"COMPARISON OF DURATION OF POSTOPERATIVE ANALGESIA OF ULTRASOUND GUIDED QUADRATUS LUMBORUM BLOCK VS TRANSVERSUS ABDOMINIS PLANE BLOCK USING 0.25% BUPIVACAINE IN LAPAROSCOPIC SURGERIES – A ONE YEAR HOSPITAL BASED RANDOMISED CLINICAL TRIAL"

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LIST OF ABBREVIATIONS USED

ASA	-	American society of Anaesthesiologists
CNS	-	Central nervous system
CO_2	-	Carbon dioxide
CVS	-	Cardiovascular system
DBP	-	Diastolic blood pressure
DPQ	-	Dartmouth Pain Questionnairre
ECG	-	Electrocardiography
Etco2	-	End tidal carbon dioxide
FLACC	-	Face, Legs, Activity, Cry, Consolability scale
GIT	-	Gastrointestinal tract
Hb	-	Haemoglobin
hr	-	Hour
HR	-	Heart rate
hrs	-	Hours
HS	-	Highly Significant
Hz	-	Hertz
ILN/IHN	-	Ilioinguinal nerve/ Ilio-hypogastric nerve
Inj.	-	Injection
IP	-	In plane technique
IV	-	Intravenous
Kgs	-	Kilograms
L	-	Liters
Mcg	-	Micrograms
Mg	-	Milligrams

MHz	-	Megahertz
min	-	Minutes
Mins	-	Minutes
Ml	-	Milliliters
MPG	-	Mallampati Grading
MPQ	-	McGill Pain Questionnairre
N_2O	-	Nitrous Oxide
NIBP	-	Non-Invasive Blood Pressure
NS	-	Nociceptive specific
NS	-	Not Significant
NSAIDs	-	Non steroidal anti-inflammatory drugs
O_2	-	Oxygen
OOP	–	Out of plane technique
PAE	-	Pre-anesthetic Evaluation
PONV	-	Postoperative Nausea Vomiting
PR	-	Pulse rate
QL	-	Quadratus lumborum
QLB	-	Quadratus lumborum block
QoR-40	-	Quality of recovery - 40
RBS	-	Random blood sugar
RR	-	Respiratory rate
RS	-	Respiratory system
S	-	Significant
SBP	-	Systolic blood pressure
SPO_2	-	Saturation percentage of oxygen

Sr	-	Serum
TAP	-	Transversus Abdominis Plane
TAPB	-	Transversus Abdominis Plane block
Temp	-	Temperature
TLC	-	Total Leucocyte count
USG	-	Ultrasonography
VAS	-	Visual Analogue Scale
VS	-	Very Significant
WDR	-	Wide Dynamic Range
WHYPQ	-	West Haven – Yale Pain Questionnairre
α	-	Alpha
β	-	Beta
µg	-	Micrograms

ABSTRACT

Background: Laparoscopic surgeries are popular over laparotomy due to its various benefits such as early recovery, less postoperative pain, etc. But they are not completely pain free. Various multimodal analgesia are used such as preemptive analgesia, NSAIDS, opioids, regional anesthesia, peripheral nerve blockade etc. Nowadays, Truncal blocks are more preferred due to its high rates of success with advancement of USG and lesser side effects.

Aims & objectives: To compare the duration of postoperative analgesia of ultrasound guided quadratus lumborum block (QLB) versus transversus abdominis plane (TAPB) block using 0.25% bupivacaine in laparoscopic surgeries based on the VAS scores, changes in HR, BP to identify the postoperative pain and efficacy of the blocks.

Methods: Sixty patients posted for laparoscopic surgeries were randomized into two groups. Routine GA induction was done for patients, baseline vital signs were noted. At the end of surgery before extubation, the blocks were performed. Patients in group 1(n=30) received QLB (type 2) and the patients in group 2 (n=30) received lateral TAPB. Postoperatively, the patients were assessed for postoperative pain at various intervals (0min, 30min, 1hr, 2hr, 4hr, 6hr, 12hr & 24 hrs) with VAS scores, changes in HR and BP. If VAS >3 rescue analgesia 1 gram paracetamol was given.

Results: 30 patients in group 1 (QLB type 2) had a mean VAS score of 2.70±0.70 at 12 hrs and 4.30±0.95 at 24 hrs (p=<0.0001 [HS]). Other 30 patients in group 2 (lateral TAPB) had a mean VAS score of 4.93±1.20 at 12 hrs and 6.57±1.14 at 24 hrs. The mean HR, BP were comparable between both the groups and was statistically significant at the end of 12 hrs and 24 hrs. When comparing both groups in terms of time for the need of rescue analgesia it was 19.52±1.78 hours in group 1 and

10.70±1.26 hours in group 2. This shows that analgesia was more effective and acted longer in QL block than TAP block.

Conclusion: Ultrasound guided QL type 2 block using 0.25% bupivacaine produces a more effective and longer duration of postoperative analgesia when compared to lateral TAP block in patients undergoing laparoscopic surgeries. The mean duration of postoperative analgesia in QLB is around 18-20 hours whereas in TAPB is around 10-12 hours.

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INTRODUCTION

In recent years, Laparoscopic surgeries have gained popularity over laparotomy due to its various benefits such as early recovery, increased patient safety, cost effectiveness and less postoperative pain [1].

But they are not completely pain free. The exact mechanism of pain following laparoscopic surgeries is still not clear. It is believed to be due to various factors such as abdominal wall tissue damage following trocar introduction leading to peripheral nociceptor stimulation, creation of pneumoperitoneum with carbon dioxide insufflation resulting in diaphragmatic irritation, residual pockets of gas in the abdominal cavity, nature of the insufflating gas, etc. [2]

Various multimodalities of analgesia have been tried such as preemptive analgesia, NSAIDS, acetaminophen, oral and intravenous opioids, patient-controlled analgesia, local infiltration of skin and wounds, local intraperitoneal anesthetic infiltration, epidural analgesia, peripheral nerve blockade etc. [3]

Use of regional anesthetic techniques such as nerve blocks remain superior to systemic analgesics in many ways.

Nowadays, peripheral nerve blocks are more preferred due to its high rates of success with advancement of ultrasound guided technique and lesser side effects compared to opioids and other systemic analgesics [4,5].

TAP block [6] inhibits the afferent nerves (sensory) that passes through the muscles of abdomen which controls postoperative incisional and somatic pain. Quadratus lumborum block [6] controls somatic pain as well as visceral pain after abdominal surgeries. These blocks can be given after abdominal laparoscopic surgeries, anterior abdominal wall surgeries, post cesarean deliveries, etc.

Many studies were done to find the effectiveness of Transversus Abdominis Plane block versus Quadratus lumborum block using 0.25% bupivacaine on perioperative control of pain and hemodynamics, quality of recovery, postoperative pain following lower abdominal surgery, post cesarean delivery [13-15].

Many studies [7-10] reveal the efficacy of transversus abdominis plane block for postoperative analgesia following laparoscopic appendicectomy and efficacy of Quadratus lumborum block for postoperative analgesia following laparoscopic cholecystectomy individually.

There are only very few studies exhibiting the effectiveness of TAP block versus QL block for postoperative pain control following laparoscopic surgeries.

Hence, we compared the duration of postoperative analgesia using 0.25% bupivacaine with ultrasound guided TAP block versus QL block in laparoscopic surgeries.

OBJECTIVE

The aim was to compare the duration of postoperative analgesia of ultrasound guided quadratus lumborum block (QLB) versus transversus abdominis plane (TAPB) block using 0.25% bupivacaine in laparoscopic surgeries based on the VAS scores, changes in HR, BP to identify the postoperative pain.

REVIEW OF LITERATURE

Enormous surgical techniques seemed to be evolved recently establishing safety and increasing the quality of life, one such is the laparoscopic surgeries which are popular nowadays [1].

Laparoscopic surgery is used for many including Abdominal surgeries to treat conditions like

- Appendicitis, Crohn's disease, Duodenal Perforation, Ulcerative Colitis, Diverticulitis, Cancer, Rectal Prolapse, and Chronic Constipation.
- Gallbladder procedures.
- Gynecologic surgeries.
- Hernia repairs.

The advantages are less trauma to the tissues, minimal pain, minimal wound complications, enhanced post-operative recovery and short hospital stay. Though laparoscopic surgeries are less painful than conventional techniques, but aren't absolutely pain-free. The reason for pain following laparoscopic surgeries remains unclear and appears to be multifactorial. Insufficient postoperative pain control delays recovery, lengthens the hospital stay and reduced patient satisfaction. Efficient postoperative pain control includes a multimodal approach with various drugs which has distinctive action mechanism. Local anesthetics routinely are used for pain control and anesthesia. They are extensively administered using techniques such as local injection, field blocks, regional nerve blocks or neuraxial blocks [2,3,4].

The specialty of peripheral nerve blockade includes adequate postoperative pain control, reduced opioids consumption, shorter length of hospital stays, less PONV, better patient satisfaction and enhanced recovery following surgery. Opioids are potent analgesics but have decreased margin of safety for postoperative pain

control due to its various side effects like sedation, respiratory depression, nausea, vomiting, hypotension, bradycardia, pruritus, and poor bowel function [5].

Peripheral nerve blockade therapy using local anesthetics remain superior to parental opioids for postoperative pain management. Especially with use of ultrasound guided techniques, blocks are more effective and have higher success rate with lesser chances of accidental intravascular injections [6].

TAP block is a novel locoregional anesthetic technique for postoperative analgesia especially in initial postoperative period. There are a lot of methods but more commonly used is the lateral method. It involves injection of local anesthetic in the fascial plane between the transversus abdominis and internal oblique muscles. The neuro-fascial plane present between internal oblique and transversus abdominal muscle is traversed by intercostal nerves (T7-12), ilioinguinal and ilio-hypogastric nerves (L1). These nerves supply part of parietal peritoneum and skin and muscles of the anterior abdominal wall [6].

QL block is a type of fascial plane block which does not target a single nerve. The mechanism of analgesia and spread of local anesthetics in QL block is still not clear. The quadratus lumborum muscle is encircled in the thoracolumbar fascia which itself forms the anterior layer, the middle layer coming between the quadratus lumborum and erector spinae, the posterior layer which encloses the erector spinae. The anterior layer combines medially with the psoas major fascia and laterally with the transversalis fascia. QLB provides both somatic and visceral analgesia. It usually provides analgesia in T7-L1 dermatomes, to an extent it is believed to spread to T4-T5 cranially and L2-L3 caudally. It results in the blockade of subcostal, ilio-hypogastric, ilioinguinal nerve and, occasionally the genitofemoral and lateral femoral cutaneous nerve. The mechanism behind the block causing wide-spread

analgesia is assumed that the local anesthetic injection in the anterior layer between the quadratus lumborum spreads cephalad under the lateral arcuate ligament to the endothoracic fascia and reaches the lower thoracic paravertebral space which contains a numerous sympathetic fibers and mechanoreceptors. It is of various types here we used the type 2 because studies say that QL2 is more effectual. The target site for injection in QL2 block (quadratus lumborum 2) is a triangular structure called the lumbar inter-fascial triangle (LIFT) [6].

Mc Donnell et al [7], in 2011 did a study titled "The Analgesic Efficacy of Transversus Abdominis Plane Block After Abdominal Surgery: A Prospective Randomized Controlled Trial". It was done to study the TAPB analgesic efficacy following abdominal surgeries for the pain in the initial post-operative 24 hours period in 32 patients. The VAS scores were less at almost all time periods (p=0.05). They found that the TAPB provides better analgesia along with reduced morphine needs in the initial postoperative 24 hours period.

Aveline et al [8], in 2011 did a study titled "Comparison between ultrasound-guided transversus abdominis plane and conventional ilioinguinal/iliohypogastric nerve blocks for day-case open inguinal hernia repair". In 273 patients either USG technique of TAPB or conventional technique of ILN/IHN block was given to analyze the VAS scores for pain in the postoperative period at rest. The results showed lower scores in the TAPB group at 12 h (p= 0.04) and 24 h (p=0.0014). The morphine needs were lower in the TAPB group (p=0.03) in the initial 24 hours postoperative period. The conclusion was that the USG technique of TAPB produces a better control of pain in the postoperative period than the conventional ILN/IHN block.

Carney J et al [9], in 2011 did multiple studies titled "Studies on the spread of local anaesthetic solution in transversus abdominis plane blocks". It was done to find out whether injection site of LA affects the drug spread in the TAPB. They studied that the landmark techniques resulted in anterior spread of LA and USG techniques had posterior spread till the para-vertebral space (T5-L1). Their study says that the TAPB analgesic extent is based on the injection site with the spread pattern inside the plane and the USG technique has higher success.

Kadam V R et al [10], in 2013 did a case series to find out "Ultrasound guided continuous trans-muscular quadratus lumborum block L4 or L2 level catheter insertion for analgesia in open abdominal surgery". It aimed to study the analgesic potency of trans-muscular QLB catheter insertion on the pain effect. In 10 patients posted for open abdominal surgery USG method of trans-muscular QLB was conducted with catheter placed at either L2 or L4 levels to evaluate the mean pain scores in 48 hours postoperative period. They found that QLB catheter placement at both the levels reduced analgesic needs along with reduced pain scores upto 48 hours postoperatively.

De Oliveira et al [11], in 2016 conducted a meta-analysis on "the effect of TAP block compared with a placebo group on postoperative pain outcomes in laparoscopic surgical procedures". It included 10 RCTs with 633 study subjects. They aimed to evaluate postoperative pain early (0-4hrs) and late (up to 24 hrs). The analysis was done to find out the TAPB effect for postoperative pain and revealed saying TAPB is a better strategy for early as well as late pain to reduce opioid needs following laparoscopic procedures.

Murouchi et al [12], in 2016 did a study on "Quadratus Lumborum Block Analgesic Effects and Chronological Ropivacaine Concentrations comparing with lateral TAPB

After Laparoscopic Surgery". The blocks were given using 0.375% ropivacaine on patients before commencement of surgery. The results showed that the duration of QLB analgesia (median duration) was more than 24 hours and a bit longer when compared to the lateral TAPB.

