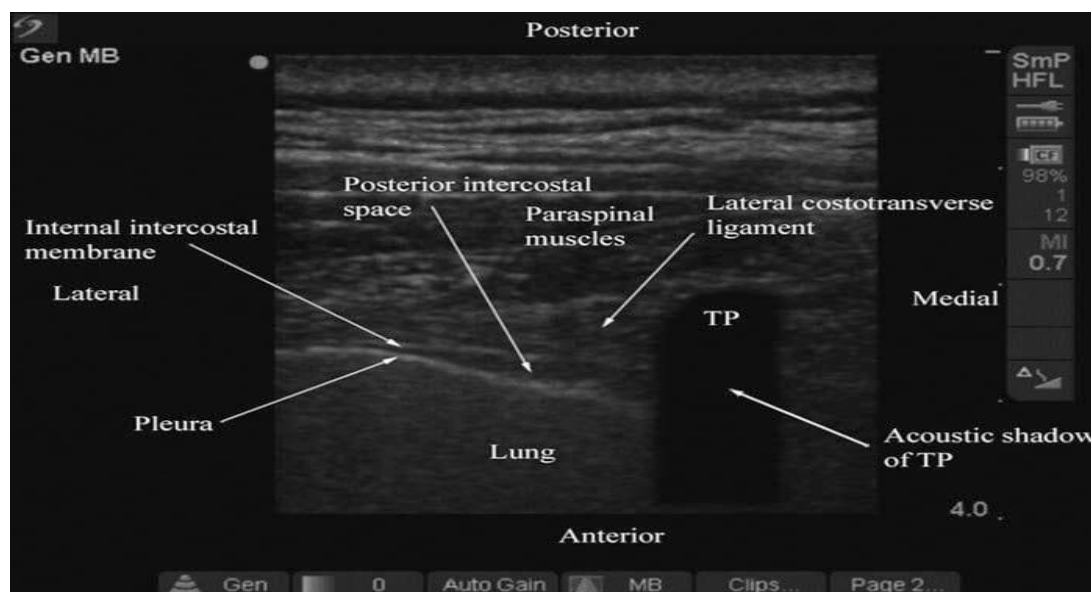
**Figure 9: The orientation of the ultrasound transducer and how the ultrasound beam is insonated during a transverse scan of the thoracic paravertebral region is shown.**

The transverse process (TP) usually casts an acoustic shadow (represented in black), which obscures the ultrasound visibility of the TPVS. (Picture in the inset shows the position of the ultrasound transducer relative to the spine).

Performing the block medially may reduce the risk of pleural puncture, but may increase the risk of dural puncture, intrathecal injection, or excessive epidural spread.

**Choice of block technique** – Use of ultrasound guidance for thoracic paravertebral block (TPVB) rather than a landmark-based technique, to improve block success and reduce complications.

**Ultrasound-guided block** –For ultrasound-guided block, the pleura must be visualized to avoid puncture and guide needle placement. Anterior pleural displacement is a key sign of desired spread of local anaesthetic (LA) .

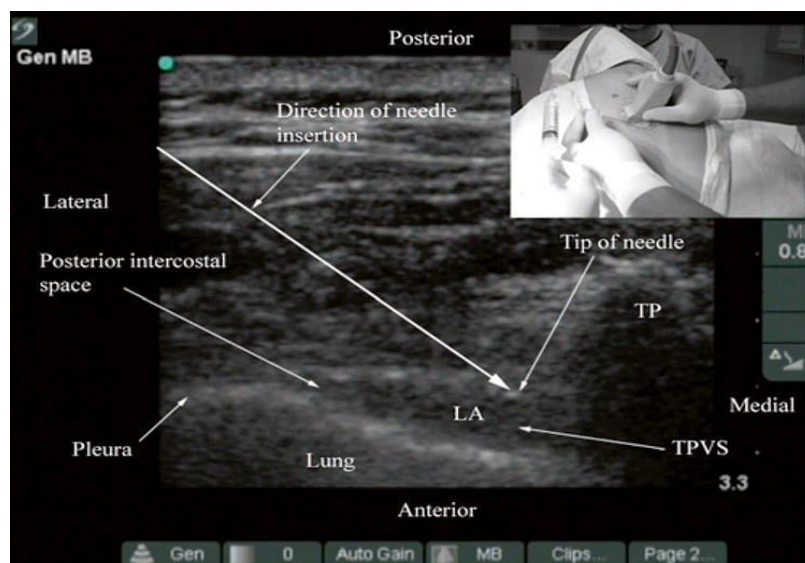


**Figure 10: Transverse sonogram of the thoracic paravertebral region with the ultrasound beam being insonated over the transverse process.**

(Note how the acoustic shadow of the TP obscures the TPVS. The hypochoic space between the parietal pleura and the lateral costotransverse ligament and internal intercostal

membrane laterally represents the apex of the TPVS or the medial limit of the posterior intercostal space).

- **Continuous real time ultrasound** – The block is performed with continuous ultrasound visualization, with the transducer centered over the tips of transverse processes.
- **Intermittent ultrasound** – Ultrasound is used to insert the needle tip at the inferior edge of the tip of the transverse process (TP) and to estimate the angle and depth required to place the tip into the TPVS. The needle is then advanced without ultrasound, after which ultrasound is used again to confirm correct needle tip placement and injection of LA.
- **Landmark-based block** – The block is performed by initially placing the needle tip on the TP, and then stepping off the TP and redirecting the needle caudally into the paravertebral space.
- **Continuous block** – Continuous block is performed as for single-injection block, using a Tuohy needle with a catheter inserted through the needle into the TPVS.



**Figure 11: Transverse sonogram of the TPVS after local anaesthetic injection (Technique 3).** (Note the widening of the paravertebral space, anterior displacement of the pleura, and spread of local anaesthetic (LA) to the posterior intercostal space laterally. The long white arrow represents the direction in which the block needle is inserted. The picture in the inset shows how the block needle is inserted in the plane of the ultrasound beam from a lateral to medial direction. TP transverse process, TPVS thoracic paravertebral space).

Technique: In the above technique, a transverse scan is used, and

the block needle is inserted laterally to medially in the plane of the ultrasound beam until the tip reaches the posterior intercostal space or the apex of the TPVS. After injecting 2-3 ml of normal saline to confirm placement, the local Anaesthetic is administered in small doses, causing the paravertebral space to widen and the parietal pleura to displace anteriorly. This method offers excellent needle visualization but carries a higher risk of epidural spread or intrathecal injection and can cause significant discomfort, requiring substantial intravenous sedation and analgesia during multilevel injections. Further research is needed to validate its safety and efficacy

#### *Side effects and complications*

- TPVB may cause hypotension (due to sympathetic block), mild local Anaesthetic systemic toxicity (LAST), and musculoskeletal pain after block resolution.
- Reported complications include pneumothorax, Horner syndrome, neuraxial spread, and LAST.
- Most clinicians consider anticoagulation a relative contraindication to TPVB, due to the deep and noncompressible location of the TPVS.

## **ULTRASONOGRAPHY**

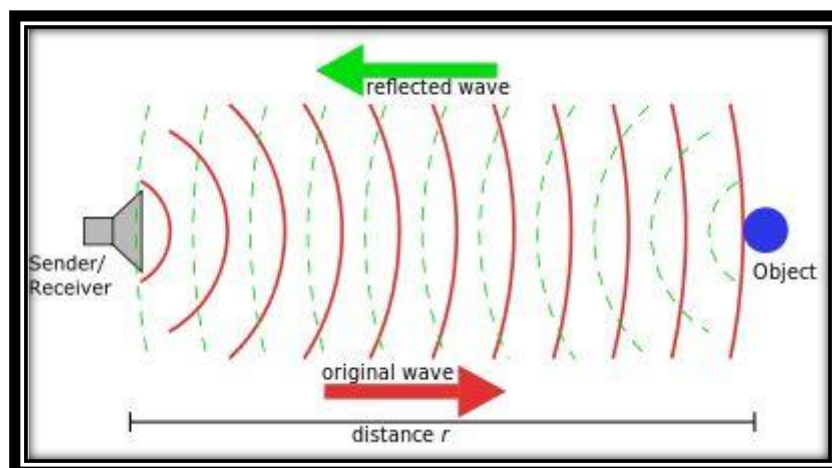
Ultrasound waves are sound waves with a frequency greater than 20,000Hz. These frequencies are above the audible upper limit of human hearing. Medical ultrasound is the application of this ultrasound waves to visualize the internal organs of our human body. The frequencies used for this purpose, ranges from 3 to 20 MHz. In recent years, ultrasound is widely used in anaesthesia for obtaining vascular access and performing peripheral nerve blocks. Ultrasound guided techniques helps in increasing success rate and reduce its complications.

### ***Ultrasound Pulse Generation***

The ultrasound transducer contains multiple piezoelectric crystals which are interconnected electronically. When mechanical energy is applied to these crystals and some ceramics, they generate electrical energy. This phenomenon known as the “Piezoelectric Effect” was first described by the Curie brothers in 1880. They also described the “Reverse Piezoelectric effect”, wherein application of electricity to these crystals produced vibrations which generate ultrasound waves.

### ***Ultrasound Wavelength and Frequency***

The wavelength and frequency are inversely related. High frequency ultrasound waves (10 to 20 MHz) give images with a high axial resolution but are more attenuated as we go deeper. Therefore, these transducers are optimal to image the superficial structures. Low frequency ultrasound waves (2 to 8 MHz) penetrate deeper but provide low axial resolution and are used to image deeper structures.



**Figure 12: Principles of Ultrasonography**

### ***Ultrasound Tissue Interaction***

As the ultrasound waves travel through tissues, they are partly transmitted to deeper structures, partly reflected back to the transducer as echoes, partly scattered, and partly transformed to heat.

### ***Reflection***

For image generation, the echoes returned after hitting a tissue interface is of interest to us. The amount of echo returned after hitting a tissue interface is determined by a tissue property called acoustic impedance. The intensity of a reflected echo is proportional to the mismatch in acoustic impedances between two mediums.

### ***Refraction***

The change in the direction of the ultrasound waves after hitting an interface between two media with different velocities of sound transmission is refraction. This causes artefacts as the returning echoes are incorrectly located.

### ***Scattering***

Ultrasound waves which incident on the tissues at right angles are reflected back to the transducer. If the waves are not at right angle, then the returning echoes are scattered in all directions in a non-uniform manner

### ***Absorption***

Some of the ultrasound waves are absorbed by the tissue and are converted to heat.

### ***Attenuation***

As the ultrasound waves travel through tissue, the returning echoes will become weaker due to absorption, scattering and refraction.

### ***Diffraction***

The spreading out of the ultrasound waves as its moves further away from the source is diffraction.

### ***Construction***

The ultrasound probe has an array of individual transducers which acts as both a transmitter and a receiver. Each transducer emits a short burst of ultrasound and is quiescent until it detects the echoes returning. This is called "Pulsed Ultrasound". The speed of ultrasound in our body tissues is fairly constant at a speed of 1540m/s. The time taken for an echo to return is used determine the distance between the tissue and the probe.

Across the plane of an image, the ultrasound image is swept to form two dimensional images one line at a time. These lines are then summated to produce a frame. The frames are

repeated to produce a real-time image. The brightness of the image depends upon the amplitude of the returning echo from the anatomical interfaces.

### **Scanning Modes**

A-mode (amplitude mode): This displays a single echo signal against time to measure depth.

B-mode (brightness mode): It is a two-dimensional image produced using an array of transducers and a series of reflected echoes.

M-mode (motion mode): is a specialized type of B-mode imaging where one particular line is ensounded repeatedly to examine a moving structure plotting out how the structure moves with time.

### ***Ultrasound controls***

Gain alters the brightness of the image by amplifying the received signal.

Time-Gain Compensation (TGC) differentially amplifies signals from different depths, allowing equal amplitudes from all depths to be displayed.

Focus adjusts the beam to be at its narrowest at the required depth to image the region of interest. It thereby improves lateral resolution

Depth can be adjusted to have the structure that is being examined to be in the centre of the screen.

### ***Approaches and techniques***

There are two basic approaches to ultrasound guidance. With the out-of-plane technique, the needle tip crosses the plane of imaging as an echogenic dot. With the in-plane approach, the entire tip and shaft of the advancing needle are visible.