Blanco et al [13], in 2016 conducted a study titled "Quadratus Lumborum Block Versus Transversus Abdominis Plane Block for Postoperative Pain after Cesarean Delivery - A Randomized Controlled Trial". The blocks were given in 76 patients who undergone elective cesarean section accordingly after the surgery using 0.125% bupivacaine. They found QLB category being more effective, also having a significantly lesser morphine needs than TAPB group.

Oksuz et al [14], in 2017 did a study titled "Quadratus Lumborum Block Versus Transversus Abdominis Plane Block in Children Undergoing Low Abdominal Surgery-A Randomized Controlled Trial". Since it was children, they used FLACC scores for pain assessment. They discovered that the children requiring analgesia postoperatively in the first 24 hours was significantly lower in QLB, also the time for first analgesic need was found to be 15 hours in the QLB group and 10 hours in the TAPB group. They concluded saying QLB group had longer and effective analgesia compared to TAPB.

Yousef et al [15], in 2018 did a study titled "Quadratus Lumborum Block versus Transversus Abdominis Plane Block in Patients Undergoing Total Abdominal Hysterectomy: A Randomized Prospective Controlled Trial". In 60 female patients, the blocks were given accordingly to evaluate total morphine needs in 24 hours, VAS for pain (at various intervals), duration of postoperative analgesia, intraoperative fentanyl requirements, need for rescue analgesics. Their evaluation revealed that the fentanyl dosage required intraoperatively was higher in TAPB group, morphine needs

postoperatively in 24 hours was less in QLB group. The duration of analgesia postoperatively was 15.1±2.12 longer in QLB group than the TAPB group (8.33±4hours).

Kumar et al [16], in 2018 did a study titled "A Comparative Study of Transversus Abdominis Plane Block versus Quadratus Lumborum Block for Postoperative Analgesia following Lower Abdominal Surgeries: A Prospective Double-blinded Study". 70 patients were studied with either one of the blocks being given accordingly to find out the time for 1st rescue analgesia and opioids consumption. In QLB patients time for first rescue analgesia was 243.00 ± 97.36 min and in TAPB patients was 447.00 ± 62.52. The conclusion resulted in QLB group having better postoperative pain relief with less opioids consumption.

Kadam V R et al [17], in 2019 did a study titled "Comparison of ultrasound-guided transmuscular quadratus lumborum block catheter technique with surgical pre-peritoneal catheter for postoperative analgesia in abdominal surgery: a randomized controlled trial". The results revealed that the transmuscular QL group had less pain and better pain relief (at rest) in the immediate postoperative period when compared with the pre-peritoneal catheter group.

Dam M et al [18], in 2019 did a study titled "Transmuscular quadratus lumborum block for percutaneous nephrolithotomy reduces opioid consumption and speeds ambulation and discharge from hospital: a single centre randomized controlled trial". It aimed at measuring opioid consumption after surgery, ambulation time and length of hospital stay. The results came out saying opioid needs was less; ambulation time was early with short hospital stay when compared to the control group. It concluded saying that unilateral QLB reduces opioid needs after surgery and promotes early ambulation.

Liu et al [19], in 2020 did a metanalysis on "Quadratus lumborum block versus transversus abdominis plane block for postoperative analgesia in patients undergoing abdominal surgeries: a systematic review and meta-analysis of randomized controlled trials". They analyzed 8 RCTs to find out analgesic efficacy of blocks to determine the better regional technique to manage early postoperative pain. QLB was found to be better technique than TAPB for early postoperative pain as it provided longer effect. QLB also reduced postoperative opioid needs to a markable point than TAPB.

M Kolacz et al [20], in 2020 did a study titled "Transversus abdominis plane block versus quadratus lumborum block type 2 for analgesia in renal transplantation". The purpose was to find the analgesic efficacy of type 2 QLB in comparison with lateral TAPB. It was performed on single side in cadaveric renal transplant. The results of the study demonstrated that the 49 patients in QLB 2 patients used less fentanyl during the initial 24hrs than the 52 patients who received TAP block after surgery. The conclusion of the study that there is a reduction of fentanyl usage in the first 24 h following renal transplantation and higher patient satisfaction in unilateral QLB2 than a unilateral TAPB in regards to postoperative pain.

Huang D et al [21], in 2020 did a study titled "Posteromedial quadratus lumborum block versus transversus abdominal plane block for postoperative analgesia following laparoscopic colorectal surgery: A randomized controlled trial". The blocks were given in 80 patients to find out the pain scores and the need for over-all opioids in the post-operative period for pain. The results showed lower VAS scores in the QLB subjects (n= 38) than the TAPB with statistical significance ($p=<0.006$), also the analgesic satisfaction was high (statistically significant; $p= <0.016$) in QLB group (vs TAPB). The study concluded saying that the USG postero-medial QLB reduced morphine needs with better analgesia than the TAPB.

Okur O et al [22], in 2021 did a study titled "Posterior quadratus lumborum versus transversus abdominis plane block for inguinal hernia repair: a prospective randomized controlled study". It was done in 63 subjects with 3 groups (S-spinal, Q-QLB, T- TAPB) to see whether these blocks are effective for pain as similar to spinal block. Spinal group was not given any analgesics further, Q group were given QLB and T group were given TAPB. The results showed a statistical significance in group Q in terms of VAS at 6 hr and 24 hrs postop (p=<0.01), also showed higher levels in terms of sensory and motor blockade (p=<0.06). They concluded that opioid consumption is lower in QLB also both the blocks are as excellent as spinal for managing postoperative pain.

BASIC SCIENCES

Pain is a complex sensory, emotional, cognitive and behavioral phenomenon. According to the International association for the study of pain as "an unpleasant sensory and emotional experience associated with actual tissue damage, or described in terms of such damage". [35]

The term "nociception" [Latin - noci means harm or injury] is used only to describe the neural response to traumatic or noxious stimuli. Nociceptive pain aims to detect, localize and limit the tissue damage.

Pain can be acute, chronic or even transient. Acute pain is primarily due to nociception and chronic pain may be due to nociception, also it has psychological and behavioural factors.

Acute pain

Acute pain is caused by noxious stimuli due to injury, disease process, or the abnormal function of muscle or viscera. It is self-limited, usually heals within few days to weeks. Failure of resolving acute pain progresses to chronic pain. [38]

Postoperative pain, obstetric pain, post traumatic pain and medical illness like acute pancreatitis are examples of acute pain.

There are two types of acute pain: somatic and visceral pain.

Somatic pain:

Somatic pain is due to nociceptive input arising from skin, subcutaneous tissues, and mucous membranes. It is characterized by being localized and described as sharp, pricking, throbbing or burning sensation.[37]

It is further classified into superficial and deep.

Superficial somatic pain is due to nociceptive input arising from skin, subcutaneous tissues, and mucous membranes. It is well localized and described as a sharp, pricking, throbbing, or burning sensation.

Deep somatic pain arises from muscles, tendons, joints, or bones. It is dull, aching pain and less well localized.[38]

Visceral pain:

Visceral pain is due to nociceptive input arising from internal organ or from the structures covered by the organs. It is dull diffuse pain, which is frequently associated with abnormal sympathetic or parasympathetic activity causing nausea, vomiting, sweating and /or changes in blood pressure or heart rate.

Four subtypes are described: (1) true localized visceral pain, (2) localized parietal pain, (3) referred visceral pain, and (4) referred parietal pain.

Parietal pain is typically sharp and often described as a stabbing sensation that is either localized to the area around the organ or referred to a distant site. The phenomenon of visceral or parietal pain referred to cutaneous areas results from patterns of embryological development and migration of tissues, and the convergence of visceral and somatic afferent input into the central nervous system. Thus, pain associated with disease processes involving the peritoneum or pleura over the central diaphragm is frequently referred to the neck and shoulder, whereas pain from disease processes affecting the parietal surfaces of the peripheral diaphragm is referred to the chest or upper abdominal wall. [38]

Chronic pain

Chronic Pain is the pain that persists beyond the expected time of healing and is usually due to long standing inflammation or neuropathic pain.

Chronic pain can be nociceptive, neuropathic or mixed. This type of pain can last longer even after injury or disease process heals itself, as Pain signals remain active in the nervous system for weeks, months or years. Most common causes of chronic pain include headache, musculoskeletal disorders such as arthritis, back pain, nerve lesions, cancer pain, etc. [38]

Neurophysiology of pain

Pain experience involves a complex neurophysiologic process known as nociception, which includes four distinct components: transduction, transmission, modulation, perception.

Transduction is the process by which noxious stimuli is converted to an electrical impulse in sensory nerve endings. **Transmission** is the conduction of these electrical impulses to the CNS with various nerve connections in the spinal cord and brain. **Modulation** is the process of altering pain transmission it can either inhibitory or excitatory mechanism. **Pain perception** is mediated by thalamus which acts as a central relay station for incoming pain signals. Pain can also be experienced in the absence of these steps. [33]

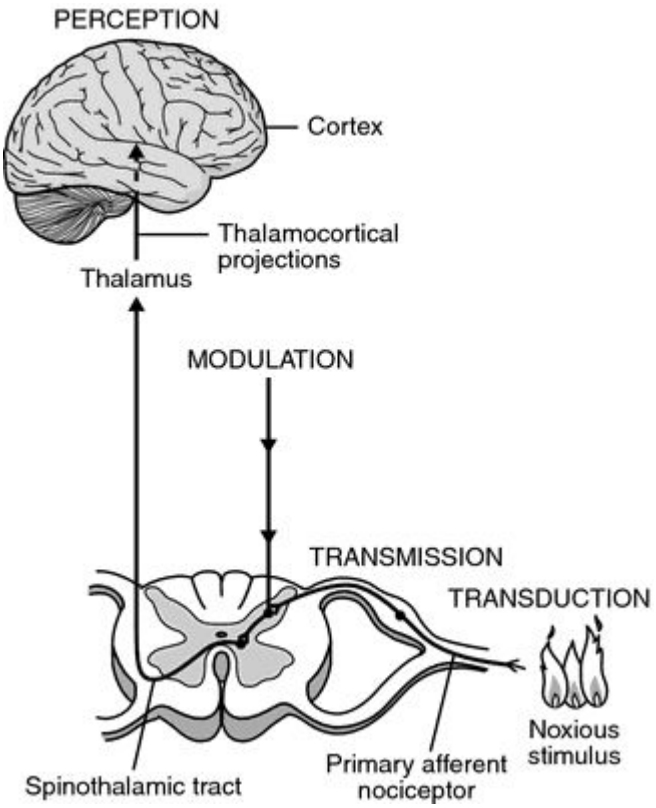


Figure 1: Pain Pathway

Nociceptors (Pain Receptors)

Nociceptors are specialized primary afferents that react to intense, noxious stimuli in skin, muscles, joints, viscera, and vasculature. They generally provide information to the CNS about the site and strength of noxious stimuli. Nociceptors are inactive in normal tissues until they are being stimulated above their resting threshold. 26-29

Types

1) Mechano nociceptors- pinch and pinprick
2) Silent nociceptors – Inflammation
3) Polymodal mechanoheat nociceptors – most prevalent and responds to excessive pressure, extremes of temperature, mechanical and chemical stimuli.

Transmission to the spinal cord

Pain is transmitted from peripheral nociceptors to the spinal cord and higher structures in the CNS involving several pathways, numerous receptors, neurotransmitters, and secondary messengers.

First order neuron

Cell bodies of these neurons are present in the dorsal root ganglion, they are pseudo unipolar neurons and have one axon which divides into a peripheral and central branch. Impulses are transmitted through the axons to the spinal cord.[35-38]

Second order neurons

They carry signals from the spinal cord to the thalamus. Cell bodies of these neurons are present in the Rexed laminae (dorsal horn is anatomically organized in the form of layers or laminae) of the spinal cord, or in the nuclei of the cranial nerves within brainstem.

The unmyelinated C fibers terminate in the most superficial lamina I and II, the thinly myelinated A delta fibers in the lamina I, III to V, whereas collaterals of the large myelinated fibers A beta terminate in lamina III to V. Lamina I and II are known as marginal nucleus and substantia gelatinosa of Rolando respectively. [36,37]

Two predominant types of second order neurons:

- Wide dynamic range (WDR)
- Nociceptive specific (NS)

WDR cells are found in the deeper laminae III to V. They receive inputs from both low threshold A beta and nociceptive A delta and C fibers. These are activated by both inoffensive and noxious stimuli. NS cells are found in the superficial laminae I and II. They respond only to noxious stimuli under physiologic conditions. [36,37]

The axons of both the WDR and NS second order neurons, they cross the midline near the cell bodies form bundles of ascending fibers in the contralateral, anterolateral spinal region and ascend cranially in the spinothalamic to the ventral posterolateral nucleus of the thalamus. [36,37]

Third order neurons

They carry signals from the thalamus to primary sensory cortex. Cell bodies of these are present in ventro-posterolateral area of thalamus. [36-38]

Ascending tracts in the spinal cord, there are two main pathways that carry nociceptive signals to higher centres in the brain. [33,34]

• The spinothalamic tract secondary afferent neurons decussate within a few segments of the level of entry into the spinal cord and ascend in the contralateral spinothalamic tract to nuclei within the thalamus. Third order neurons then ascend to terminate in the somatosensory cortex. There are also projections to the periaqueductal grey matter (PAG). The spinothalamic tract transmits signals that are important for pain localization.

• The spinoreticular tract fibres also decussate and ascend the contralateral cord to reach the brainstem reticular formation, before projecting to the thalamus and hypothalamus. There are many further projections to the cortex. This pathway is involved in the emotional aspects of pain.

In addition to the Aδ and C fibres that carry noxious sensory information, there are primary afferent Aβ fibres that carry non-noxious stimuli. Each of these fibre types possesses different characteristics that allow the transmission of particular types of sensory information.

• Aβ fibres are highly myelinated and of large diameter, therefore allowing rapid signal conduction. They have a low activation threshold and usually respond to light touch and transmit non-noxious stimuli.