#### ***Out-of-plane***

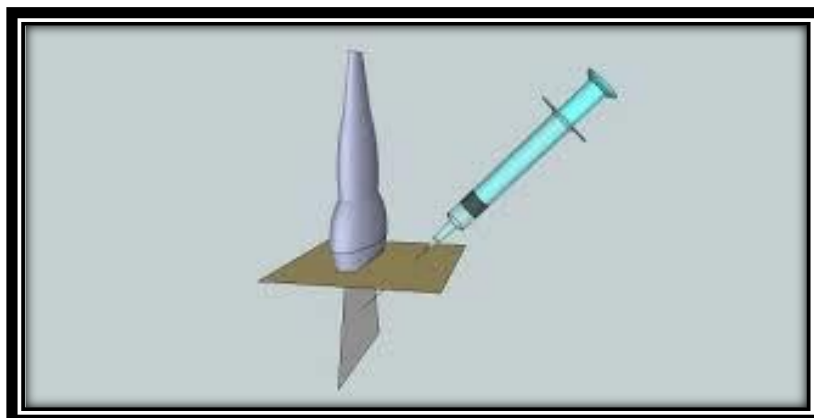
This technique involves insertion of needle at the midpoint of probe such that the needle cuts across the ultrasonic beam. The image obtained is a cross section of the needle shaft or tip. Path to target is shorter as compared to in-plane technique, but visibility of needle is not optimum, indirect markers like tissue movement or hydro dissection is needed to confirm placement.

#### ***Advantages***

- 1) Most similar to other approaches to regional block (nerve stimulation or palpation)
- 2) Shorter needle path than with in-plane approaches
- 3) Along the nerve path (catheters)

#### ***Disadvantages***

Unimaged needle path, crossing the plane of imaging without recognition.



**Figure 13: Out of plane approach*****In-plane (IP)***

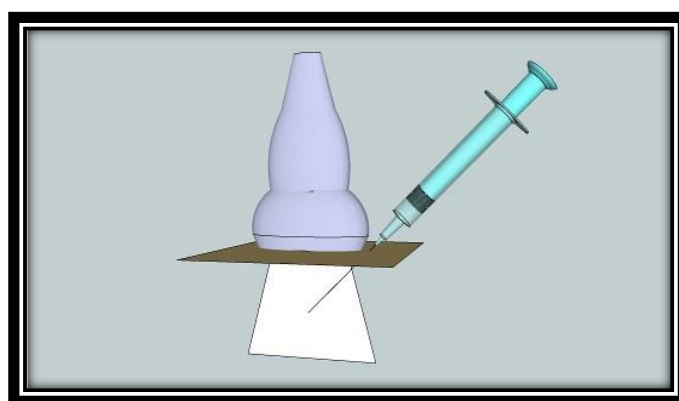
In this technique needle is inserted along the length of ultrasound probe. It aligns the entire length of the beam with the shaft of needle. The image displayed will depict the entire needle shaft and its tip thereby improving the precision of nerve blocks. But the needle visibility depends on angle of insertion and the needle traverses a longer path to reach the target area.

**Advantages**

Most direct visualization.

***Disadvantages***

- 1) Partial line-ups (creating a false sense of security when the needle tip is not correctly identified).
- 2) Some unimaged needle path occurs with IP approach, but typically less than with OOP approach.
- 3) Longer paths and therefore more structures to cross with the block needle.

**Figure 14: Inplane approach of ultrasonography*****Ultrasound probes***

Commonly used are three types

- Linear high frequency (6 to 12 MHz) probes which has high resolution and lesser penetration and is ideal for visualizing superficial structures.
- Curvilinear low frequency probes (2-5MHz) which has low resolution, higher penetration and is ideal for deeper structures like intraabdominal organs.
- Phased Array Probe also has low frequency (2MHz – 7.5MHz) gives a large depth with a small acoustic window, ideal for chest ultrasound



**Figure 15: Ultrasound probes**

### ***Imaging***

Ultrasound image is produced by echoes received as the Ultrasonic beam interacts with the tissues it travels through. Acoustic impedance of a structure is the function of the elasticity and density of the particular tissue. Materials with higher acoustic impedance transmit sound faster, and do not allow for continued compression by the impending wave. The sound beam is attenuated while traversing various tissues within the body. The beam will be scattered somewhat when it encounters varying tissues on the way with different acoustic impedances or it may be reflected back from structures and returns back to the transducer. Refraction and absorption by tissues may also attenuate the waves. Those tissues that reflect the wave are

termed echoic and those which do not reflect the wave are termed anechoic. Always use plenty of sterile ultrasound gel to remove the air interface between the skin and probe. Air does not allow the passage of the ultrasound beam even though it has low Acoustic impedance. Bone has high acoustic index so it appears to be white on the ultrasound image as it is hyper reflective to the beam. Blood and other fluids appear to be black on the image since they are anechoic in nature. Soft tissue appears as grey on the sonographic image as they have medium echogenicity.

The nerves appear round or oval in transverse view and are hypo-echoic or they appear as honeycomb structures with septations inside them. Nerves are bordered by a hyper-echoic layer of connective tissue. Blood vessels will appear as circular hypoechoic to anechoic structures with a well-defined hyper-echoic border which is the vessel wall. Veins are compressible with thinner walls whereas arteries have thicker walls and appear pulsatile in nature. Muscles have fibrous-lamellar texture and appear as heterogeneous or homogeneous hypoechoic structures with hyper-echoic septa in between.

***Basic principles of ultrasound guided nerve blocks.***

- First involves the identification of anatomical structures like muscles, fascia, blood vessels and bones.
- Visualization of the nerve plexus or the fascial plane where drug should be deposited.
- Should be able to differentiate between normal and altered anatomy of the region scanned.
- Identify the correct plane for needle insertion to avoid trauma to vessels
- Strict aseptic technique
- Real time visualization of needle when it is inserted inside.

- -Once the target is reached, inject a small volume of drug or saline and see the spread and confirm location, else reposition the needle.
- Do frequent aspiration during injection of drug to rule out intravascular injection.
- Complete visualization of the spread of total volume of local anaesthetic drug injected.
- Always keep ready all resuscitation equipment, drugs and standard monitoring

## ROPIVACAINE

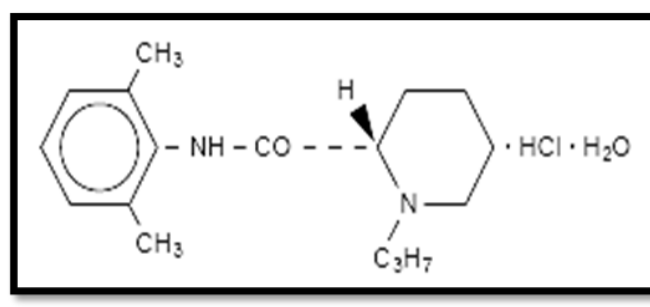
### *Introduction*

Ropivacaine, a newer and longer-lasting local Anaesthetic belonging to the amino amide group, was synthesized by Ekenstam in 1957 but wasn't introduced for clinical use until 1996. Chemically akin to bupivacaine and mepivacaine, ropivacaine is a pipercoloxylidide local Anaesthetic.

Research revealed that butyl derivatives of pipercoloxylidides, such as bupivacaine, posed greater cardiotoxicity risks, leading to numerous cardiac arrests. In response, ropivacaine was developed as a pure S-enantiomeric form of pipercoloxylidides. While ropivacaine has been available internationally for over three decades, its introduction to the Indian market is relatively recent.

Ropivacaine is gaining popularity among Anaesthesiologists and is extensively utilized in various regional Anaesthesia techniques, including infiltration, peripheral nerve blocks, spinal Anaesthesia, epidural Anaesthesia, and caudal epidural blocks in pediatric patients.

### *Chemical Structure*



**Figure 16: Chemical structure of ropivacaine**

Ropivacaine is an amino amide local anaesthetic agent, chemically described as S-(-)-1-propyl-2',6'-pipercoloxylidide hydrochloride monohydrate. The *International Union of Pure and Applied Chemistry* name is (S)-N-(2,6-dimethylphenyl) -1- propylpiperidine-2-carboxamide. It's molecular formula is  $C_{17}H_{26}N_2O \cdot HCl \cdot H_2O$  and it has a molecular weight of 328.89.

Ropivacaine is a white crystalline powder. At 25°C ropivacaine hydrochloride has a solubility of 53.8 mg/mL in water and a distribution ratio between n-octanol and phosphate buffer at pH 7.4 of 14:1. The pKa of ropivacaine is 8.07 which is very similar to that of bupivacaine (8.1) .



**Figure 17: Drug ampule of Ropivacaine**

However, ropivacaine has a much lesser lipid solubility as compared to bupivacaine and mepivacaine. This can be explained on the basis of presence of a propyl (3 Carbon) side chain in ropivacaine as compared to a butyl (4 Carbon) side chain in the other two local anaesthetics.

### **Mechanism Of Action And Correlation With Structure**

Ropivacaine reversibly inhibits the voltage gated sodium channels present on the nerve cell membranes thus preventing the influx of sodium ions into the cells. This:

- I. Block generation and conductance of nerve impulses.
- II. Slows propagation of nerve impulses
- III. Reduces the rate of rise of action potential

Almost all local anaesthetic agents block the unmyelinated C and myelinated A $\delta$  fibres, which transmit pain impulses, at the same rate.

The rate of blockade of motor fibres (A $\alpha$  and A $\beta$ ), however depends upon the physiochemical properties like pKa and lipid solubility of the individual drug. As Ropivacaine is less lipid soluble than bupivacaine, the A $\alpha$  and A $\beta$  blockade is slower and hence motor blockade is less potent. Studies of lumbar epidural block in humans have confirmed that equal volumes and concentrations of bupivacaine and Ropivacaine produce similar degree of sensory block but the motor block produced by Ropivacaine is slower in onset, lesser in intensity and shorter in duration.

Clinically the order of blockade of nerve fibres is autonomic, sensory and motor, while the regression of the block occurs in reverse order.

The nerve impulse transmission is lost in the following order:

The order of the loss of nerve function is

1. Pain
2. Temperature
3. Touch
4. Proprioception
5. Skeletal muscle tone.

## **Pharmacokinetics**

### ***Absorption:***

The systemic concentration of ropivacaine depends on the total dose and concentration of drug given, the route of administration, the patient's haemodynamic state and the vascularity of the site of administration. When administered in the epidural space, ropivacaine has a biphasic absorption. The half-lives of the two phases ( mean $\pm$  SD) are 14 $\pm$ 7 minutes and 4.2  $\pm$ 0.9 hours respectively.

### ***Distribution:***

After intravascular infusion, ropivacaine has a steady state of distribution of 41  $\pm$  7 litres. It is 94% protein bound, mainly to  $\alpha_1$ -acid glycoprotein. In case of continuous epidural infusion of ropivacaine the plasma concentration can rise due to increased protein binding and reduced clearance. Ropivacaine can easily cross the placenta.

### ***Metabolism and excretion:***

Ropivacaine is extensively metabolized by the liver, predominantly by the cytochrome P<sub>450</sub>1A mediated aromatic hydroxylation to produce 3 – hydroxyl ropivacaine. After a single IV dose, approximately 37% of the total dose is excreted in the urine as both free and conjugated 3-hydroxy ropivacaine. An additional unquantified amount of 2 – hydroxyl – methyl ropivacaine has also been identified as a metabolite.

Ropivacaine metabolites are mainly excreted via kidney. After i.v. administration 86% of the dose is excreted in urine of which only 1% is in unchanged form. Following IV administration, ropivacaine has a mean  $\pm$  SD total plasma clearance of 387  $\pm$  107 mL/min, an

unbound plasma clearance of  $7.2 \pm 1.6$  L/min and a renal clearance of 1 mL/min. The mean  $\pm$  SD terminal half-life is  $1.8 \pm 0.7$  h and  $4.2 \pm 1.0$  h after i.v. and epidural administration respectively.

### **Pharmacodynamics**

#### ***Central Nervous System & CardioVascularSystem :***

Ropivacaine exhibits a higher threshold for both cardiac and neurotoxicity compared to bupivacaine, attributed to its lower lipid solubility and stereo-selective properties. This characteristic applies to both isomers of ropivacaine, which have demonstrated less cardiodepressant effects than their respective bupivacaine counterparts in animal studies. In healthy volunteers, CNS toxicity manifests earlier than cardiac toxicity during intravenous infusion.

#### ***Potency:***

Lipid solubility of a local anaesthetic correlates well with its potency and toxicity. Compounds which are more lipophilic penetrate the nerve cell membrane more readily. Thus, fewer molecules are required to produce the desired conduction blockade.

#### ***Others:***

Continuous epidural infusion of 0.375 % and 0.188% ropivacaine has been shown to inhibit platelet aggregation in plasma.