• Aδ fibres are lightly myelinated and smaller diameter, and hence conduct more slowly than Aβ fibres. They respond to mechanical and thermal stimuli. They carry rapid, sharp pain and are responsible for the initial reflex response to acute pain.

• C fibres are unmyelinated and are also the smallest type of primary afferent fibre. Hence, they demonstrate the slowest conduction. C fibres are polymodal, responding to chemical, mechanical and thermal stimuli. C fibre activation leads to slow, burning pain.

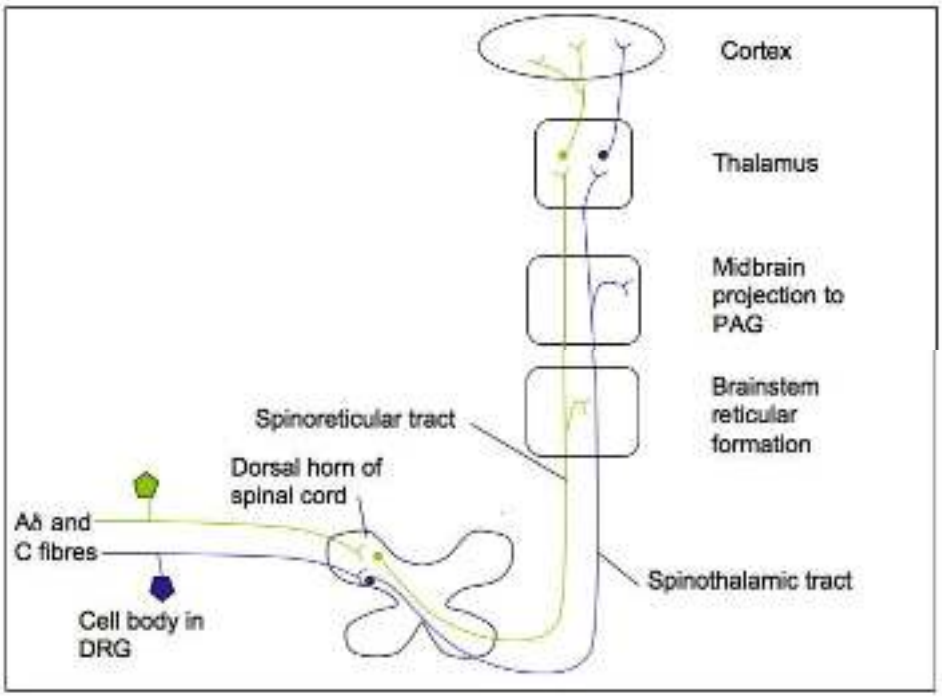


Figure 2: Ascending tracts in the spinal cord.

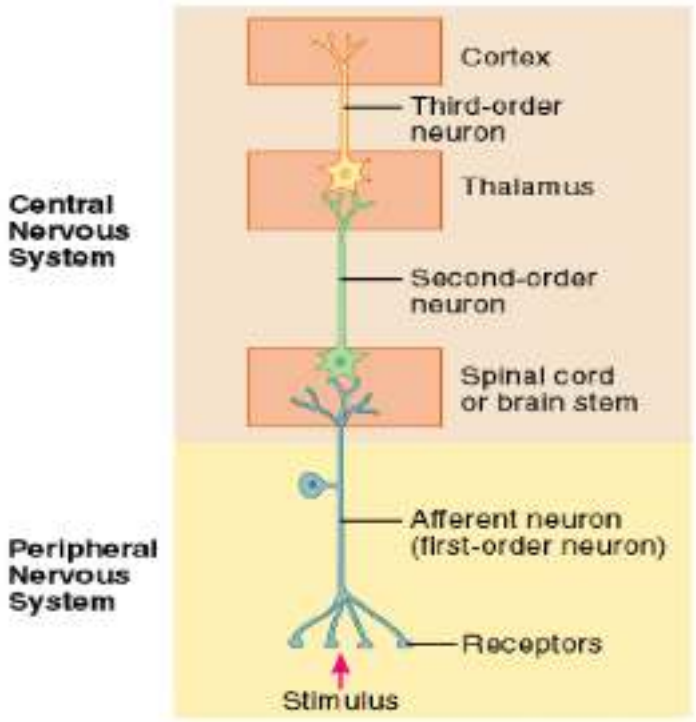


Figure 3: Organization of the sensory pathway

Inhibition of pain transmission [33,34,35]

There are mechanisms that act to inhibit pain transmission at the spinal cord level and via descending inhibition from higher centres.

Gate control theory of pain

The gate control theory of pain was proposed by Melzack and Wall in 1965 to describe a process of inhibitory pain modulation at the spinal cord level. By activating Aβ fibers with tactile, non-noxious stimuli inhibitory interneurons in the dorsal horn are activated leading to inhibition of pain signals transmitted via C fiber.

Descending inhibition

The periaqueductal grey (PAG) in the midbrain and the rostral ventromedial medulla (RVM) are two important areas of the brain involved in descending inhibitory modulation. Both these centres contain high concentrations of opioid receptors and endogenous opioids, which helps explain why opioids are analgesic.

Descending pathways project to the dorsal horn and inhibit pain as well as pain transmission. These pathways are monoaminergic, utilising noradrenaline and serotonin as neurotransmitters.

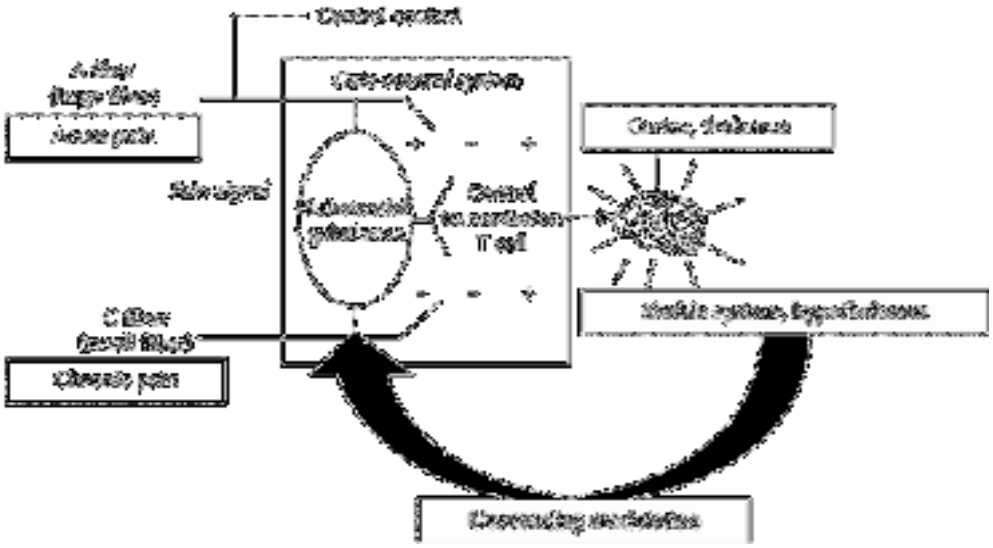


Figure 4: Gate control theory of pain.

POSTOPERATIVE PAIN [41-48]

Postoperative pain is one of the major concerns of patients. Moderate to severe acute pain can affect organ function nearly and can cause postoperative morbidity and mortality. Inadequate pain management could be associated with various respiratory, cardiovascular, gastrointestinal and psychologic complications. Thromboembolic events can happen because of reduced mobility due to postoperative pain.

Cardiovascular system

It increases heart rate, blood pressure, systemic vascular resistance and myocardial irritability, increases oxygen demand, can precipitate infarction and arrhythmias.

Respiratory system

It increases oxygen consumption and carbon dioxide production leading to increased minute ventilation. It reduces Functional Residual Capacity leading to atelectasis, V/Q mismatch and hypoxemia.

Hematological system

Pain reduces fibrinolysis and hypercoagulability and causes increased incidence of thromboembolic phenomenon.

Gastrointestinal system

Pain increases sympathetic tone leading to raised sphincter tone and reduces motility leading to paralytic ileus and urinary retention. It also increases acid secretion causing stress ulceration.

Endocrine

It increases catabolic hormones like catecholamines, cortisol and glucagon and reduces anabolic hormones like insulin, testosterone.

Immune system

It causes leukocytosis with lymphopenia and depresses reticuloendothelial system and decreases immune function.

Psychological manifestations like anxiety, disturbed sleep, depression and anger.

Pain after open surgeries is usually somatic in origin, whereas pain following laparoscopic surgeries is of both somatic and visceral in origin. Laparoscopic surgeries are minimally invasive, less pain compared to open surgeries but not completely pain free.

Mechanism of pain in laparoscopic surgeries [52-56]

Early postoperative pain is the most troublesome that it requires strong analgesia including opiates after elective laparoscopic surgeries. Many efforts have been made to improve postoperative analgesia, but postoperative pain, however, does not completely disappear and several studies have shown that visceral pain is the major component. Nonetheless, pain may be moderate or even severe for some patients during the first 24 postoperative hours, and has frequently been treated with nonsteroidal anti-inflammatory drugs (NSAIDs) or opioid treatment.

The exact etiology of pain after laparoscopic surgeries is still unclear; however, it appears to be multifactorial. The causes include abdominal wall trauma by trocar entrances, diaphragmatic irritation secondary to CO_2 insufflation and pneumoperitoneum, type and temperature of insufflated gas, residual intraperitoneal gas, intraabdominal trauma, micro ruptures of the parietal peritoneum due to abdominal distension, chemical irritation of the peritoneum, etc.

Therefore, abdominal distention should be slow with adequate muscle relaxation to ensure suitable abdominal compliance. The prolonged presence of shoulder tip pain suggests excitation of the phrenic nerve that is caused by the persistence of gas in the abdomen (pneumoperitoneum). There is statistically significant correlation between the width of the gas bubble and pain score, and this pain can be reduced by the aspiration of the gas under the diaphragm.

Factors associated with gaseous pneumoperitoneum [55,56]

1. Neuropraxia of the phrenic nerve

It has been suggested that distention of the diaphragm during gas insufflations and the resultant phrenic nerve neuropraxia possibly contribute to postoperative pain, which may include the related C4 dermatome.

2. The type of insufflated gas and intraabdominal pH

The phrenic nerves may be damaged by the acid milieu created by the dissolution of CO_2. The intraperitoneal pH when CO_2 gas is insufflated has been measured to be 6.0 immediate postoperatively. On the first postoperative day, the pH rises to 6.4 to 6.7, and on the second postoperative day to 6.8 to 6.9. Thereafter it normalizes to above 7.0. Similar values were found when argon gas was substituted.

3. Residual intraabdominal gas

Several reports have indicated that residual intraabdominal gas after laparoscopy causes pain. Carbon dioxide dissolution, intraabdominal acidosis, and the consequent peritoneal irritation occur for a longer period if the gas is not evacuated at the end of the laparoscopic procedure. Residual gas also may result in a loss of peritoneal surface tension and support to the abdominal viscera, thus contributing to postoperative pain.[55]

4. Temperature of gas

The effect of gas temperature on postoperative pain after gynaecologic laparoscopic procedures has been investigated in a prospective randomized study of standard insufflation gas (20^0 C) versus gas at body temperature. This study foundthat pain reduction was significantly greater for those patients in whom warmed

gas was used, especially with respect to diaphragmatic and shoulder tip pain, with the lasting effect of three days. [53]

5. Humidity of gas

A prospective randomized controlled trail was conducted at the Queen Elizabeth Hospital, Adelaide, to investigate the outcome when humidified gas was insufflated during laparoscopic cholecystectomy instead of standard dry gas. This study demonstrated significantly reduced postoperative pain in patients who underwent humidified gas insufflation. The humidified insufflations showed a trend of less post-operative analgesic consumption, along with shorter hospital stay and earlier return to work. The exact relation between dry gas and postoperative pain is not yet determined, but other animal studies have observed that dry gas insufflation is implicated in ultrastructural damage to exposed membranes, an effect that was not seen with the use of humidified gas. [51]

Pain assessment [38-40]

- Physical examination
- Questioning on characteristics of pain – onset, duration, location, quality, severity and intensity
- The impact of pain on the patient's functional, behavioral and psychological status should also be assessed

Pain measurement is done by two methods

Type I methods:

Those are objective methods, done by the physician as he assigns numbers about the patient condition. It includes the following:

Physiological indices

- Endocrinal (increase in serum cortisol and catecholamine).
- Cardiovascular (increase in blood pressure and heart rate)
- Respiratory (increase in respiratory rate and decrease in tidal volume)

Neuro-pharmacological

- Correlation with beta endorphin (decreased in acute painful conditions)
- Thermography (hypo-emission in chronic pain)

Neurological

- Nerve conduction velocity
- Evoked potentials
- Single positron emission tomography (SPET).

Behavioral

Sighing, crying, shouting, trembling.

Type II methods:

It includes either

Single-dimension methods

- Category scale (verbal rating scale)
- Numerical rating scale
- Graphic rating scale

Multi-dimensional methods

- Mc Gill pain Questionnaire, MPQ
- Dartmouth pain Questionnaire, DPQ
- West Haven-Yale pain Questionnaire, WHYPQ.

Measurement of pain in clinical practice depends largely on verbal dialogue between the patient and the doctor or nurse. A rating scale is mandatory in research projects and ideally when clinical data are being collected.

A number of individual differences between patients make comparisons of pain measurements more difficult. For example, the past experiences of the patients influence their present perception of pain. Also, demographic factors such as gender, age, and ethnic background influence the individual's perception of pain. Again, patients who are clinically depressed and anxious tend to report increased pain intensity.

Although pain is a subjective experience, great attention has been paid to the quantification of this experience. As pain is subjective experience, everyone has different perceptions of that experience. Differences are found in how individuals quantify pain. For example, some individuals would never say that their pain was a (10) on a scale from (0) to (10).

On the other hand, other individuals report their pain as a constant (10) despite looking calm and relaxed. Also, all numeric scales used to measure pain have floor and ceiling effects. If the patients describe their pain to be a (10), there is no way to report an increase in pain intensity.

Of the many methods of pain scoring VAS and VRS are the most commonly used in the single dimension method.

Visual analogue scale (VAS):

The visual analogue scale uses a straight line with extremities of pain intensity on either end. The line is typically 10 cm long with one end defined as "no pain" and the other end being excruciating "unbearable pain". The line can be either vertical or horizontal. The patients are asked to place a mark on the line to describe the amount

of pain that they are currently experiencing. The distance between the end labeled "no pain" and the mark placed by the patient is measured and rounded to the nearest centimeter.

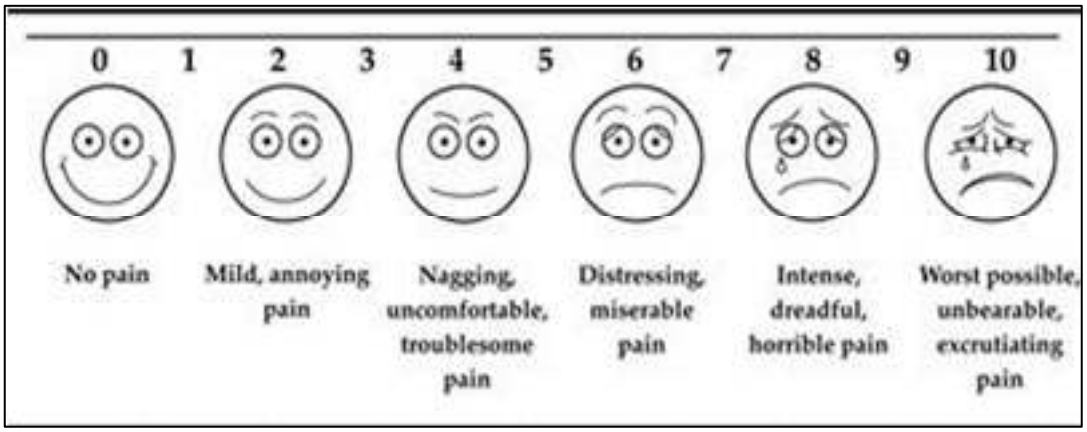


Figure 5: Visual Analog Scale

To assist in describing the intensity of pain, words can be placed along the scale (for example, mild, moderate, or severe). Such descriptors can help to orient the patient for the degree of pain; this particular variation of the VAS has been known as a graphic rating scale. Explanation to the patient is needed by the clinician when using the VAS. Occasionally, the patient may be confused about the line, perceiving it to represent time of degree of relief rather than degree of pain intensity.

MANAGEMENT OF POSTOPERATIVE PAIN [41-47]

Prophylactic measures:

The incidence, severity, and duration of pain and suffering during the postoperative period can be decreased by proper preoperative and postoperative surgical and psychological care. Although the accepted definition of pain emphasizes the cognitive, emotional response to tissue damage, the role of psychological techniques in the relief of acute pain has been minimized. Psychoeducational care has

beneficial effects on recovery, postoperative pain and psychological distress after surgery.

Psycho-educational care was classed as health-care information (information in preparation for surgery, timing of procedures, function and roles of health-care providers, self-care actions, and pain and discomfort information); skills teaching (coughing, breathing and bed exercises, relaxation, hypnosis); and psychosocial support (identifying and alleviating concerns, reassurance, problems solving, and encouraging questions).

Optimal surgical care also helps to decrease the severity of postoperative pain. Skillful and gentle handling of tissues while carrying out the operation and observance of other surgical principles assist to minimize trauma. Proper postoperative care help to decrease the magnitude of postoperative pain which involves continuing psychological support, proper care of wounds, early ambulation, and of course good nursing care.

Active measures

Postoperative pain can be partially or completely relieved by one of the following methods:

Systemic analgesics and adjuvant

- Opioids
- Non-steroidal anti-inflammatory drugs
- NMDA antagonists
- Alpha-2 adrenergic agonists
- Miscellaneous non-opioid compounds

Regional analgesia with local anaesthetics

- Local infiltration and field block
- Continuous segmental epidural block
- Intra-pleural instillation
- Intra-peritoneal instillation
- Infiltration of the incision site

Regional analgesia with neuro-axial opioids and local anaesthetics

Regional analgesia with combined local anaesthetics and opioids

Electrical analgesia achieved with transcutaneous electrical stimulation or electro-acupuncture.

ANATOMY OF THE ABDOMINAL WALL [57-60]

The abdominal wall protects the internal organs from injury. It is bounded superiorly by the xiphoid process and costal margins, posteriorly by the vertebral column and inferiorly by the pelvic bones and inguinal ligament.

The abdominal wall is divided into anterolateral and posterior abdominal walls, consisting of various layers, from superficial to deep - skin, superficial fascia, muscles and their respective fascia, and peritoneum.

The superficial fascia is a connective tissue which has contents based upon its location

Above the umbilicus – a single sheet of connective tissue. It is continuous with the superficial fascia in other regions of the body.

Below the umbilicus – divided into two layers; the fatty superficial layer (Camper's fascia) and the membranous deep layer (Scarpa's fascia). The superficial vessels and nerves run between these two layers of fascia.

Muscles of the anterior abdominal wall on either side of the midline are four large muscles namely external oblique, internal oblique, the transversus abdominis and rectus abdominis and two small muscles, the cremaster and the pyramidalis.

The external oblique, the internal oblique and the transversus abdominis are large flat muscles in the anterolateral part of the abdominal wall. In the anteromedial aspect of the abdominal wall, each flat muscle forms an aponeurosis (a broad, flat tendon), which covers the vertical rectus abdominis muscle. The aponeuroses of all the flat muscles fuse together in the midline, forming the Linea alba (a fibrous structure that extends from the xiphoid process of the sternum to the pubic symphysis).

External Oblique

The external oblique is the largest and most superficial muscle in the abdominal wall. Its fibres run infero-medially.

Attachments: Originates from ribs 5-12, and inserts into the iliac crest and pubic tubercle.

Functions: Helps in the maintenance of abdominal tone, also in increasing intra-abdominal pressure, and in the lateral flexion of the trunk against resistance.

Blood supply and Innervation: It is supplied by branches from the lower posterior intercostal, subcostal arteries and deep circumflex iliac artery. Thoraco-abdominal nerves (T7-T11) and subcostal nerve (T12).

Internal Oblique

The internal oblique lies deep to the external oblique. It is smaller and thinner in structure, with its fibres running super medially (perpendicular to the fibres of the external oblique).

Attachments: Originates from the inguinal ligament, iliac crest and thoracolumbar fascia, and inserts into cartilages of lower six ribs and Linea alba.

Functions: Bilateral contraction compresses the abdomen, while along with the external oblique of the other side helps in lateral trunk flexion. It also helps in expiration process.

Blood supply and Innervation: Thoraco-abdominal nerves (T7-T11), subcostal nerve (T12) and branches of the lumbar plexus, Iliohypogastric and Ilioinguinal nerve.

Transversus Abdominis

The transversus abdominis is the deepest of the flat muscles, with transversely running fibres. Deep to this muscle is a well-formed layer of fascia, known as the transversalis fascia.

Attachments: Originates from the inguinal ligament, costal cartilages 7-12, the iliac crest and thoracolumbar fascia. Inserts into the conjoint tendon, xiphoid process, linea alba and the pubic crest.

Functions: Compression of abdominal contents.

Innervation: Thoracoabdominal nerves (T7-T11), subcostal nerve (T12) and branches of the lumbar plexus Muscles of the posterior abdominal wall are the psoas major, the psoas minor, the iliacus and the quadratus lumborum

Quadratus Lumborum

It is located laterally in the posterior abdominal wall and quadrilateral in shape. The muscle is positioned superficially to the psoas major.

Attachments: It originates from the iliac crest and iliolumbar ligament. The fibres travel superomedially, inserting onto the transverse processes of L1 – L4 and the inferior border of the 12^{th} rib.

Actions: Extension and lateral flexion of the vertebral column. It fixes the 12th rib during inspiration, so that the contraction of diaphragm is more effective.

Innervation: Anterior rami of spinal nerves T12- L4 nerves.

Psoas Major

The psoas major is located near the midline of the posterior abdominal wall, immediately lateral to the lumbar vertebrae.

Attachments: Originates from the transverse processes and vertebral bodies of T12 – L5. It then moves inferiorly and laterally, running deep to the inguinal ligament, and attaching to the lesser trochanter of the femur.

Actions: Flexion of the thigh at the hip and lateral flexion of the vertebral column.

Innervation: Anterior rami of L1 – L3 nerves.

Psoas Minor

The psoas minor muscle is only present in 60% of the population. It is located anterior to the psoas major.

Attachments: Originates from the vertebral bodies of T12 and L1 and attaches to a ridge on the superior ramus of the pubic bone, known as the pectineal line.

Actions: Flexion of the vertebral column.

Innervation: Anterior rami of the L1 spinal nerve.

Iliacus

The iliacus muscle is a fan-shaped muscle that is situated inferiorly on the posterior abdominal wall. It combines with the psoas major to form the iliopsoas – the major flexor of the thigh.

Attachments: Originates from surface of the iliac fossa and anterior inferior iliac spine. Its fibres combine with the tendon of the psoas major, inserting into the lesser trochanter of the femur.

Actions: Flexion and lateral rotation of the thigh at the hip joint.

Innervation: Femoral nerve (L2 – L4).

Diaphragm

The posterior aspect of the diaphragm is considered to be part of the posterior abdomen

Fascia of the Posterior Abdominal Wall is a layer (sheet of connective tissue) that lies between the parietal peritoneum and the muscles of the posterior abdominal wall. This fascia is continuous with the transversalis fascia of the anterolateral abdominal wall.

Psoas Fascia

The psoas fascia covers the psoas major muscle. It is attached to the lumbar vertebrae medially, continuous with the thoracolumbar fascia laterally and continuous with the iliac fascia inferiorly.

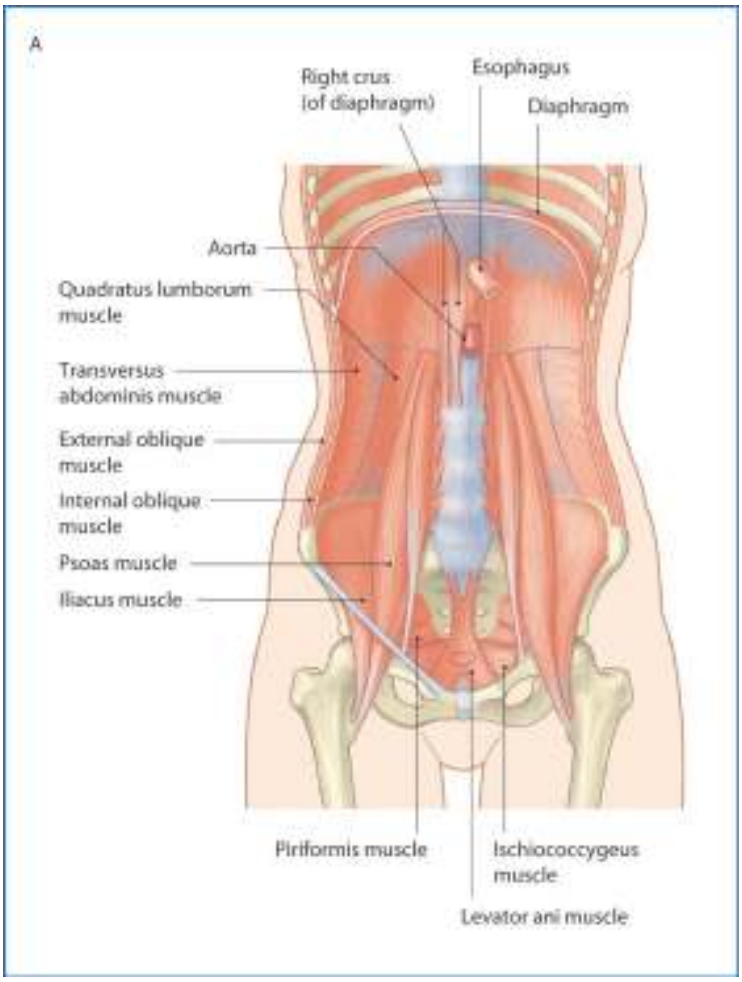


Figure 6: Muscles of the Abdomen.

Thoracolumbar fascia

The thoracolumbar fascia is made up of multiple fascial layers which is most prominent at the caudal end of the lumbar spine. It composes of three layers in the lumbar region. The posterior layer is attached medially to the spines of the lumbar vertebrae and to the supraspinous ligament.

The Aponeurosis of Latissimus Dorsi muscle forms the superficial lamina of posterior layer and its deep lamina encloses the posterior surface of the paraspinal muscles. The middle layer is attached medially to the tips of the lumbar transverse processes and goes laterally behind quadratus lumborum. Inferiorly, it has attachment to the iliac crest, and superior attachment is to the lower border of the twelfth rib. The anterior layer covers the anterior region of quadratus lumborum and is attached medially to the transverse processes of the lumbar vertebrae behind the psoas major muscle. It fuses with the transversalis fascia laterally and to the aponeurosis of transversus abdominis muscle

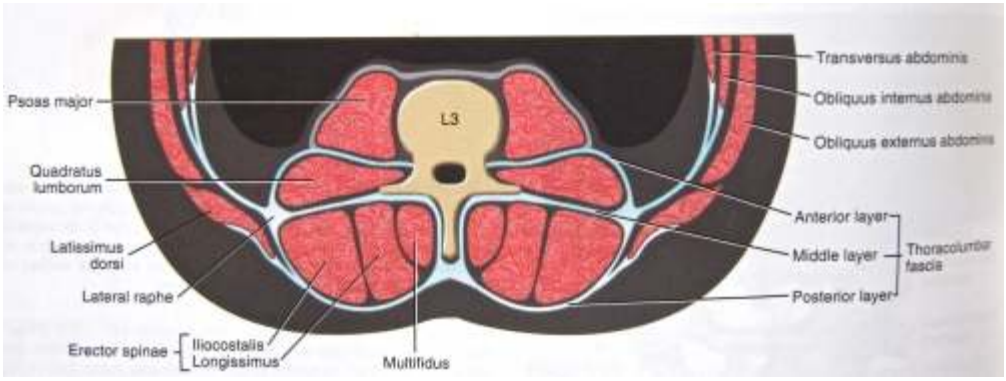


Figure 7: Thoracolumbar fascia

Inferiorly, it is also attached to the iliolumbar ligament and nearby region of iliac crest. The superior attachment of anterior layer of thoracolumbar fascia is to the inferior border of the twelfth rib and it also extends to the transverse process of the L1

vertebra thereby forming the lateral arcuate ligament of the diaphragm. The posterior and middle layers of the thoracolumbar fascia (or the lateral raphe) join at the lateral margin of the paraspinal muscles and encloses them in an osteofascial compartment. The aponeurosis of transversus abdominis muscle joins the anterior layer of thoracolumbar fascia at the lateral border of quadratus lumborum and with the lateral raphe posterior to quadratus lumborum.