### **Adverse Effects**

Excessive plasma levels are due to over dosage, unintentional intravascular injection or slow metabolic degradation. The mean doses at which CNS symptoms of toxicity begin to

occur in human beings are 4.3 and 0.6 mcg/mL of total and free plasma concentrations respectively. When prolonged blocks are used the risks of reaching a toxic plasma concentration or inducing local neural injury are increased. Various possible side effects include

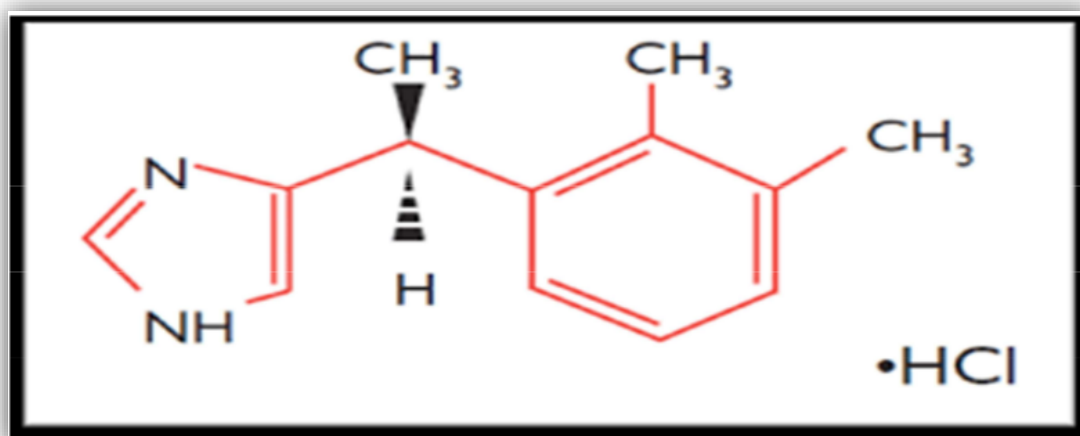
- a) Injection site pain
- b) Cardiovascular system toxicity: Vasovagal reaction, syncope, postural hypotension, non-specific ECG abnormalities which include wide QRS complexes, increased conduction time and reduced contractility.
- c) Gastrointestinal system toxicity: Faecal incontinence, tenesmus, nausea, vomiting.
- d) Central nervous system toxicity: Tremor, Horner's syndrome, dyskinesia, neuropathy, vertigo, convulsion and coma. Because of depressant effect of ropivacaine on medulla, excitatory stage of CNS might not occur.
- e) Liver and Biliary system toxicity: Jaundice
- f) Metabolic disorders: Hypomagnesemia

***Advantages Over Other Local Anaesthetics:***

Ropivacaine offers a more distinct blockade, providing improved differentiation between sensory and motor functions. In comparison to bupivacaine, ropivacaine induces a less intense motor blockade of shorter duration, facilitating earlier patient mobilization and discharge. This leads to reduced morbidity and treatment costs. Additionally, ropivacaine exhibits lower systemic toxicity and a more favorable cardiovascular profile than bupivacaine. Developed as a safer alternative to bupivacaine, ropivacaine maintains the desirable blocking properties of racemic bupivacaine.

### DEXMEDETOMIDINE

Dexmedetomidine is a selective  $\alpha_2$  agonist which have properties of sedation, analgesia, anxiolysis and sympatholytic effect. Since dexmedetomidine is having all these properties, it is used in perioperative period and in intensive care unit for sedation, analgesia. Few studies have shown that dexmedetomidine have anti-shivering properties. Physical and Chemical Properties:



**Figure 18: Dexmedetomidine chemical formula**

Dexmedetomidine is a d-enantiomer of medetomidine which belongs to imidazole group of  $\alpha_2$  agonists. It has high specificity for  $\alpha_2$  receptors than  $\alpha_1$  receptors ( $\alpha_2$ :  $\alpha_1$  = 1600:1) when compared to clonidine ( $\alpha_2$ :  $\alpha_1$  = 200:1). Dexmedetomidine is highly water soluble. pKa is about 7.1.



**Figure 19: Drug ampule of dexmedetomidine.**

The presynaptic  $\alpha$ adreno receptors which regulates the release of Noradrenaline was designated as  $\alpha$ 2 adrenoreceptors. These  $\alpha$ 2 adreno receptors are widely distributed in CNS and peripheral tissues, thereby controlling the modules of sympathetic nervous system. The  $\alpha$ 2 receptors subdivided into  $\alpha$ 2A ,  $\alpha$ 2B,  $\alpha$ 2c etc.; . All these are required for normal regulation of presynaptic neurotransmitter release from the central noradrenergic area and from sympathetic nerves in heart.

### ***Pharmacokinetics***

Dexmedetomidine is a dextro-isomer of medetomidine. It is administered by intravenous route. It is short acting with linear concentration dependent kinetics. Dosing and administration: The pharmacodynamic effects of the drug are achieved at a plasma concentration of 0.5-1.2ng/dl. The dose of the drug approved by FDA is a loading dose of 1mcg/kg body weight over a period of 10 minutes followed by a maintenance dose of continuous intravenous infusion of 0.2 to 0.7 mcg/kg/hr.

The rate flow of this infusion is titrated according to required level of sedation and by careful monitoring of hemodynamics of the patient. Dexmedetomidine is used as a good sedative agent in ophthalmic surgeries. In these surgeries the drug is administrated

intravenously as a loading dose of 0.5 mcg/kg followed by a maintenance dose of 0.6 mcg/kg/hr. Distribution: Dexmedetomidine is significantly bound to plasma protein (94%). The pharmacokinetics of this drug is explained as a “two-compartment model”. After intravenous injection it is rapidly distributed with a distribution half-life of 6 minutes. The elimination half-life of the drug is 2 to 2.5 hours. The steady state volume of distribution is estimated as approximately 68L to 72L.

### ***Metabolism And Elimination***

The dexmedetomidine is mostly metabolized in the liver by the cytochrome P450 enzymes by glucuronidation and biotransformation. There are various metabolic pathways by which dexmedetomidine is metabolized. 1. N-glucuronidation to inactive metabolites (41%). 2. N-methylation to produce 3-hydroxy N-methyl dexmedetomidine (21%). 3. Hydroxylation followed by conjugation. 4. Conjugation and N-methylation. 5. Hydroxylation followed by conjugation.

Most of the drug undergoes complete biotransformation which results in minor quantity of drug to be excreted in urine and feces as unconjugated form. The elimination half-life of the drug is approximately 2 hours with an average clearance of 45L/hour in adults. The pharmacokinetics of the drug are impaired in patients with hepatic and renal diseases. In hepatic diseases, there is an increase in half-life, volume of distribution and as well as decrease in clearance and protein binding of the drug. In renal diseases, there is a decrease in terminal elimination half-life, but no change in clearance and volume of distribution.

**Table-1: Pharmacokinetics Of Dexmedetomidine**

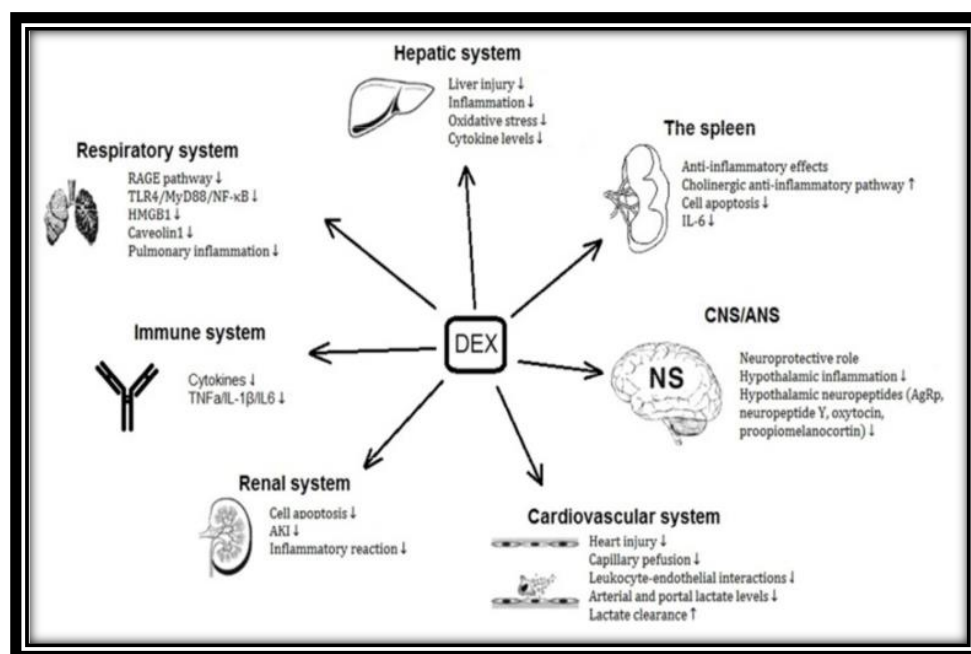
Molecular weight	236.7 Daltons
------------------	---------------

Lipid solubility	30
Distribution half life	6 minutes
Protein Binding	94%
Volume of distribution	118 L
Elimination t <sub>1/2</sub>	120 – 180 minutes
Context sensitive half life	4- 250 minutes

**Mechanism of action:** Dexmedetomidine is a potent  $\alpha_2$  agonist. The  $\alpha_2$  receptors are a part of both central nervous system and peripheral nervous system. These receptors are also present in liver, kidney and pancreas. The site of action of these receptors are presynaptic, post synaptic and extra synaptic regions among which presynaptic site is of major concern. So, depending on site of action of these receptors, various responses are evaluated. The presynaptic site is the region where modulation of release of Nor-adrenaline and ATP occurs. Since it is a potent  $\alpha_2$  agonist; it mainly acts on presynaptic region and causes inhibition of release of nor-adrenaline. Its main action is to inhibit the neuronal firing in the brain and spinal cord by action on the  $\alpha_2$  receptors and thus leading to bradycardia, hypotension, sedation and analgesia.

**Pharmacodynamics:** Dexmedetomidine after its initial dose administration exerts a brief biphasic pattern of cardiovascular response. This response is seen after a loading dose of 1 microgram/kg of body weight. There is initial increase in blood pressure followed by reflex bradycardia. This initial increase in blood pressure is because of stimulation of  $\alpha_{2b}$  receptors which are present in smooth muscles. This is followed by decrease in blood pressure which is because of central sympathetic system outflow blockade. Dexmedetomidine inhibits the release of noradrenaline, thus leading to further hypotension and bradycardia. Postoperative

bradycardia is commonly noticed with dexmedetomidine injection. Cautious use of dexmedetomidine to patients with poor left ventricular function should be considered. Dexmedetomidine sedative effects are achieved by action on  $\alpha_2$  adrenoreceptor located on postsynaptic membrane. It inhibits the G-protein which leads to increase in conductance through the potassium channels. The sedative effect of dexmedetomidine is achieved by action on locus coeruleus located in brain stem.



**Figure 20: Dexmedetomidine clinical effects.**

### **USES:**

The uses of the drug dexmedetomidine are as follows:

1. Sedation of intubated patients in ICU. (NOTE: it should be used more than 24 hours.)
2. Sedation of surgery patients without being intubated.
3. Reduction of use of opioids and other Anaesthetic agents.
4. Anxiolytic.
5. Before performing laryngoscopy to reduce intubation response.

6. Anti-shivering property. (Dexmedetomidine acts as anti-shivering agent by binding to  $\alpha_2$  receptors, thus mediate vasoconstriction and acts as anti-shivering agent. Dexmedetomidine reduces vasoconstriction and shivering threshold by acting on central thermoregulatory mechanisms rather than peripheral neurotransmitter.)
7. As an adjuvant to spinal Anaesthesia and peripheral nerve blocks.

***ADVERSE EFFECTS:***

- 1) Bradycardia
- 2) Sinus arrest.
- 3) Hypotension.
- 4) Transient hypertension.
- 5) Hypoxia
- 6) Nausea and vomiting.
- 7) Anemia
- 8) Atrial fibrillations
- 9) Fever, tachycardia.
- 10) Headache, agitation and nervousness (occurs if the drug is used for more than 24 hours.)

***CONTRAINDICATIONS:***

- 1) Drug hypersensitivity
- 2) Cardiac dysfunction (mainly left ventricular dysfunction mainly)
- 3) Advanced cardiac blocks.
- 4) Shock/ hypovolemia.

## **METHODOLOGY**

Title: “Comparative evaluation of post operative analgesic efficacy of ultrasound guided erector spinae block and ultrasound guided paravertebral block in patients undergoing lower abdominal surgeries under spinal anaesthesia: one-year randomised control study.”

Type of Study: A one-year Randomised Control Trial

Source of Data: Patients between the years 18-65, of both genders, of ASA grading I and II, undergoing elective lower abdominal surgery following spinal anaesthesia at KLE’s Dr. Prabhakar Kore Hospital and Medical Research Centre, Nehru Nagar, Belagavi -10.

Study Design: Hospital based clinical study

Duration: March 2023 to April 2024

Study population: Adult population scheduled for surgical procedures on the lower abdomen following spinal anaesthesia at KLE’s Dr Prabhakar Kore Hospital and Medical Research Centre, Nehru Nagar, Belagavi- 590010 between March 2023 and February 2024 were recruited as per inclusion and exclusion criteria.