NERVES AND ARTERIES OF ABDOMINAL WALL

The abdominal wall has innervations from anterior primary rami of T7- L1. Cutaneous distribution is T7 at xiphoid, T10 at umbilicus and L1 at groin. T7-11 and the subcostal nerve T12 enters the wall of abdomen between the interdigitations of diaphragm and transverses abdominis.

DERMATOMES OF ABDOMEN

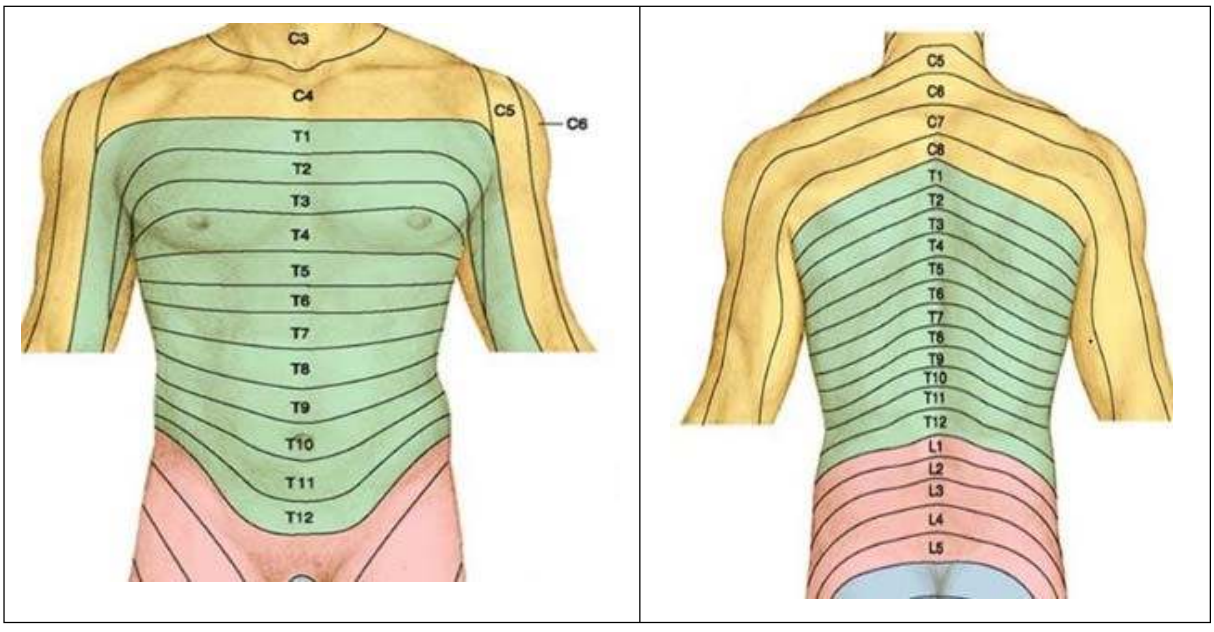


Figure 8: Dermatomes of the Abdomen

In their thoracic course, these nerves lie between the internal and innermost intercostals and in abdomen they lie in Transversus abdominis plane. L1 lumbar nerve divides anterior to quadratus lumborum muscle into iliohypogastric and ilioinguinal nerves which then penetrates transverses abdominis muscle to lie in TAP plane.

The iliohypogastric nerve pierces internal oblique muscle above and in front of Anterior Superior Iliac Spine, goes deep to external oblique and just above the inguinal canal and its ends by giving cutaneous innervations to suprapubic region. The ilioinguinal nerve also penetrates the internal oblique, runs in inguinal canal superior to spermatic cord, emerges via external ring and supplies skin of scrotum/labia majora and upper thigh.

All these nerves except ilioinguinal nerve gives off lateral cutaneous branch in midaxillary line each of which divides into anterior and posterior branches and supplies the area from lateral border of rectus muscle to in front of erector spinae muscle posteriorly.

TAP BLOCK [5-9,31]

The Transversus abdominis plane block technique was first introduced by Rafi et al in the year 2001 and McDonnell et al in the year 2004 with a landmark technique, via the lumbar triangle of Petit, the plane of injection between the muscle layers the internal oblique muscle and transverse abdominis. The thoracolumbar nerves from T6 to L1 spinal roots supply sensory nerves in the anterolateral abdominal wall, blocking these neural afferents provides analgesia to the anterolateral abdominal wall.

Using conventional technique, it has blind end points two pop offs and their success is unpredictable. With the advancement of ultrasound guided techniques there is better visualization, localization and drug deposition with improved accuracy and higher successful rate.

This block generally is indicated for lower abdominal surgeries including appendicectomy, hernia repair, caesarean section, abdominal hysterectomy, prostatectomy and laparoscopic surgeries.

Conventional technique

The point of needle entry is in the triangle of Petit which is bound anteriorly by the External oblique muscle, posteriorly by the Latissimus dorsi muscle and inferiorly by the iliac crest. It is located along the midaxillary line below the lower costal margin and above the iliac crest. This technique depends on feeling of experiencing double pops as the needle pierces the external oblique and internal oblique muscles. The loss of resistance is better felt with a blunt needle. It provides anesthesia and analgesia to the anterior abdominal wall by blocking T6-L1 spinal nerves.

Sonographic anatomy of TAP block

The first step in performing TAP blocks with ultrasound guidance is to identify the muscles of the anterolateral abdominal wall. The external oblique is usually the most echogenic muscle of the anterolateral abdominal wall. The external oblique and internal oblique muscles typically extend farther posteriorly than the transversus abdominis muscle. Retroperitoneal fat (hypoechoic appearance on ultrasound scans) lies under the posterior aspect of the transversus abdominis muscle.

The layers underneath the transversus abdominis muscle are (in order) the transversalis fascia, extraperitoneal fat, and peritoneum.

Lateral TAP block

The three layers of the abdominal wall muscles are visualized with a linear transducer being placed on the midaxillary line between the subcostal margin and the iliac crest.

Anterior TAP block

A linear transducer is positioned medial to the anterior iliac spine pointing towards the umbilicus with a caudal tilt. The target is the fascial plane between the internal oblique and transversus abdominis at the level of deep circumflex artery.

Subcostal TAP block

A linear transducer is placed along the lower margin of the rib, angled towards costal margin. The rectus abdominis muscle and its posterior rectus sheath are visualized along with the transverse abdominis muscle deep to the posterior rectus sheath. The target is the fascial plane between the posterior rectus sheath and transversus abdominis muscle.

Posterior TAP block

A linear transducer is placed in the axial plane in the midaxillary line and moved posteriorly to the posterior most limit of the TAP between the internal oblique and transversus abdominis.

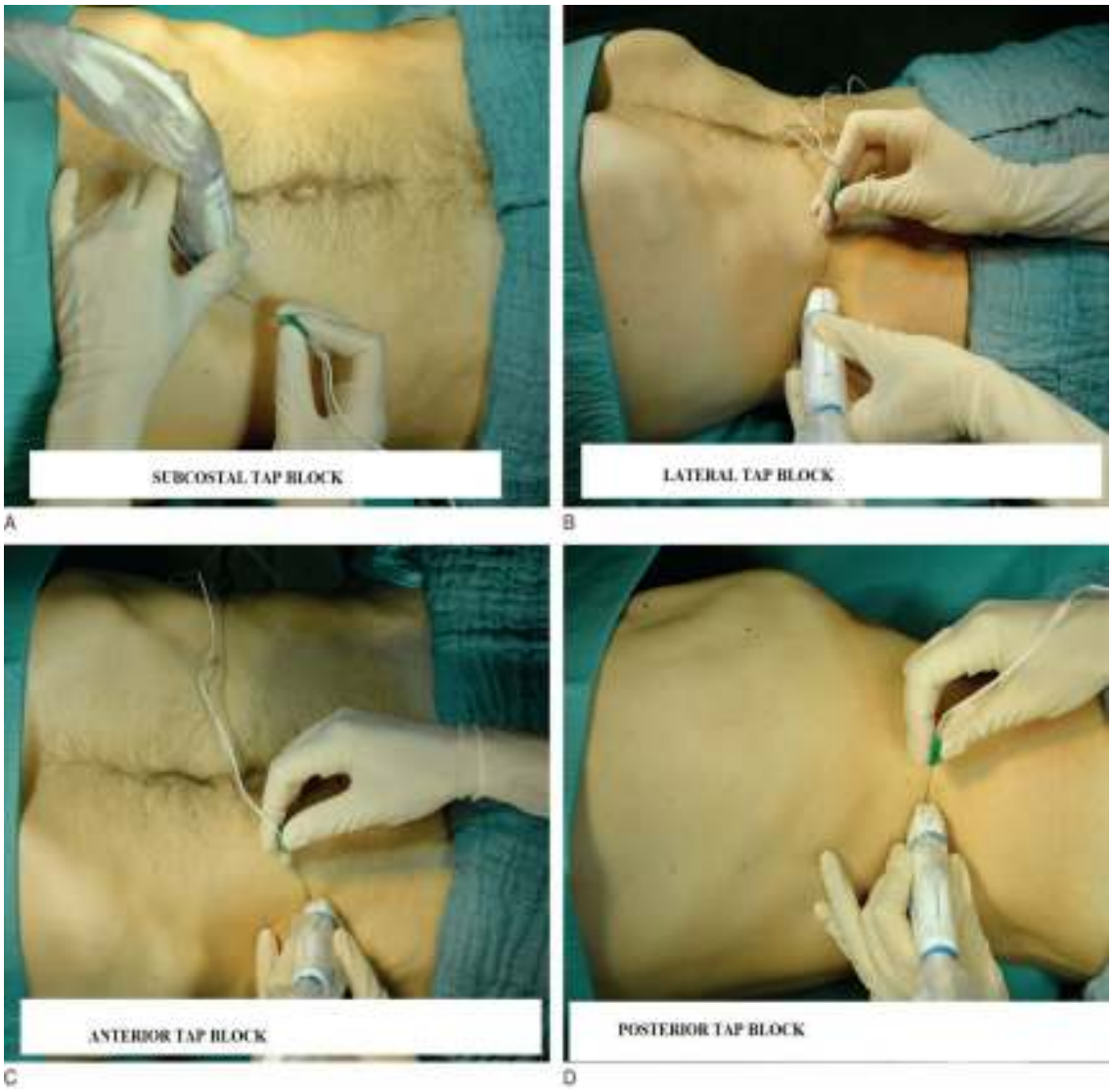


Figure 9: Various types of the TAP block

QUADRATUS LUMBORUM BLOCK [6,9,12]

In 2007, Rafael Blanco first described the ultrasound guided quadratus lumborum block, which is the ultrasound guided deposition of local anesthetic drug into the anterolateral surface of Quadratus Lumborum muscle, blocking the same nerves as the Transverse Abdominis Plane (TAP) block, while providing some degree of visceral analgesia too due to closer proximity to the central neuraxis and the sympathetic trunk. Later, R. Blanco described the type 2 QLB, in which the drug deposition is posterior to the QL muscle, which is now favored due to more predictable drug spread to the paravertebral space, improved safety, and better ultrasonographic resolution as it is a more superficial block than QLB type1. In 2013, Dr. Jens Borglum from Copenhagen (Denmark) published the ultrasound guided trans muscular Quadratus Lumborum block, also describing the "Shamrock sign" for the point of drug deposition.

It is indicated for surgeries like exploratory laparotomy, bowel resection, ileostomy, appendicectomy, hernioplasty, cholecystectomy, lower segment cesarean section, total abdominal hysterectomy, Prostatectomy, and Nephrectomy/renal surgeries, Abdominoplasty, Iliac crest bone graft and Femoral neck surgeries. Incisions involving midline needs bilateral QLB blocks.

The lateral decubitus position is the preferred position because it gives adequate exposure to the Quadratus Lumborum muscle and nearby structures and more stability in the handling of ultrasound probe and needle, and offers increased patient comfort than supine posture. Supine position also reduces the visualization of the lumbar paravertebral muscles.

With the patient positioned in the lateral position, scanning started in the mid-axillary line between the iliac crest and the costal margin, moving the probe posteriorly until the three abdominal muscle layers –External, Internal oblique and Transverses Abdominis gets tapered and Quadratus Lumborum muscle appears. The fascia transversalis appears as a hyper-echoic layer and separates the muscle layers from the fat and the abdominal contents below. Another method of scanning is done starting posteriorly, 4-6 cm lateral to the L3-L4 lumbar spinous process level or higher. The transverse process of lumbar vertebrae, the Erector Spinae muscle, the Psoas Major muscle and the Quadratus Lumborum muscle can be identified which is termed as the Shamrock sign.

Type 1 QL block

A linear transducer is placed in the axial plane in the mid-axillary line and moved posteriorly until the posterior aponeurosis of the transversus abdominis muscle. The target is just deep to the aponeurosis but superficial to the transversalis fascia at the lateral margin of the QL muscle. The QL1 block is identical to the transversalis plane block. The main effect is anesthesia of the lateral cutaneous branches of the ilio-hypogastric, ilioinguinal and subcostal nerves.

Type 2 QL block

A linear transducer is placed in the axial plane in the mid-axillary line and moved posteriorly as in the QL1 block, until the para-spinal muscles, becomes visible between the latissimus dorsi and QL muscles. The target is the deep layer of the middle layer of the TLF.

Trans-muscular QL block

A curvilinear transducer is placed in the axial plane on the patient's flank just cranial to the iliac crest. The shamrock sign is visualized, the transverse process of

vertebra L4 is the stem, whereas the erector spinae posteriorly, QL laterally, and psoas major anteriorly represent the three leaves of the trefoil. The target for injection is the fascial plane between the QL and psoas major muscles.

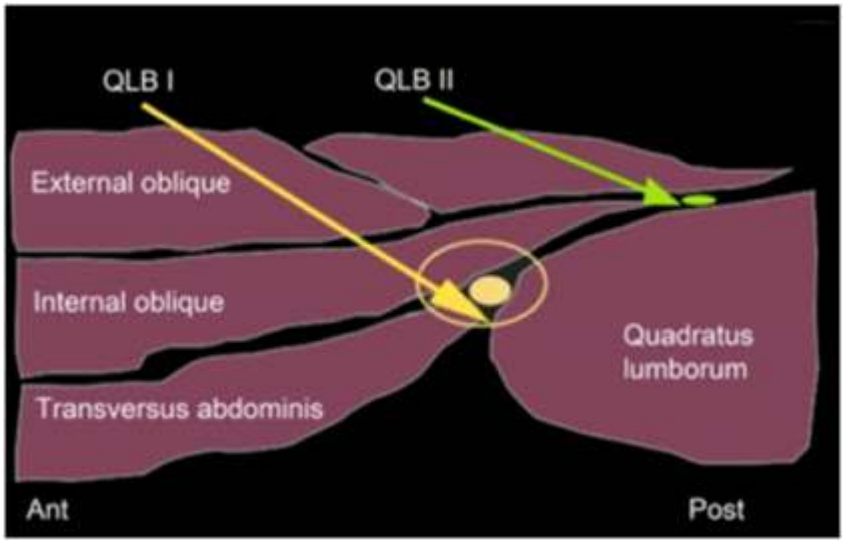


Figure 10: Various types of the QL block

ULTRASONOGRAPHY [61,62]

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. Ultrasounds 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

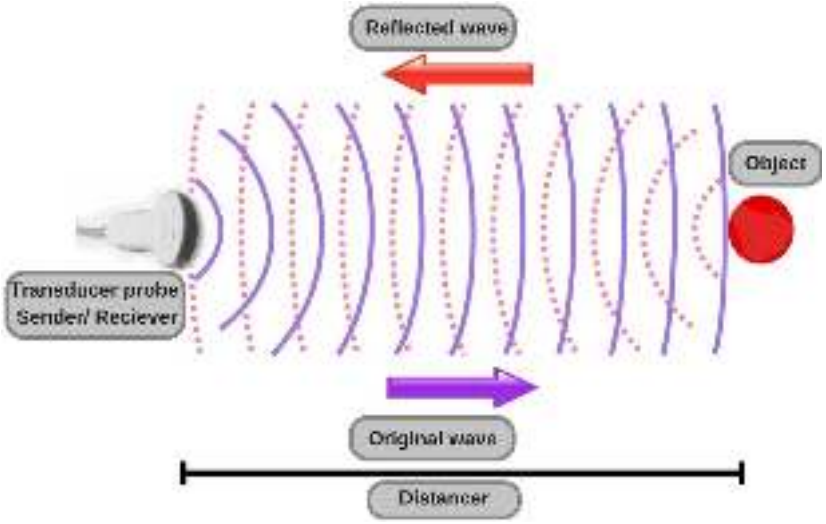


Figure 11: Principles of Ultrasonography

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.

Image 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 ensonified 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.

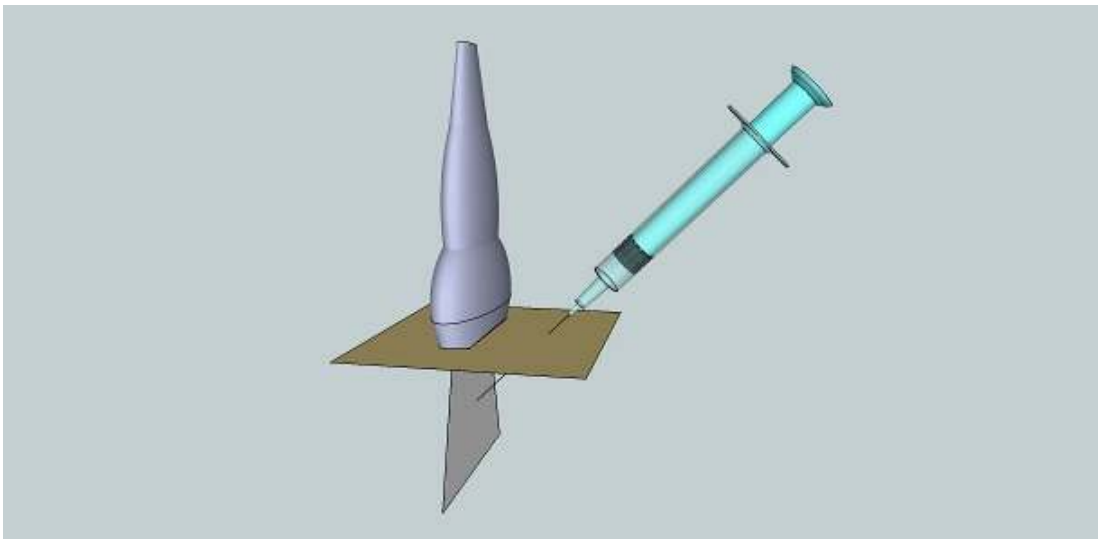


Figure 12: Out of plane technique

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 isnot correctly identified.
2) Some unimaged needle path occurs with IP approach, but typically lessthan with OOP approach.
3) Longer paths and therefore more structures to cross with the block needle.

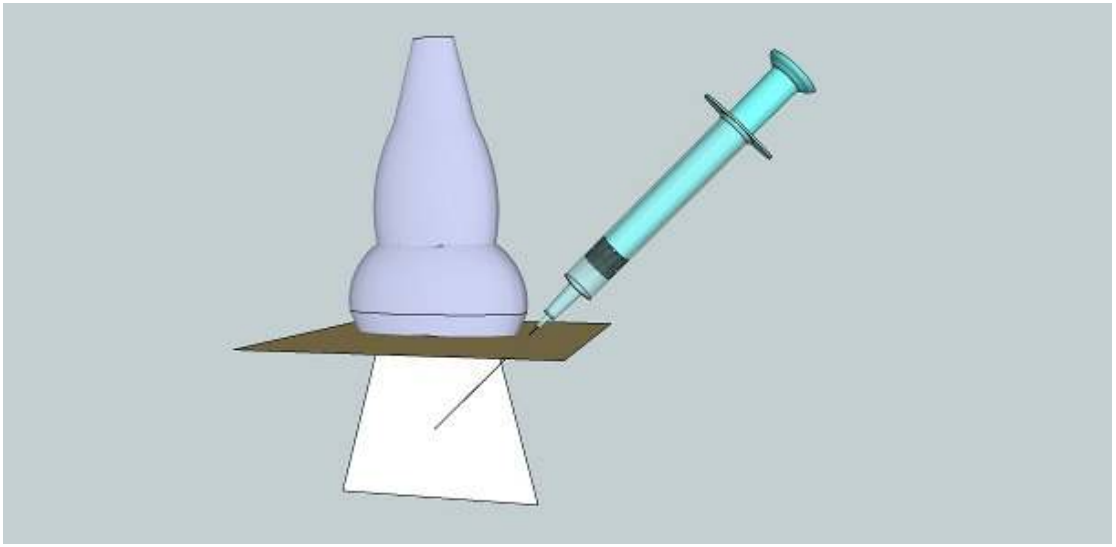


Figure 13: In-plane Technique

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.

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 do 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 anechoi*c* 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 anechoiec 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.

BUPIVACAINE [33,34,35]

Bupivacaine is an amino amide class of local anaesthetic drug. It was first synthesized by Ekenstam in 1957 and its clinical use was started by LJ Telivuo in 1963. Since then, it has become one of the widely used local anaesthetic agents clinically.

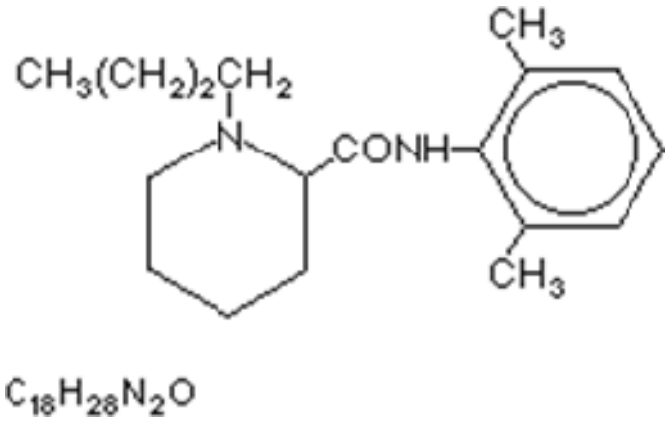


Figure 14: Chemical structure of Bupivacaine.

Bupivacaine consists of a tertiary amine attached to a substituted aromatic ring by an amide linkage. The butyl group attached to the piperidine nitrogen makes bupivacaine more lipid soluble and potent. The molecular weight is 288. It is a chiral drug that exists as two enantiomeric forms – dextrorotary (R-) and levorotary (S-) forms. The pure levorotary form Levobupivacaine produce less cardiotoxicity compared to that of the racemic mixture.

PHARMACODYNAMICS

Bupivacaine permeates the nerve's axon membranes and accumulate within the axoplasm. Binding to sites on voltage-gated Na+ channels prevent opening of the channels by inhibiting the conformational changes that underlie channel activation. On comparison with lignocaine, it is four times more potent but the onset of action is

slower. The duration of action is considerably longer. The sensory blockade caused by bupivacaine is much more than the motor blockade.

PHARMACOKINETICS

It is a weak base with a pKa of 8.1. Bupivacaine is highly protein bound (95%). and most important plasma protein binding site is alpha1 acid glycoprotein. At physiological pH of 7.4, 17% is non-ionised.

The onset and duration of action depend on the dose, concentration, route of administration and vascularity of the site of administration. The volume of distribution is 54 L. The elimination half-life is 210 minutes. The Clearance is 0.32 L/min. Bupivacaine undergoes biotransformation in liver by aromatic hydroxylation, N-dealkylation, amide hydrolysis, and conjugation. The metabolites are excreted via the kidney. Less than 5% of the drug is excreted unchanged.

Dosage and preparations

Maximum dose of bupivacaine 2-3 mg/kg. Preparations available include 0.25%, 0.5% solutions in 10 ml and 20 ml vials, preservative free 0.5% bupivacaine and 0.75% bupivacaine for intrathecal injections.

Uses

- Peripheral nerve block (0.25-0.5%)
- Epidural Anaesthesia (0.25-0.5%)
- Spinal Anaesthesia (0.5%, 0.75%)
- Caudal Anaesthesia (0.25-0.5%)
- Infiltration Anaesthesia (0.25-0.5%)

Contraindications

- Known hypersensitivity to local anaesthetics
- Intravenous regional anaesthesia (IVRA)

Adverse effects

Local Anaesthesia Systemic Toxicity– Plasma concentration greater than 5mcg/ml due to overdosage, unintentional intravascular injection and slow metabolic degradation causes systemic toxicity.

Central Nervous System Toxicity

Non-specific signs of toxicity are metallic taste, circumoral numbness, diplopia, tinnitus, dizziness. Excitation is characterized by restlessness, anxiety, dizziness, tinnitus, blurred vision or tremors. Then, there is a depression of central nervous system causing drowsiness, unconsciousness and cardiac arrest.

Cardiovascular system effects

Part of the cardiac toxicity that occurs with high plasma concentrations of bupivacaine occurs because of the blockade of cardiac sodium channels. Accidental intravenous injection of bupivacaine causes cardiac dysrhythmias, atrioventricular block, ventricular tachycardia and ventricular fibrillation, bradycardia and asystole. Pregnancy increases the sensitivity of cardiotoxic effects of bupivacaine.

MATERIALS AND METHODS

The current study was done at KLES Dr. Prabhakar Kore Charitable Hospital and MRC, Nehru Nagar, Belagavi 590010, on patients undergoing laparoscopic surgeries under General Anesthesia between January 2020 to December 2020.

Study design:

One year hospital based randomized clinical trial.

Sample size:

Total sample size: 60

Sample size calculation:

Sample size formula

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

z_α – significance level and z_β - power of the test.

For 5% significance level, z_α =1.96 and z_β =0.84 for 80% power of the test.

Ref:

Based on the pain scores obtained at the end of 12 hours postoperatively in both groups.[14]

$\bar{X}_1$ - 1st group Mean (0.08)

$\bar{X}_2$ - 2nd group Mean (0.44)

s_1 - 1st group (0.40) SD and

s_2 - 2nd group (0.58) SD.

With above values the sample size came as 30 in each group (total 60).

Selection Criteria:

Inclusion Criteria:

1. ASA grade I and II patients.
2. 18-60 years of age patients posted electively for laparoscopic surgeries under general anesthesia.

Exclusion Criteria:

1. ASA grade III or IV patients.
2. Patients who are not willing / not giving consent for the study.
3. Patients undergoing emergency surgeries.
4. Patients with known allergy to local anesthetics.
5. Patients with infection at injection site.
6. Patients with anticipated difficult airway
7. Patients with diseases which can alter interpretation of pain scores.

After approval from the Institutional ethics committee, this one year randomized clinical trial was conducted at KLES Dr. Prabhakar Kore Hospital and MRC, Jawaharlal Nehru Medical College, Belagavi.

With the inclusion and exclusion criteria being ruled out and having obtained the consent, patients were randomized based on computer generated randomization table into one of the two groups.

GROUP 1:

Patients (n=30) in whom quadratus lumborum (QL) block was performed.

GROUP 2:

Patients (n=30) in whom transversus abdominis plane (TAP) block was performed.