Sample size: 60 patients total

Sampling procedure: A one-year randomized control study. Randomization was achieved by computer generated randomization chart.

Sample Size: Using the mean and standard deviation as a basis, the minimum sample size formula is

$$n = \frac{(z_{\alpha} + z_{\beta})^2 (s_1^2 + s_2^2)}{(\bar{X}_1 - \bar{X}_2)^2}$$

where  $z_{\alpha}$  and  $z_{\beta}$  are related to tests significance level and linked to power of the test respectively. At the 5% significance level,  $z_{\alpha} = 1.96$  and  $z_{\beta} = 0.84$  correspond to 80% power of test

Ref: Comparison of the efficacy of ultrasound-guided paravertebral block versus erector spinae plane block for postoperative analgesia in modified radical mastectomy, by Shilpi Agarwal, et al.

The parameter considered in the calculation is the cumulative 24-hour opioid consumption after surgery

$\bar{X}_1$  is mean of first group (25.7),  $\bar{X}_2$  the mean of second group (34.0).

$s_1$ - standard deviation of first group (2.0) and  $s_2$ - standard deviation of the second group (14.0).

With the above values, sample size generated was 23.

To round off, the sample size was increased to 25

To strengthen the study, there will be two groups, each with thirty.

**Inclusion Criteria:**

- ASA I and II
- Age range: 18- 65 years
- Undergoing elective lower abdominal surgeries under subarachnoid block
- Consent given by the patients for the procedure

**8.7: Exclusion Criteria:**

- Anaphylactic reactions to local anaesthetics in the past.
- Infection at the injection site
- Are taking analgesics for chronic illness or have a history of substance abuse.
- Morbid obesity (BMI >40)

**Ethical Clearance:** The approval by the Institutional Ethical and Research Committee, Jawaharlal Nehru Medical College, Belagavi, was obtained before commencing the trial.

**Informed Consent:**

Type of research and the intervention being done was explained to all the patients who met the selection criteria.

Prior to enrollment, we acquired written informed consent from each patient.

**Study protocol:**

Following their fulfilment of the inclusion and exclusion requirements and acquisition of informed consent, individuals were selected in random and assigned into two categories with the assistance of randomization using computer generated random number table.

**Group A:** Received Erector Spinae Block

**Group B:** Received Paravertebral Block

A thorough pre anaesthetic evaluation was performed on the day prior to the procedure and patients were advised 8 hours of nil per mouth. Patients received the details of the study's methodology, as well as the possible advantages and disadvantages of PVB and ESP approaches; also they were taught to interpret the Visual Analogue Scale.

On the day of surgery, the nil per mouth status was confirmed and an intravenous cannula was secured using a 18G or 20G IV cannula. The patients were administered INJ ONDANSETRON 4MG intravenously and INJ RANITIDINE 50mg intravenously, in the pre operative period, standard ASA monitors were attached.

Computer-generated random numbers were used for the distribution of the patients into 2 groups, and the respective block were administered in the preparation room. The blocks were administered with the assistance of an experienced anaesthesiologist.

**Group A:** Patients undergoing ultrasound assisted erector spinae block, with administration of 25mcg Dexmedetomidine+ 0.75% (10ml) Ropivacaine on each side in the pre operative period.

**Group B:** Patients undergoing ultrasound assisted paravertebral block, with administration of 25mcg Dexmedetomidine + 0.75% (10ml) Ropivacaine on each side in the pre operative period.

**Erector spinae block:**

High frequency linear probe was positioned at T10 level in the midline over the back in cephalocaudal alignment. The transverse process was identified by moving the probe laterally. The ribs appeared thinner and deeper than the transverse process, which was larger and more

superficial. Using an in-plane approach, the 23G Quincke spinal needle was placed above the ultrasound probe, sliding from cephalad to caudal. A tiny bolus of local anaesthetic was administered through the needle when the needle tip was beneath the erector spinae muscle. With bevel of the needle pointing inferiorly and posteriorly it was further introduced under the guidance of ultrasound via the erector spinae muscle and towards the transverse process. It was possible to see the erector spinae muscle detachment from the transverse process. Accurate needle placement was confirmed by this separation from the transverse process. The next step was to inject the local anaesthetic in 5 ml increments, aspirating after each 5 ml to avoid intravascular injection. For the block, 10 ml of 0.75% Ropivacaine and 25 mcg of Dexmedetomidine were utilized for each side.

### **Paravertebral block:**

Group B, with patient lying in prone position. The 10th thoracic vertebra was identified by applying the ultrasonic transducer in the parasagittal plane, about 2.5 cm from the midline to the side. The intended paravertebral space was brought to the centre of the image by adjusting the position of the ultrasound transducer. At the transducer's caudal border, a 23-gauge Quincke spinal needle was placed, and it was then advanced sagittally to the cranial and anterior regions. The superior costotransverse ligament was seen to be the entry point for the needle tip. A thin layer of 25 mcg Dexmedetomidine mixed with 10 ml of 0.75% Ropivacaine was laid directly above the hyperechoic pleural line. The correct injection of local anaesthetic was confirmed by anterior displacement of the underlying pleura.

The patients were moved to the surgical room after getting the block. Baseline vital indicators such as arterial oxygen saturation, blood pressure, and heart rate were recorded on the operation table.

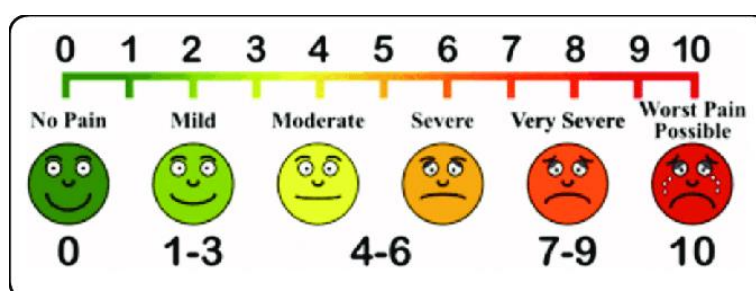
All the patients received sub arachnoid block with 25G Quinckes Spinal Needle at L2-L3 level, 3cc of 0.5 % Hyperbaric Bupivacaine after confirming free clear CSF backflow.

Measuring the length of post-operative analgesia—which is the first time a patient has complained of a VAS >4 after surgery—was the primary objective of the investigation.

Measuring the total amount of rescue analgesic requirement within the 24-hours after the procedure and assessing satisfaction of the subject represents the secondary goals.

The patients VAS scores were monitored in the immediate recovery period and then every hour for 6hrs, followed by every 6<sup>th</sup> hourly for 24hrs.

In either group, Visual Analog Scores



**Figure 21: Visual Analog Scale**

In case patient complaints of pain with a VAS Score of greater than or equal to 4, the First Rescue Analgesic Injection Paracetamol 15mg/kg was intravenously administered. If VAS score remained more than or equal to 4 even after 30minutes of administration of Injection paracetamol a second rescue analgesic, Injection Tramadol 1mg/kg was given intravenously.

First rescue analgesic administration was noted, for a period of 24hrs VAS scores were monitored to assess the number of first and second rescue analgesics the patient received, to assess the total analgesic consumption in 24hr period and hence to compare the efficacy of the two blocks.

Patients were also monitored for complications due to the block like pneumothorax, nerve injury, accidental intrathecal injection of the local anaesthetic following the block

## **STATISTICAL ANALYSIS**

Analysis of the data was done using R version of 4.4.0 and Microsoft. Categorical variables were produced as frequency tables. Mean  $\pm$  SD /Median (Min, Max) were representations of Continuous variables. The relation between categorical variables and groups were done with Chi square test. Shapiro Wilk test and QQ plot was used to check the Normality of variable. If normal distribution is followed by data, parametric tests were used else distribution free tests utilized. For the comparison of mean of variables over groups, the independent t test was utilised. MW-U test determined the distribution of variables over groups P-value= or  $< 0.05$  is statistically significant.

## RESULTS

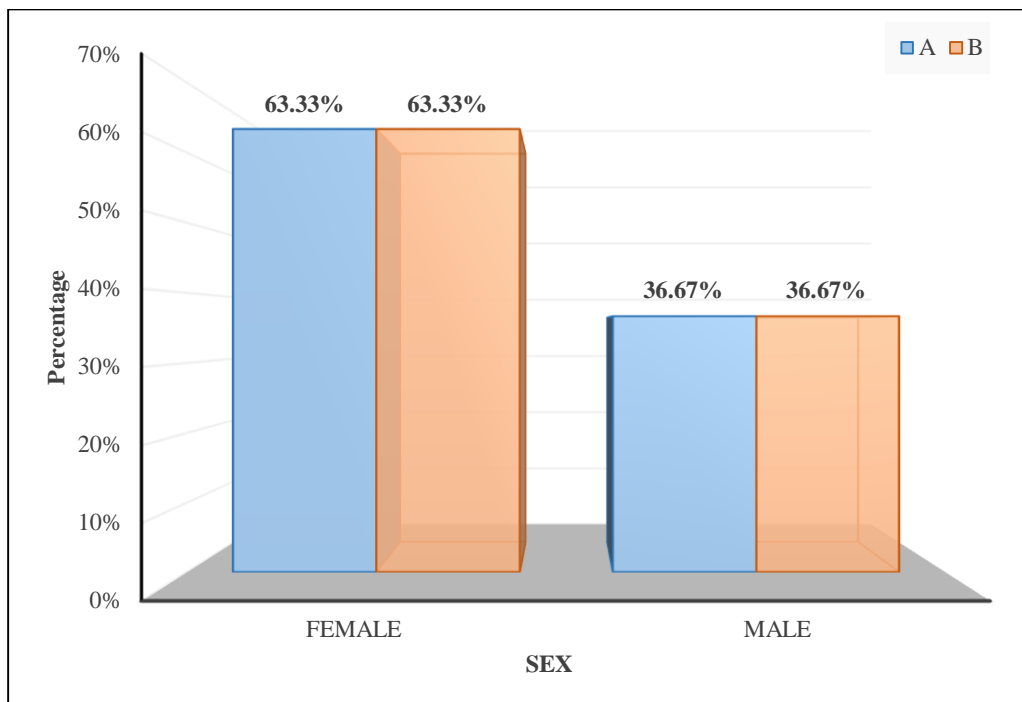
Measurements on 60 subjects, split into two groups of 30 subjects each, are included in the data. The comparison of demographic variables among groups is shown in the following table.

**Table 2: Demographic characteristics**

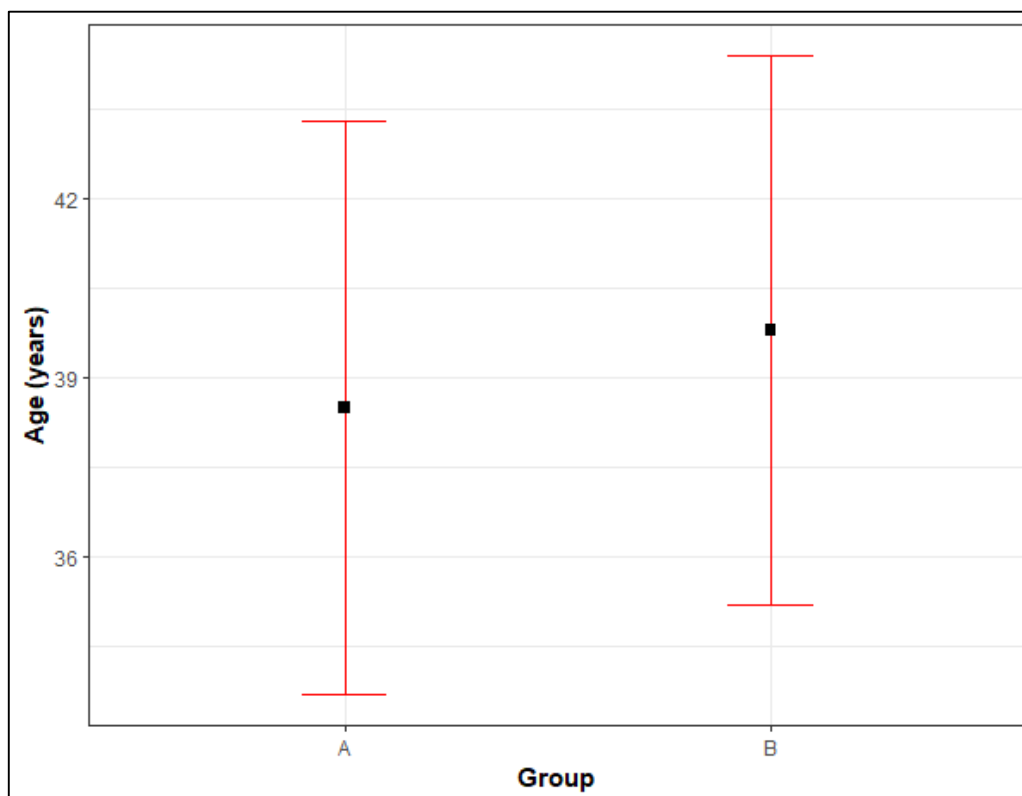
Variables		Groups		Total	p-value
		A	B		
Sex	Female	19 (63.33%)	19 (63.33%)	38 (63.33%)	1 <sup>c</sup>
	Male	11 (36.67%)	11 (36.67%)	22 (36.67%)	
Age (years)	Mean $\pm$ SD	38.53 $\pm$ 12.83	39.8 $\pm$ 12.4	39.17 $\pm$ 12.52	0.6988 <sup>t</sup>
	Median (Min, Max)	35.5 (19, 60)	39.5 (19, 60)	37.5 (19, 60)	

No discernible variation in the distribution of sex was observed using Chi square test. Specifically, both groups have an identical distribution of sex, with 63.33% of participants being female and 36.67% being male.

Group A has a mean age of 38.53  $\pm$  12.83 years, while Group B has a mean age of 39.8  $\pm$  12.4 years. Two sample t test noted no notable variation in mean ages among trail subjects.



**Graph 1: Distribution of sex**



**Graph 2: Mean plot of age over groups**

**Table 3: Patient parameters**

Variables	Sub Category	Groups		Total	p-value
		A	B		
Weight (Kg)	Mean $\pm$ SD	66.07 $\pm$ 11.28	69.5 $\pm$ 9.38	67.78 $\pm$ 10.43	0.2050 <sup>t</sup>
	Median (Min, Max)	65 (45, 90)	70 (45, 85)	70 (45, 90)	
PR (BPM)	Mean $\pm$ SD	70 $\pm$ 9.56	71.83 $\pm$ 8.98	70.92 $\pm$ 9.24	0.3468 <sup>MW</sup>
	Median (Min, Max)	70 (59, 90)	70 (59, 90)	70 (59, 90)	
SBP	Mean $\pm$ SD	132.33 $\pm$ 9.35	131.1 $\pm$ 6.98	131.72 $\pm$ 8.21	0.2317 <sup>MW</sup>
	Median (Min, Max)	130 (110, 140)	130 (110, 140)	130 (110, 140)	
DBP	Mean $\pm$ SD	74.33 $\pm$ 8.58	72.3 $\pm$ 6.28	73.32 $\pm$ 7.53	0.3560 <sup>MW</sup>
	Median (Min, Max)	70 (60, 90)	70 (60, 90)	70 (60, 90)	
ASA	1	25 (83.33%)	23 (76.67%)	48 (80%)	0.5186 <sup>C</sup>
	2	5 (16.67%)	7 (23.33%)	12 (20%)	

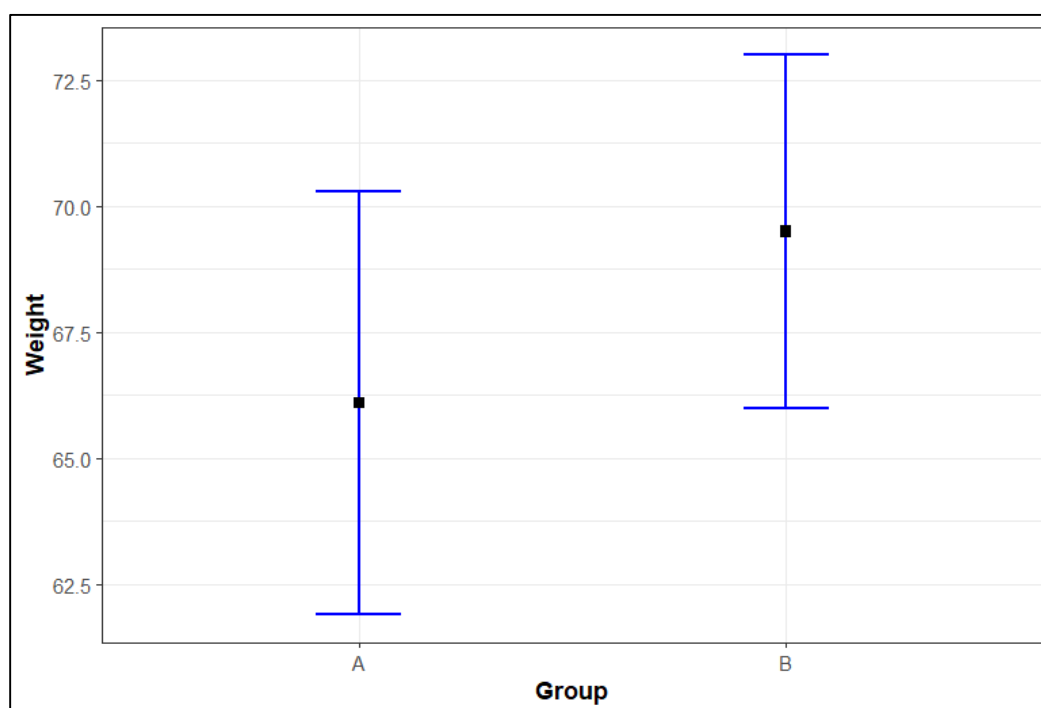
Mean weight of patients in Group A is 66.07  $\pm$  11.28 kg, while in Group B it is 69.5  $\pm$  9.38 kg. However, as per two-sample t-test, no notable distinction in mean weight between the two groups.

Regarding Pulse Rate (PR), Group A has a mean of 70  $\pm$  9.56 BPM, whereas Group B shows a slightly higher mean of 71.83  $\pm$  8.98 BPM. Despite this difference, the Mann-Whitney U test indicates no noteworthy distinction in PR distribution among subjects.

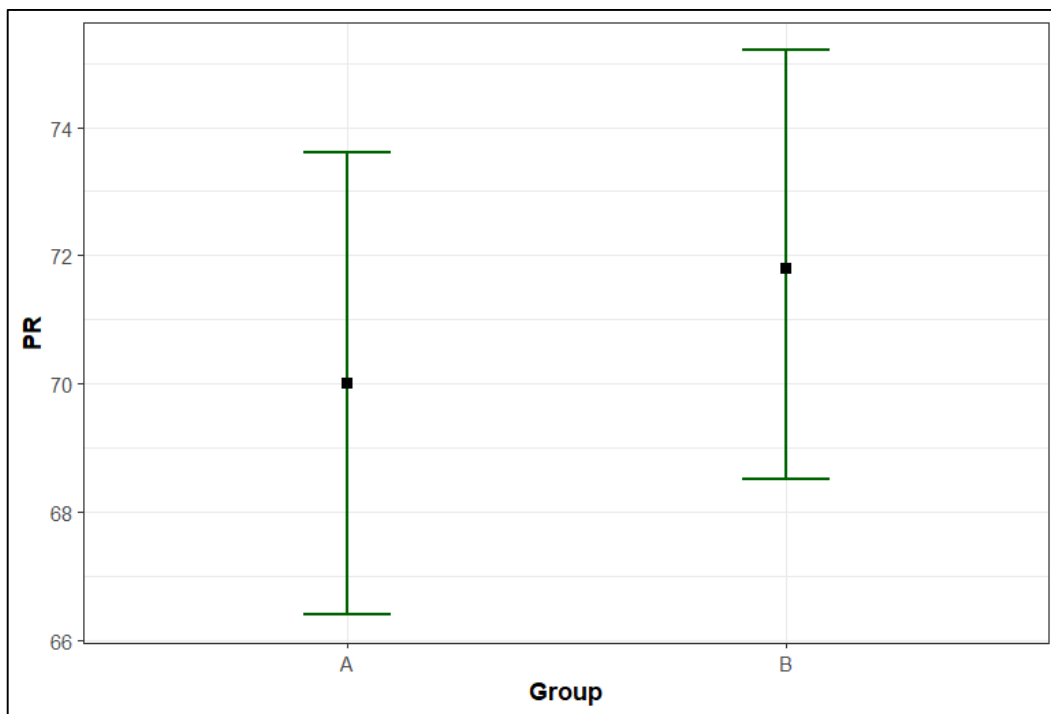
Similarly, in terms of Systolic Blood Pressure (SBP), Group A has a mean of  $132.33 \pm 9.35$  mmHg, while Group B has a slightly lower mean of  $131.1 \pm 6.98$  mmHg. However, the Mann-Whitney U test does not reveal any distinct change in SBP distribution among subjects.

Furthermore, the analysis of Diastolic Blood Pressure (DBP) shows that Group A has a mean of  $74.33 \pm 8.58$  mmHg, whereas Group B has a mean of  $72.3 \pm 6.28$  mmHg. Again, the Mann-Whitney U test indicates no distinct difference of DBP values among subjects.

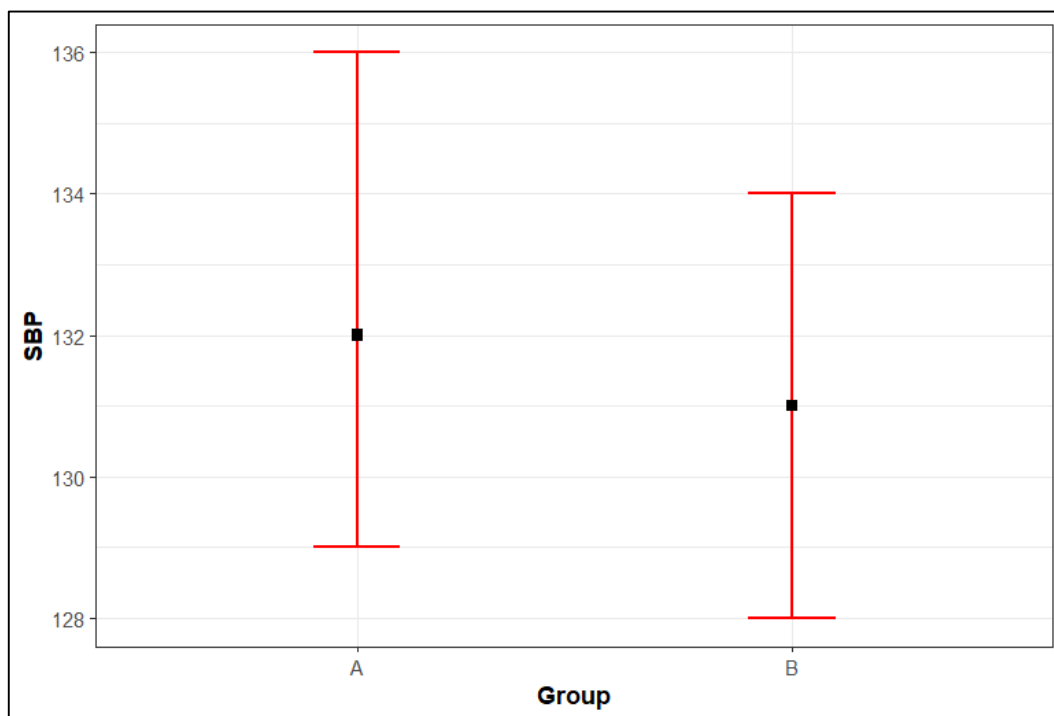
In ASA class 1, there are 25 individuals belonging to group A (83.33%) and 23 individuals who belong to group B (76.67%). For ASA class 2- 5 in group A (16.67%) and 7 in group B (23.33%). The data indicates that most subjects in either group fall under ASA 1 classification, with a smaller proportion in the ASA 2 category. No statistically discernible distinction found in ASA classification using Chi square test.