A detailed PAE was done for all patients and routine investigations were also reviewed. Peri-operatively routine vital monitors (Spo2, ECG, NIBP, ETco2) were all applied. Baseline readings of vitals including HR, RR, SBP, DBP and Sp02 were noted. Intravenous (IV) line was secured and IV fluid was started.

In all patients, Pre-medications were given. GA was induced with IV Inj. fentanyl (1 µg/kg), propofol (2 mg/kg), and atracurium (0.5 mg/ kg) was administered. Pre-oxygenation was done for 3-5 minutes, then endotracheal intubation was carried out and put on mechanical ventilation. Anesthesia was maintained with oxygen, nitrous oxide, isoflurane titrated according to the MAC values. Intra-operatively routine analgesics were given.

Before extubation and at the end of the surgery, either quadratus lumborum or transversus abdominis block was performed under strict aseptic precautions using ultrasound guided technique.

In TAPB group, blocks were performed with patient in supine position, the probe was placed between the iliac crest and the sub-costal margin in the anterior axillary line at the level of umbilicus. The abdominal wall layers were visualized (EO, IO and TP muscles). The needle insertion was done using in-plane technique with tip lying between the IO and TA muscles. After confirmation with negative aspiration which rules out vascular injection, 20 mL of 0.25% bupivacaine on each side was injected.

In QL group, blocks were performed with patient in supine position with lateral tilt, with probe at the level of the ASIS and shifted cephalad until the 3 abdominal wall muscles were visualized. The EO muscle was traced postero-laterally until its posterior border is visualized (hook sign), with the IO muscle being a roof over the QL muscle. Then probe was traced down to see a bright hyperechoic line that denotes the middle layer of the TLF. The needle insertion was done using in-plane technique directed from antero-lateral to postero-medial. The tip of the needle was positioned between the TLF and the QL muscle. After confirmation by negative aspiration to rule out vascular injection,20 mL of 0.25% bupivacaine was injected on each side.

Patients were reversed with neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg. Routine extubation was done and after the patients were responding to commands, fully conscious and oriented they were shifted to the PACU. Visual analog scale (VAS) was used to identify VAS score which evaluated the pain in the postoperative period. If VAS scores >3 in the postoperative period, rescue analgesic 1gm Paracetamol was used. Side effects such as hypotension (SBP <90 mmHg), arrhythmia, LA toxicity, bradycardia (HR <50 beats/min), nausea or vomiting, numbness, or other complications were noted.

Objective criteria

Baseline BP, Heart rate, Respiratory rate were recorded pre operatively and postoperatively at 0 minutes, 30 minutes, 1, 2, 4, 6, 12 and 24 hours.

Subjective criteria

Visual Analog scale (VAS) with a range of 0 to 10 (0 means absence of pain and 10 means intolerable pain) was evaluated in the postoperative period to identify pain at various intervals (0 minutes, 30 minutes, 1, 2, 4, 6, 12 and 24 hours).

Statistical Analysis:

The study was determined to compare the two groups.

The mean and standard deviation was calculated for the continuous quantitative variables.

The inter group continuous variables were differentiated using statistical tools like unpaired student's t test. Quantitative variables were differentiated with student's paired t test.

The rates, ratios and percentages were used to express categorical data.

The association between the outcome, clinical and demographic characteristics were analyzed using Chi-square test or Fisher's exact test.

Discrete variables were represented by mean.

Nonparametric tests were used for comparing discrete variables.

Appropriate graphs were used to express the comparison.

For all the tests the value of p less than 5% (0.05) was considered significant.

RESULTS

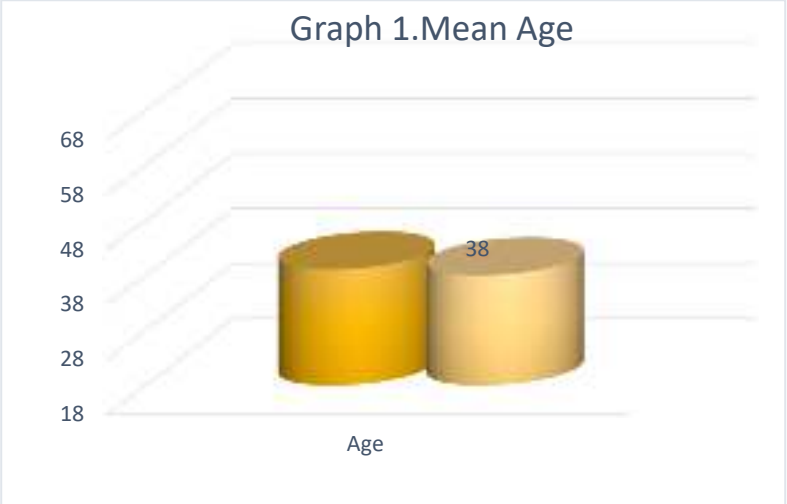
The present study was conducted to compare the duration of postoperative analgesia of ultrasound guided quadratus lumborum block (QLB) versus transverses abdominis plane (TAPB) block using 0.25% bupivacaine in laparoscopic surgeries.

60 patients were selected for the trial, with awareness of the inclusion and exclusion criteria. 30 patients in group 1 (QLB) and 30 patients in group 2 (TAPB) were alloted.

DEMOGRAPHIC DATA

Table 1: Mean Age

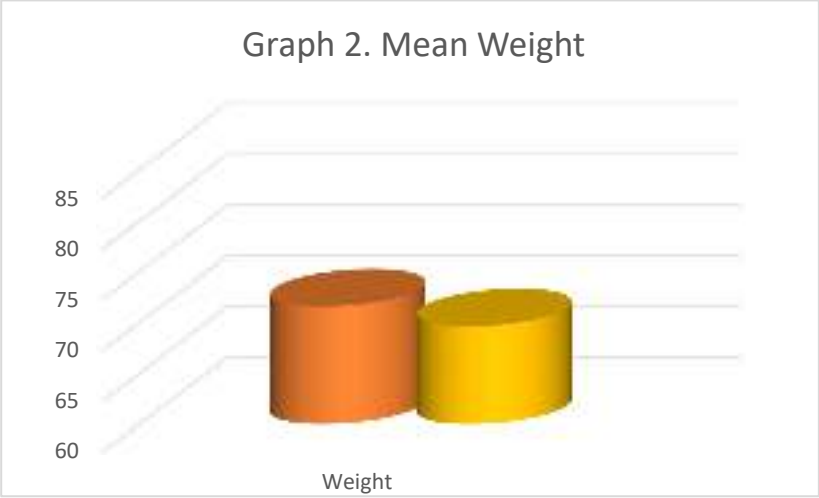
	GROUP 1		GROUP 2		
	Mean	**SD**	**mean**	**SD**	**P value**
Age	39.07	9.04	38	9.89	0.7801



In our study we found no statistical significance between group 1 and group 2 with regards to mean age (39.07±9.04 years, 38.00±9.89 years respectively; p=0.7801).

TABLE 2: Mean Weight

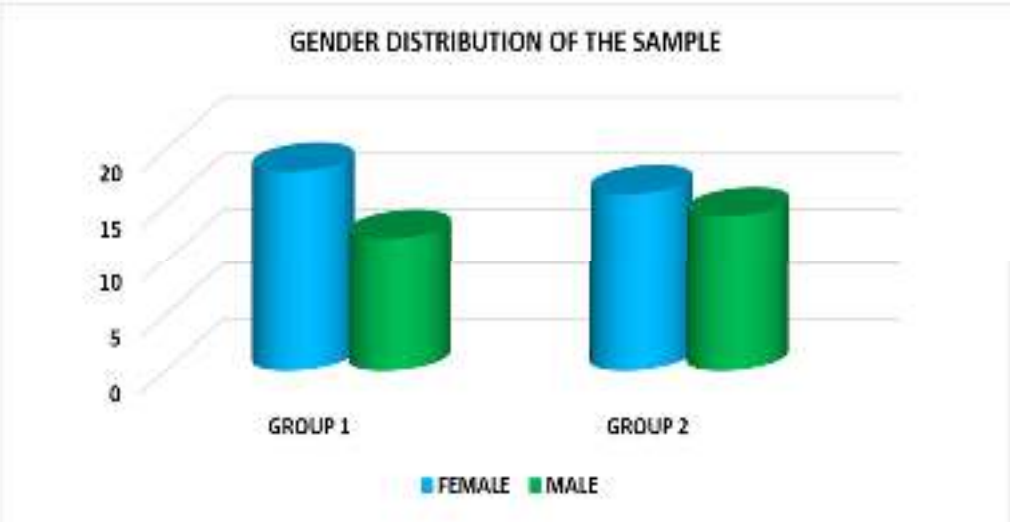
	GROUP 1		GROUP 2		
	Mean	**SD**	**mean**	**SD**	**P value**
Weight	71.57	7.75	69.63	10	0.4426



In our study we found no statistical significance between group 1 and group 2 with regards mean weight (71.57±7.75 kgs, 69.63±10.00 kgs respectively; p=0.4426).

TABLE 3: Gender distribution of the sample

GENDER	GROUP 1	GROUP 2
FEMALE	18	16
MALE	12	14
TOTAL	30	30



In group 1, out of 30 patients 18 were females and 12 were males. In group 2, out of 30 patients 16 were females and 14 were males. On comparison, we found that there is no statistical significance between the two groups.

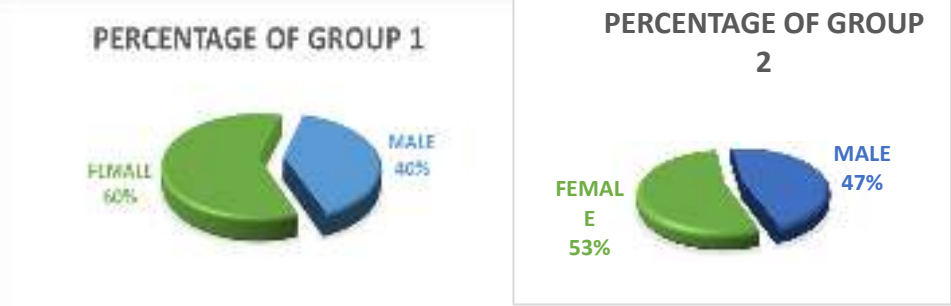


TABLE 4: ASA status

ASA	GROUP 1		GROUP 2	
	Number	Percent	Number	percent
1	25	83.33%	26	86.66%
2	5	16.66%	4	13.34%
TOTAL	30	100%	30	100%

In group 1, out of the total 30 patients 25 (83.33%) patients were ASA grade I and 5 (16.66%) patients were ASA grade II. In group 2, out of the total 30 patients 26 (86.66%) patients were ASA grade 1 and 4 (13.34%) patients were ASA grade II. The data was comparable in both groups.

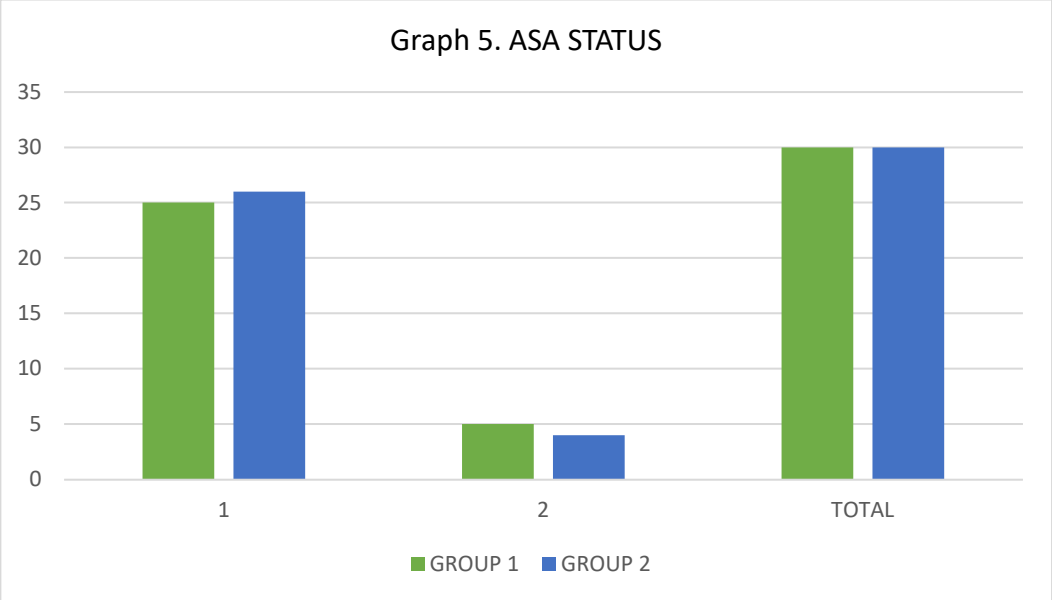


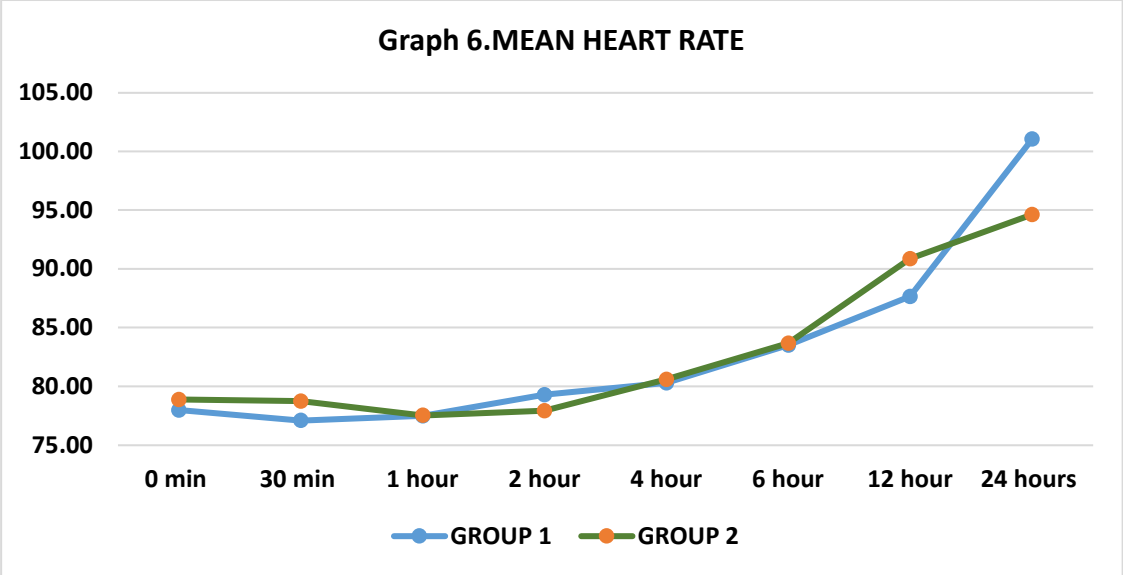
TABLE 5: Pre-operative baseline vitals

	GROUP 1				GROUP 2					
	MEAN	**S.D.**	**MIN**	**MAX**	**MEAN**	**S.D.**	**MIN**	**MAX**	**p VALUE**	
HR	78.17	6.74	65	90	79.20	7.87	58	94	0.7576	NS
SBP	121.57	7.56	108	132	123.17	9.29	110	140	0.3947	NS
DBP	76.17	6.29	60	90	74.77	5.37	60	88	0.2935	NS
RR	12.77	0.94	12	14	12.80	1.00	11	14	0.9783	NS

There was no statistical significance among the two groups in terms of baseline mean heart rate (78.17±6.74 beats per minute,79.20±7.87 beats per minute respectively; p= 0.7576), mean SBP (121.57±7.56 mmhg,123.17±9.29 mmhg respectively; p=0.3947), mean DBP (76.17±6.29 mmhg,74.77±5.37mmhg respectively; p= 0.2935), mean RR (12.77 breaths per min±0.94,12.80±1.00 breaths per min respectively; p=0.9783).