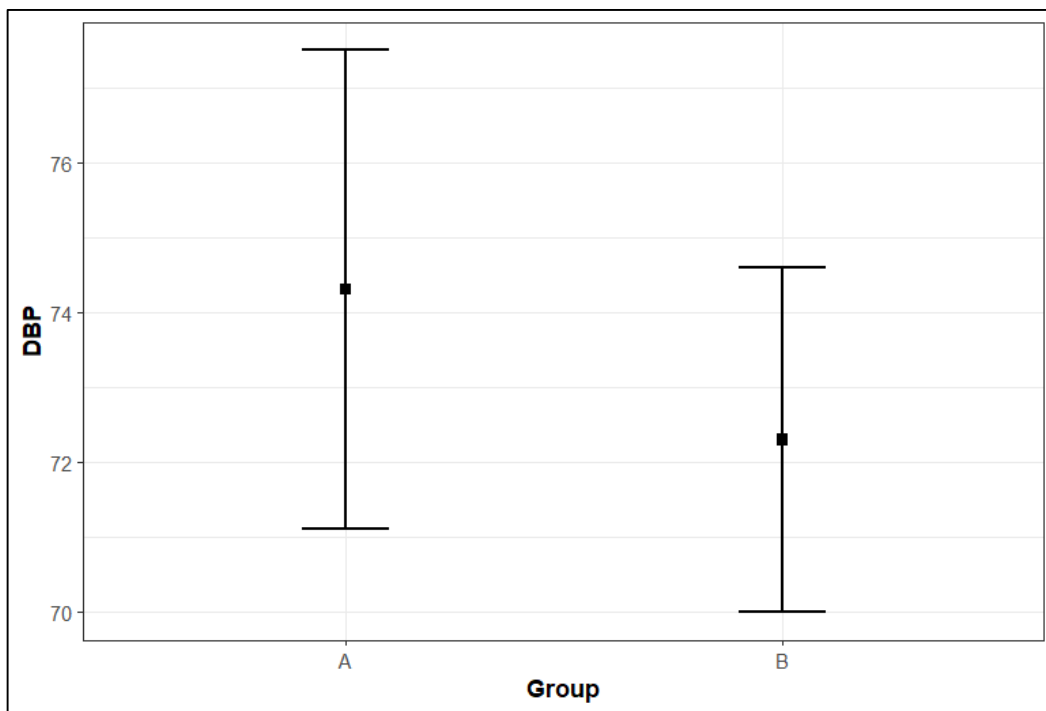
**Graph 3: Mean plot of weight over groups**



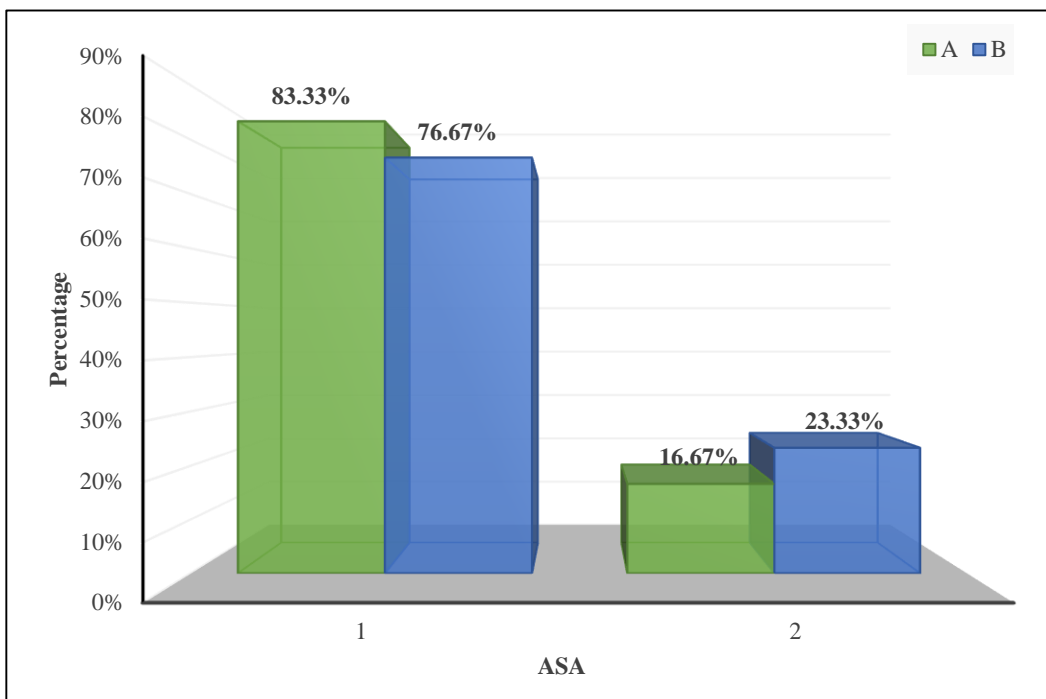
**Graph 4: Pulse Rate**



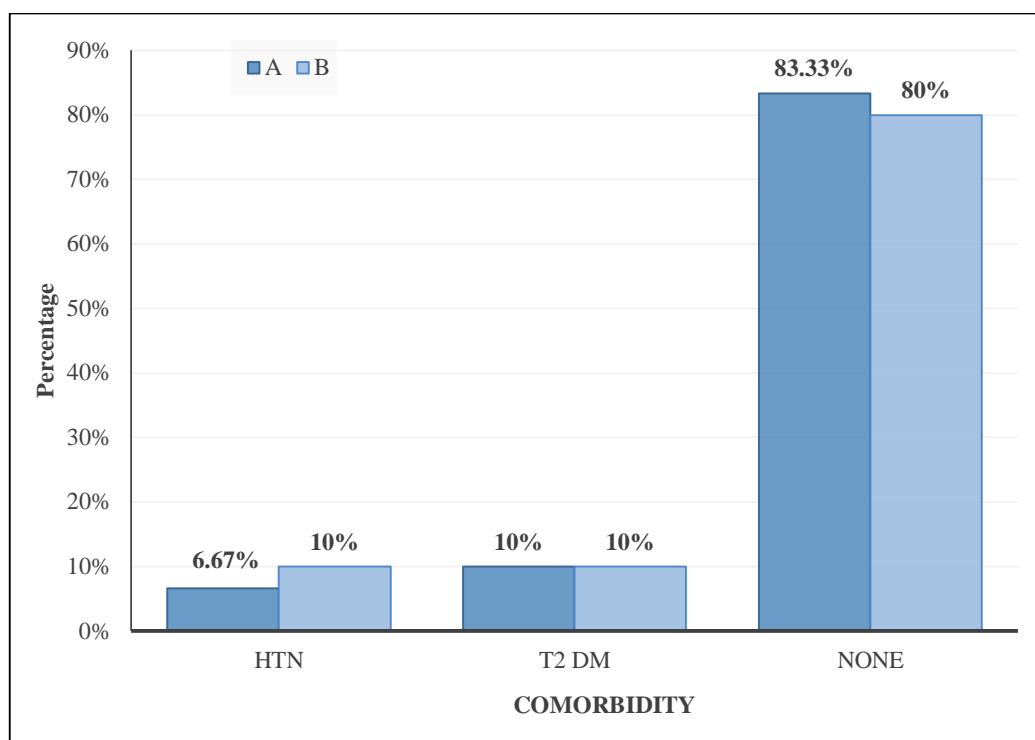
**Graph 5: Mean plot of SBP over groups**



**Graph 6: Mean plot of DBP over groups**



**Graph 7: Distribution of ASA over groups**



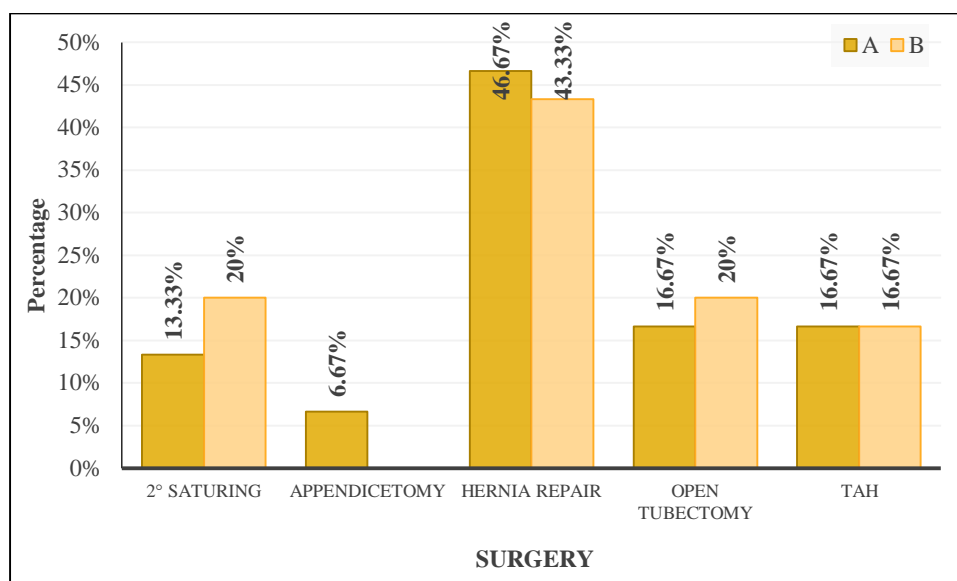
**Graph 8: Distribution of comorbidities over groups.**

**Table 4: surgical performed**

Variables	Sub Category	Groups		Total	p-value
		A	B		
Surgery	2° Suturing	4 (13.33%)	6 (20%)	10 (16.67%)	0.7231 <sup>MC</sup>
	Appendicectomy	2 (6.67%)	(0%)	2 (3.33%)	
	Hernia repair	14 (46.67%)	13 (43.33%)	27 (45%)	
	Open tubectomy	5 (16.67%)	6 (20%)	11 (18.33%)	
	TAH	5 (16.67%)	5 (16.67%)	10 (16.67%)	

“Abbreviation: C – Chi Square test, MC – Chi square test with Monte Carlo simulation.”

From Chi square test, it is noted that the distribution of surgical operations done and anaesthetic techniques used between groups does not significantly differ from one another.



**Graph 9: Distribution of surgery performed over groups.**

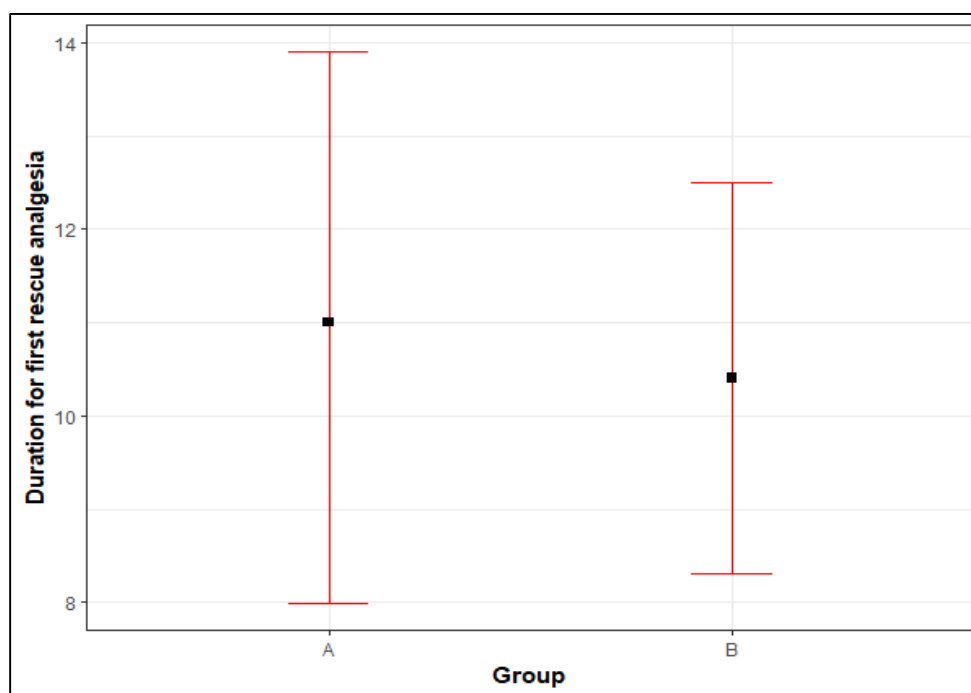
The comparison of initial rescue analgesia duration among groups is shown in the following table.

**Table 5: Duration for initial rescue analgesia**

Variables	Sub Category	Groups		Total	p-value
		A	B		
Duration for first rescue analgesia	Mean $\pm$ SD	10.97 $\pm$ 7.98	10.4 $\pm$ 5.59	10.68 $\pm$ 6.84	0.7230 <sup>MW</sup>
	Median (Min, Max)	6 (2, 24)	12 (3, 24)	12 (2, 24)	

*Abbreviation: MW – Mann Whitney U test.*

The first rescue analgesia took  $10.97 \pm 7.98$  hours on average in Group A, with a range of 2 to 24 hours and a median of 6 hours. Conversely, Group B displays a somewhat reduced average duration of  $10.4 \pm 5.59$  hours, encompassing a range of 3 to 24 hours and a median of 12 hours. But according to the MW-U test, distribution of initial rescue analgesia's duration does not differ significantly.



**Graph 10: Mean plot of Duration for first rescue analgesia over groups**

The comparison of VAS Scores and Additional Analgesia consumption among groups is shown in the following table.

**Table 6: VAS Scores and Additional Analgesics**

Variables		Groups		Total	p-value
		A	B		
VAS 30min after first rescue analgesia	<4	25 (83.33%)	24 (80%)	49 (81.67%)	0.7386 <sup>C</sup>
	>4	5 (16.67%)	6 (20%)	11 (18.33%)	
If VAS>4, 2nd RAA	No	25 (83.33%)	24 (80%)	49 (81.67%)	0.7386 <sup>C</sup>
	Yes	5 (16.67%)	6 (20%)	11 (18.33%)	

Abbreviation: C – Chi Square test.

The majority individuals of both Group A and Group B had VAS values of less than 4, with 83.33% in Group A and 80% in Group B falling into this group. These scores were obtained 30 minutes after the initial rescue analgesia. Nevertheless, the distribution of VAS scores among groups does not differ significantly, according to the Chi square test. Moreover, in situations when the VAS score was higher than 4, the percentage of patients in both groups who received a second round of rescue analgesia (RAA) was comparable. More specifically, while most subjects did not require further analgesia in either group, 16.67% of subjects in Group A and 20% subjects belonging to Group B required a second RAA. But according to the Chi square test,

The following table gives the comparison of first and second rescue analgesia consumption across groups.

**Table 7: Duration for first and second rescue analgesia**

Variables		Groups		Total	p-value
		A	B		
First rescue analgesia	0	6 (20%)	2 (6.67%)	8 (13.33%)	0.0805 <sup>MC</sup>
	1	7 (23.33%)	15 (50%)	22 (36.67%)	
	2	14 (46.67%)	8 (26.67%)	22 (36.67%)	
	3	3 (10%)	5 (16.67%)	8 (13.33%)	
Second rescue analgesia	0	25 (83.33%)	24 (80%)	49 (81.67%)	0.7386 <sup>C</sup>
	1	5 (16.67%)	6 (20%)	11 (18.33%)	

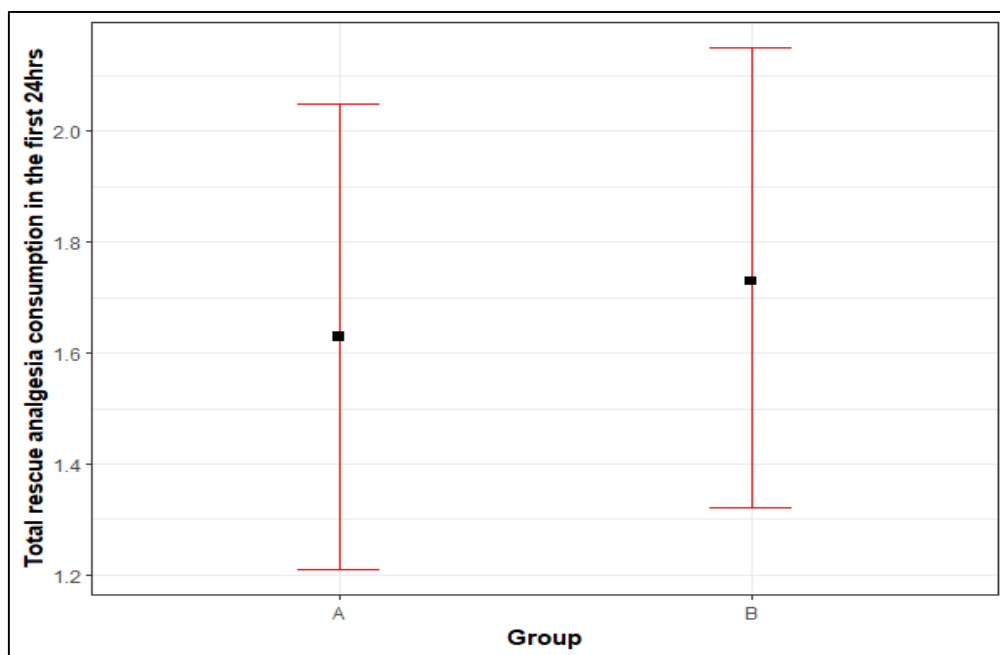
Within Group A, 23.33% got single dosage, 46.67% got two doses, 10% got three doses, and 20% had no initial rescue analgesia. Group B, on the other hand, saw 16.77% receive three doses, 50% receive one dose, 26.67% receive two doses, and 6.67% receive no initial rescue analgesia. Chi square test showed no discernible variation in distribution of first rescue analgesia consumption across subjects despite differences

Between 83.33% and 80% of subjects in Group A and Group B, respectively, the majority did not need a second rescue analgesic. The remaining patients, 16.67% in Group A and 20% in Group B, received single dose. Among the subjects the distribution of second rescue analgesia consumption wasn't notably distinct.

**Table 8: Total rescue analgesia consumption in the first 24hrs**

Variables		Groups		Total	p-value
		A	B		
Total rescue analgesia consumption in the first 24hrs	Mean $\pm$ SD	1.63 $\pm$ 1.13	1.73 $\pm$ 1.11	1.68 $\pm$ 1.11	0.8597 <sup>M</sup> <sub>W</sub>
	Median (Min, Max)	2 (0, 4)	1 (0, 4)	1.5 (0, 4)	

With a median of two doses and a range from 0 to 4 doses, Group A's mean total rescue analgesia intake in the first 24 hours is 1.63  $\pm$  1.13 doses. On the other hand, Group B has a marginally higher mean total rescue analgesia consumption of 1.73  $\pm$  1.11 doses, with a range of 0 to 4 doses and a median of 1. In spite of these differences, the distribution of total amount of rescue analgesia consumed as per the initial 24-hour period was not statistically noteworthy as per MW-U test among the two sets.



**Graph 11: Mean plot of total rescue analgesia consumption in the first 24hrs.**

## **DISCUSSION**

The intent of the current trial was to contrast the outcomes of bilateral ultrasound-assisted ESPB and PVB in the treatment of pain in the post-operative period in patients who underwent elective surgeries of the lower abdomen under spinal anaesthesia, as well as demand for rescue analgesics within the initial 24 hours following surgery.

While USG provides dynamic imaging, anaesthesiologists may watch in real time how the local anaesthetic spreads around the nerve. This input makes it possible to make modifications during the process, guaranteeing the anaesthetic's ideal distribution and boosting the block's efficacy.

In the current study, the analysis of demographic data between two groups of thirty patients each showed that the mean age and gender distribution did not vary in a significant manner. There were equal number of men (36.67%) and women (63.33%) in both groups, and their mean ages (38.53 years for Group A and 39.8 years for Group B) were comparable. Overall, the analysis indicates that there wasn't significant statistical variation between these two groups' mean ages, gender distributions. No statistically discernible differences were noted in parameters such as mean weight, pulse rate, SBP and DBP (t-tests and Mann-Whitney U tests). Furthermore, there is no apparent disparity in the ASA classification distribution between the groups. The research indicates that the above features are comparable among, Groups A and B.

In the present study, all the participants underwent one of the following surgeries of the lower abdomen, which included inguinal hernia repair, appendectomy, secondary suturing of post LSCS scar, total abdominal hysterectomy and open tubectomy all under spinal anaesthesia and the Chi-square test indicates that there were no notable distinctions between Groups A and

B in view of distribution of surgical operations done. Overall, there were no notable disparities found on clinical parameters or surgical details among Groups A and B.

The current trial compared distribution of the first rescue analgesia (Injection Paracetamol) among Group A and Group B. Despite Group B having slightly shorter mean time period till the demand of first rescue analgesia of 10.4 hours in comparison to Group A having an average length of 10.97 hours, the statistical test (Mann Whitney U test) did not discover a noteworthy distinction between the two sets. This suggests that the observed numerical difference in mean durations may be due to chance rather than a true difference between the groups. Although the data in the present trial did not yield statistically significant findings, we could deduce that patients in group B required first rescue analgesic before group A and that the group receiving PVB complained of pain earlier.

While PVB space is easy to identify with USG, accessing the space is technically difficult and requires training. In research conducted by Zhang JW et al., the preoperative single Thoracic Paravertebral Block using ultrasound guidance as opposed to ESPB for thoracoscopic pulmonary lobectomy had been found effective in alleviating postoperative pain as well as the quantity of postoperative remedial analgesics and perioperative sufentanil. This trial compared the efficacy in post-operative pain management during thoracoscopic lung lobectomy<sup>23</sup>.

In the present study, 20% among Group A and 6.67% among Group B didn't require first rescue analgesia in the initial twenty-four hours. 23.33% in Group A received one dosage of first rescue analgesic in comparison to 50% in Group B. 46.67% in Group A received 2 doses of initial rescue analgesic in contrast to 26.67% in Group B. Finally, 10% of individuals received 3 doses in Group A in comparison to 16.67% in Group B.

The subjects in Group A required lesser initial analgesic in comparison to Group B in terms of the total number of doses. Despite these variations Chi square test showed no discernible difference in the allocation of initial rescue analgesia consumption in the two groups and hence it is not statistically significant. Priya TK et al.'s conducted a trial in patients undergoing spinal anaesthesia for caesarean section assessing the effectiveness of quadratus lumborum block and erector spinae plane block demonstrated no statistically noteworthy distinction in the cumulative fentanyl doses among the two groups during postoperative period.<sup>24</sup>

In the present trial, majority of the subjects in both Group A and B did not require a second rescue analgesic, with 83.33% and 80% respectively falling into this category. The remainder received one dose, with 16.67% in Group A and 20% Group B. There wasn't a noticeable variation in the distribution of consumption of the second rescue analgesic between the groups. The results from both groups suggested no statistically noteworthy disparity in the consumption of rescue analgesia between Groups A and B.

Trial done by Aygun H et al., tested the use of ultrasound-assisted quadratus lumborum block and ultrasound guided Erector Spinae Plane Block for pain relief following laparoscopic cholecystectomy. According to the findings, the average quantity of morphine used within the initial 24 hours was  $3.47 \pm 1.57$  mg for Quadratus lumborum block and  $3.40 \pm 1.42$  mg for ESPB. In terms of pain relief and postoperative opiate requirement, the two blocks were similar.<sup>25</sup>

The current trial, with a median of two doses and a range of 0 to 4 doses, Group A's mean intake of total rescue analgesics, which included administering both Inj Paracetamol, the first rescue analgesic and Inj Tramadol, the second rescue analgesic, was  $1.63 \pm 1.13$  doses in initial twenty-four hours. Group B exhibited a greater average total intake of both the first and

second rescue analgesia ( $1.73 \pm 1.11$  doses) in the initial 24 hours. However, despite accounting for these differences, among the two groups, there was no statistically notable difference detected with reference to the total amount of rescue analgesics consumed within the first 24 hours.

In a research by Wu W et al., patients who underwent uniportal thoracoscopic lobectomy, received either Serratus Anterior Plane Block or ESPB also demonstrated no discernible variation in the requirement for rescue analgesics and an effective reduction in postoperative opioid consumption<sup>26</sup>.

PVB is known to be a challenging block to perform with a steep learning curve and potential for consequences such as pneumothorax.<sup>27</sup> Dualé C et al, conducted a state wide survey in France on the anaesthesiologists' perceptions of obstacles to the use of paravertebral and epidural blocks during thoracic surgery stated that the primary obstacles to the widespread usage of PVB are technical in nature and include things like complexity of the block, risk associated, and time commitment.<sup>28</sup> Furthermore, patients who received PVB reported reduced post-operative morphine intake, according to Wahba et al<sup>29</sup> and Abdel-Halim J. M. K.<sup>30</sup> Additionally, a pooled assessment of 242 individuals that got ESPB revealed that 76% of the cases showed a decrease in opioid consumption.<sup>31</sup>

Due to its prolonged duration of action along with better preservation of motor function and improved safety profile, Ropivacaine stands out as the optimum local anaesthetic in regional anaesthesia and is appropriate for a variety of surgical operations. Early mobility and recuperation are facilitated by its capacity to sustain motor function, which lessens postoperative weakness, and its prolonged pain relief capabilities, thereby lowering the need for frequent administration analgesics like opioids, NSAID's, etc.<sup>5</sup>

Dexmedetomidine a non-opioid, alpha-2 agonist shows promising results as it provides sedation and better postoperative comfort and outcomes without the adverse effects of opioid addiction.<sup>5</sup> In order to address the issue of postoperative pain during a thoracoscopic lobectomy, Yang, J. et al.'s study combining TPVB and ESPB with ropivacaine plus dexmedetomidine found that this combination could delay the onset of postoperative remedial analgesia, lower the amount of sufentanil consumed during the procedure and postoperatively, and also lowering the postoperative NRS score in patients having a thoracoscopic lobectomy.<sup>32</sup> In our study we have administered these two drugs in combination for the regional blocks.

The findings mentioned above prompt several considerations in the discussion. Firstly, the observed differences in the consumption of first rescue analgesia between the groups could stem from various factors, including variations in patient pain perception, surgical procedures performed, or differences in postoperative management protocols. Secondly, while the majority of patients in both groups did not require a second rescue analgesic, the reasons behind the minority who did, could be explored further to optimize pain management strategies.<sup>33</sup>

Moreover, the similarity in the consumption of total rescue analgesia within the initial 24 hours between these two groups suggests that both groups received adequate pain relief postoperatively, as evidenced by the comparable mean values and lack of significant difference. This highlights the effectiveness of the analgesic regimen administered in both groups, contributing to overall patient comfort and satisfaction.

#### **Future prospects could include-**

- To investigate the effectiveness of the block while using various adjuvants and anaesthetics.
- Exploration of ESPB and PVB on the lumbar regions.

In summary, while minor variations exist in the consumption of rescue analgesia between Groups A and B, the overall trends suggest comparable pain management outcomes. Further research could delve into the specific factors influencing individual analgesic requirements to tailor pain management strategies effectively.

## **CONCLUSION**

In conclusion, the effectiveness of analgesia using ultrasound assisted paravertebral block and ultrasound assisted erector spinae plane block after lower abdominal operations are comparable, as is the demand for first rescue analgesia and total analgesic consumption in the initial 24hours post surgery. The trial suggests that both techniques are equally effective in alleviation of pain following surgeries of the lower abdomen.

## **LIMITATIONS**

- The types of surgeries varied - Even though all the surgeries were performed on the lower abdomen, below the umbilical region, the surgical stress caused by each procedure varied. Therefore, the pain experienced by the patients vastly differed from person to person.
- Even though spinal anaesthesia (which was the primary anaesthetic technique) was a confounding factor in this investigation, the study lacked an objective measurement of the spread and the commencement of the block after induction.

## **SUMMARY**

60 cases of American society of Anaesthesiologists physical status I, II who were posted for lower abdominal surgeries were divided randomly into Group A (erector spinae block) and Group B (paravertebral block), by computerised randomisation method. Both groups underwent a block technique using USG and 20cc of a mixture of equal volume ropivacaine 0.75% with 25mcg of dexmedetomidine was used as local anaesthetic

Following parameters were seen in present study-

- With VAS scores  $>4$ , the need for first rescue analgesic in the first 24hr period
- VAS score 30min after administration of the first rescue analgesic
- Total analgesic consumption of the first and second rescue analgesia for the 24hr period, to compare the efficacy of the blocks in the two groups
- In present study the observations are as follows-
  - There is no discernible difference in the groups' initial rescue analgesia length distribution.
  - It is noted that the distribution of additional analgesia across groups does not significantly differ.
  - The study revealed that there was no statistically significant difference between the two groups' distributions of the total amount of rescue analgesia used in the first 24 hours.

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**ANNEXURE-I**

**CONSENT FORM**

I am making a voluntary decision to participate in the study “Comparative evaluation of post operative analgesic efficacy of USG guided erector spinae block and paravertebral block in patients undergoing lower abdominal surgeries under spinal anaesthesia: one year RCT”

My signature below indicates that I have decided to participate and I have read the information provided above or it has been read to me in the language I understand best. I have been given the opportunity to ask questions and they have been answered to my satisfaction.

Name of the participant:

Signature/left thumb impression of the participant:

Name of the witness:

Name of the investigator:

Signature of the investigator:



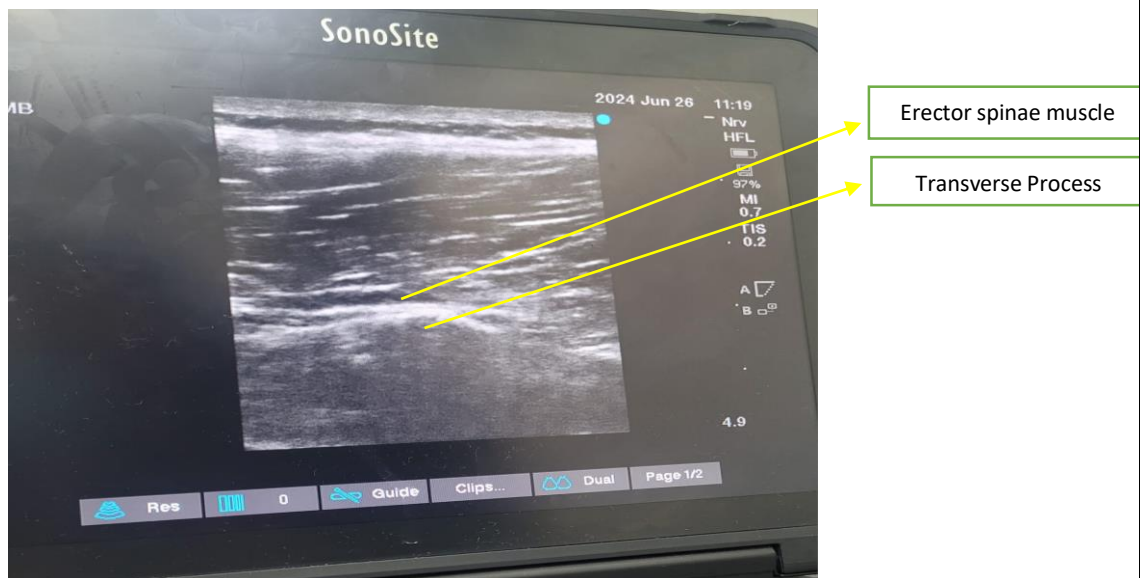


**ANNEXURE-III**

**PHOTOGRAPHS**



PHOTOGRAPH A: Transverse plane Ultrasound image of Paravertebral space



Photograph B: Sagittal plane Ultrasound image of Erector spinae muscle



Photograph C: Linear probe



Photograph D: Sonosite USG machine



Photograph E: 0.75% Ropivacaine vial



Photograph F: Injection Dexmedetomidine



Photograph G: Block Tray



Photograph H: 23G Quinckes spinal needle

ANNEXURE-IV

SlNo	Sex	Age	Weight	Energy Administered	Date of Examination	PK BP	SBP	DBP	ASA	Concomitance	OS	PA	R5	OS	Diagnosis	Surgery	Anesthesia	FRMA	Duration of FRMA	VAS Skin After FRMA	P-A, JMAA	First	Second	Total
1	Female	45	75	8	11.05.23	70	140/70	140	2	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	12.HRS	12	-4	No	0	0	1
2	Female	40	80	8	16.06.23	70	130/70	140	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	16.12.24.HRS	6	-4	No	3	0	3
3	Female	29	80	8	11.07.23	74	140/70	140	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	WOUND DRESSING	2*SAKURING	SAB	12.HRS	12	-4	No	1	0	1
4	Female	19	85	8	12.06.23	69	120/60	130	0	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	WOUND DRESSING	2*SAKURING	SAB	12.HRS	12	-4	No	1	0	1
5	Female	40	75	8	11.06.23	70	140/70	140	0	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	24.HRS	24	-4	No	0	0	0
6	Female	35	65	8	27.08.23	75	140/70	140	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	WOUND DRESSING	2*SAKURING	SAB	12.HRS	12	-4	No	1	0	1
7	Male	35	70	8	11.08.23	65	130/60	130	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	WOUND DRESSING	2*SAKURING	SAB	12.HRS	12	-4	No	1	0	1
8	Male	47	65	8	27.08.23	70	130/70	130	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	WOUND DRESSING	2*SAKURING	SAB	12.HRS	12	-4	No	1	0	1
9	Female	27	65	8	11.08.23	70	130/70	130	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	WOUND DRESSING	2*SAKURING	SAB	24.HRS	24	-4	No	1	0	1
10	Female	45	70	8	11.08.23	60	130/60	130	0	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	5.12.HRS	5	-4	Yes	2	1	3
11	Female	45	80	8	21.12.23	70	140/80	140	0	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	6.12.HRS	6	-4	Yes	2	1	3
12	Female	27	60	8	11.11.23	78	130/70	130	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	12.HRS	12	-4	No	1	0	1
13	Male	45	70	8	21.11.23	65	140/60	140	0	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	WOUND DRESSING	2*SAKURING	SAB	12.HRS	12	-4	No	1	0	1
14	Male	35	70	8	11.01.24	60	130/70	130	2	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	WOUND DRESSING	2*SAKURING	SAB	12.HRS	12	-4	No	1	0	1
15	Male	45	75	8	12.03.24	59	130/70	130	2	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	6.12.HRS	6	-4	No	2	0	2
16	Female	24	60	8	11.08.23	70	140/70	130	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	12.HRS	12	-4	No	1	0	1
17	Female	35	45	8	10.09.22	70	140/70	140	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	5.12.24.HRS	5	-4	No	3	0	3
18	Female	25	50	8	11.01.23	60	110/70	110	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	WOUND DRESSING	2*SAKURING	SAB	24.HRS	24	-4	No	0	0	0
19	Female	59	65	8	07.07.22	70	130/70	130	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	6.HRS	6	-4	No	0	0	0
20	Female	54	70	8	27.12.22	60	130/70	130	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	WOUND DRESSING	2*SAKURING	SAB	3.12.HRS	3	-4	Yes	2	1	3
21	Male	55	70	8	01.06.23	65	130/70	130	2	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	5.12.24.HRS	5	-4	Yes	2	1	3
22	Male	60	85	8	08.07.23	60	130/80	130	0	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	12.24.HRS	12	-4	No	2	0	2
23	Female	20	80	8	08.06.23	65	130/70	130	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	16.12.HRS	6	-4	No	2	0	2
24	Male	60	80	8	16.06.23	70	130/70	130	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	6.12.HRS	6	-4	Yes	2	0	2
25	Female	37	55	8	19.06.23	60	130/70	130	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	WOUND DRESSING	2*SAKURING	SAB	12.HRS	12	-4	No	1	0	1
26	Male	35	70	8	17.06.23	60	130/70	130	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	6.12.24.HRS	6	-4	No	3	0	3
27	Male	60	70	8	15.01.23	60	140/70	140	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	5.12.HRS	5	-4	No	2	0	2
28	Female	32	60	8	27.12.23	79	140/70	140	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	WOUND DRESSING	2*SAKURING	SAB	24.HRS	24	-4	No	0	0	0
29	Female	21	60	8	18.12.22	69	140/70	140	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	WOUND DRESSING	2*SAKURING	SAB	12.HRS	12	-4	No	1	0	1
30	Male	38	55	8	01.01.23	60	130/70	130	2	DM+	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	12.24.HRS	12	-4	No	2	1	3
31	Male	38	83	8	07.12.22	70	140/80	140	0	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	24.HRS	24	-4	No	0	0	0
32	Female	34	70	8	16.12.22	65	140/70	140	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	24.HRS	24	-4	No	0	0	0
33	Female	29	60	8	06.01.23	59	120/70	110	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	24.HRS	24	-4	No	0	0	0
34	Male	29	60	8	06.01.23	59	120/70	110	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	24.HRS	24	-4	No	0	0	0
35	Male	38	75	8	11.06.23	65	140/70	140	2	TYPE 2 DM A/R	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	4.12.HRS	4	-4	No	2	0	2
36	Female	30	60	8	26.09.22	75	130/70	130	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	24.HRS	24	-4	No	0	0	0
37	Female	47	80	8	27.12.22	70	140/80	140	0	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	3.12.HRS	3	-4	Yes	2	1	3
38	Female	33	65	8	11.06.23	60	130/60	130	0	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	6.12.24.HRS	6	-4	No	3	0	3
39	Male	60	70	8	01.01.23	60	130/70	130	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	16.12.HRS	6	-4	No	2	0	2
40	Male	50	80	8	01.01.23	70	140/80	140	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	16.12.HRS	6	-4	No	2	0	2
41	Male	60	60	8	16.09.22	70	130/70	130	2	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	2.12.24.HRS	2	-4	No	3	0	3
42	Male	31	65	8	11.12.22	70	140/80	140	0	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	6.HRS	6	-4	No	1	0	1
43	Female	25	65	8	11.12.22	70	140/70	140	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	6.12.HRS	6	-4	Yes	2	1	3
44	Female	46	50	8	21.12.22	70	140/70	140	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	16.12.HRS	6	-4	No	2	0	2
45	Female	28	50	8	16.01.23	60	110/70	110	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	12.HRS	12	-4	No	1	0	1
46	Female	27	50	8	05.07.22	65	130/70	130	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	2.12.HRS	2	-4	Yes	2	1	3
47	Female	33	65	8	14.01.23	70	110/70	110	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	12.24.HRS	12	-4	No	2	0	2
48	Male	19	68	8	16.09.22	65	120/60	120	0	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	12.HRS	12	-4	No	1	0	1
49	Male	27	80	8	21.07.23	60	140/70	140	1	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	24.HRS	24	-4	No	0	0	0
50	Female	48	80	8	21.12.22	70	130/70	130	2	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	24.HRS	24	-4	No	0	0	0
51	Female	15	65	8	16.12.22	60	140/60	140	0	72 DM ON TREATMENT	S1S1+	SOFT NON TENDER	BL.A.R. V.WBS+	CONSCIOUS ORIENTED	PH1 A1 for tubectomy	Open tubectomy	SAB	2.12.HRS	2	-4	Yes	2	0	2
52	Female	45	58	8	16.09.22	60	130/60																	

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