TABLE 6: Heart Rate postoperatively at various intervals.

	GROUP 1		GROUP 2			
	MEAN	**S.D.**	**MEAN**	**S.D.**	**p VALUE**	**INFERENCE**
0 min	77.97	6.59	78.87	7.99	0.8230	NS
30 min	77.10	7.39	78.73	7.83	0.5563	NS
1 hour	77.50	6.66	77.53	8.01	0.8484	NS
2 hour	79.30	6.65	77.93	7.72	0.3466	NS
4 hour	80.30	7.06	80.60	7.37	0.8852	NS
6 hour	83.50	7.28	83.67	7.88	0.8779	NS
12 hour	87.67	7.68	90.87	6.92	0.1445	NS
24 hours	94.63	4.94	101.07	6.77	0.0624	NS



Despite the statistical insignificance between HR at 0 min, 30 min, 1st hour, 2nd hour, 4th hour, 6th hour, 12th hour and 24 hours, there is an increase in mean heart rate in group 2 compared to group 1 at 12 hours (90.87±6.92 bpm vs 87.67±7.68 bpm) and 24 hours (101.07±6.77 bpm vs 94.63±4.94 bpm) postoperatively.

TABLE 7: SBP postoperatively at various intervals

SYSTOLIC BLOOD PRESSURE										
	GROUP 1				GROUP 2					
	MEAN	S.D.	MIN	MAX	MEAN	S.D.	MIN	MAX	p VALUE	INFERENCE
0 min	120.80	7.42	108	130	121.87	8.67	100	135	0.5115	NS
30 min	120.77	7.41	106	132	121.73	7.89	108	138	0.5688	NS
1 hour	121.20	8.23	106	134	122.90	8.14	106	140	0.3692	NS
2 hour	122.20	8.07	106	134	123.10	7.96	108	142	0.5777	NS
4 hour	123.77	7.77	110	135	125.07	8.73	104	144	0.4644	NS
6 hour	125.70	8.15	112	136	128.97	8.76	112	146	0.1125	NS
12 hour	127.93	7.67	115	138	134.60	8.64	120	148	0.0017	VS
24 hours	131.90	7.84	118	142	138.60	8.61	126	152	0.0019	VS

Despite the statistically insignificant difference between mean systolic blood pressure at 0 min, 30 min, 1st hour, 2nd hour, 4th hour, 6th hour postoperatively, there is a statistically significant difference between them at 12 hours (127.93±7.67 mmhg and 134.60±8.64 mmhg respectively; p=0.0017) and 24 hours (131.90±7.84 mmhg and 138.60±8.61 mmhg respectively; p= 0.0019) postoperatively. There is a gradual increase in mean systolic blood pressure in group 2 compared to group 1 at 12 hours (134.60±8.64 mmhg vs127.93±7.67 mmhg) and 24 hours (138.60±8.61 mmhg vs 131.90±7.84 mmhg) postoperatively.

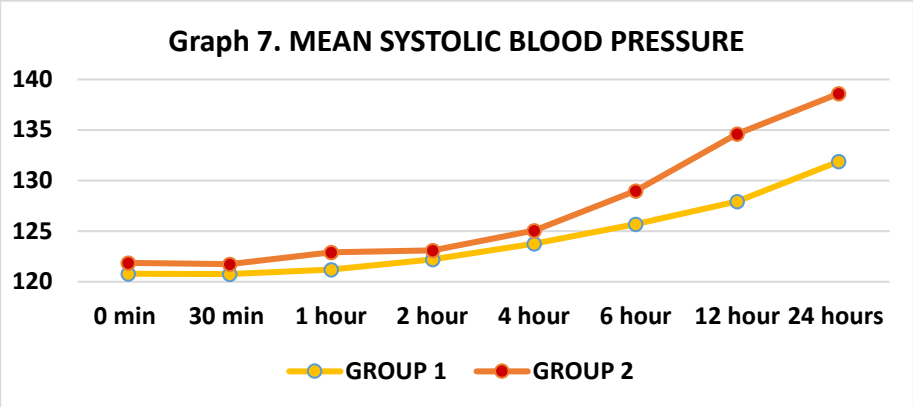


TABLE 8: DBP postoperatively at various intervals.

DIASTOLIC BLOOD PRESSURE										
	GROUP 1				GROUP 2					
	MEAN	S.D.	MIN	MAX	MEAN	S.D.	MIN	MAX	p VALUE	INFERENCE
0 min	73.07	6.14	60	82	73.17	6.42	60	88	0.9638	NS
30 min	73.13	5.88	60	80	73.27	5.55	62	86	0.9866	NS
1 hour	73.97	6.08	61	82	73.57	5.94	60	84	0.6657	NS
2 hour	74.13	5.60	63	82	74.00	5.99	60	84	0.8200	NS
4 hour	76.27	5.93	64	86	75.90	6.51	62	86	0.7205	NS
6 hour	77.97	5.95	65	88	79.77	5.68	70	88	0.2966	NS
12 hour	80.13	6.08	68	90	84.13	5.14	72	92	0.0122	S
24 hours	83.07	5.96	70	92	87.07	4.86	76	96	0.0083	VS

Despite the statistical insignificance between mean DBP at 0 min, 30 mins, 1st hour, 2nd hour, 4th hour, 6th hour postoperatively, there is a statistically significant difference between them at 12 hours (80.13±6.08 mmhg and 84.13±5.14 mmhg respectively; p=0.0122) and 24 hours (83.07±5.96 mmhg and 87.07±4.86 mmhg respectively; p= 0.0083) postoperatively.

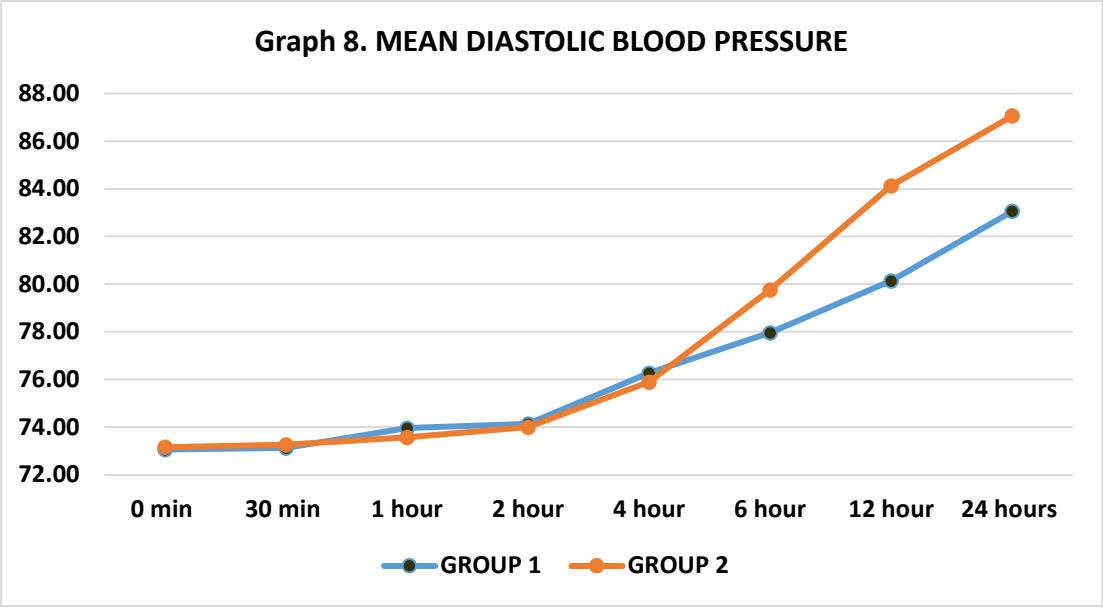


TABLE 9: RR postoperatively at various intervals

RESPIRATORY RATE										
	GROUP 1				GROUP 2					
	MEAN	**S.D.**	**MIN**	**MAX**	**MEAN**	**S.D.**	**MIN**	**MAX**	**p VALUE**	**INFERENCE**
0 min	12.40	1.00	11	14	12.50	1.01	11	14	0.8428	NS
30 min	12.47	1.14	11	14	12.33	0.55	12	14	0.5251	NS
1 hour	12.50	0.78	11	14	12.27	0.64	11	14	0.1835	NS
2 hour	12.53	0.90	11	14	12.33	0.71	11	14	0.3077	NS
4 hour	12.63	0.93	12	14	12.80	0.81	12	14	0.5262	NS
6 hour	12.73	0.94	11	14	13.20	0.96	12	15	0.0816	NS
12 hour	13.67	0.92	12	16	15.13	1.07	14	18	< 0.0001	HS
24 hours	15.00	1.29	13	18	16.07	1.31	14	18	0.0028	VS

We found the mean respiratory rate among the two groups postoperatively at 0 min was (12.40 vs 12.50), at 30 min was (12.47 vs 12.33), at 1st hour was (12.50 vs 12.27), at 2nd hour was (12.53 vs 12.33), at 4th hour was (12.63 vs 12.80), at 6th hour was (12.73 vs 13.20), at 12th hour was (13.67 vs 15.13) and at 24 hours was (15.00 vs 16.07). The mean respiratory rate at the end of 12 and 24 hours is slightly on the higher side when compared to group 1.

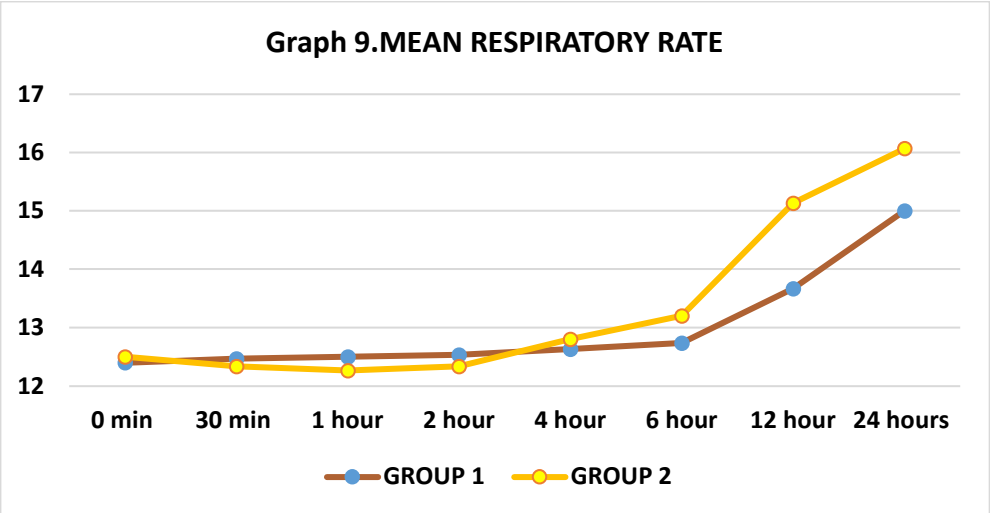


TABLE 10: VAS SCORES postoperatively at various intervals.

	VISUAL ANALOG SCALE									
	GROUP 1				GROUP 2					
TIME	MEAN	S.D.	MIN	MAX	MEAN	S.D.	MIN	MAX	p VALUE	INFERENCE
0 min	0.00	0.00	0	0	0.00	0.00	0	0	--	EQUAL
30 min	0.00	0.00	0	0	0.07	0.25	0	1	0.1626	NS
1 hour	0.03	0.18	0	1	0.53	0.51	0	1	0.1324	NS
2 hour	0.83	0.38	0	1	1.10	0.80	0	3	0.1482	NS
4 hour	0.97	0.18	0	1	1.50	0.97	0	4	0.1528	NS
6 hour	1.40	0.81	1	3	2.70	1.29	1	6	0.1851	NS
12 hour	2.70	0.70	1	3	4.93	1.20	3	7	< 0.0001	HS
24 hours	4.30	0.95	3	5	6.57	1.14	4	8	< 0.0001	HS

The data was comparable between both the groups from the 6th hour postoperatively showing slight increase in mean VAS score in group 2 compared to group 1 (2.70±1.29 vs 1.40±0.81), also 12th hour postoperatively (4.93±1.20 vs 2.70±0.70) and 24 hours (6.57±1.14 vs 4.30±0.95).

The mean VAS at 12th hour and 24 hours postoperatively in group 2 was 4.93±1.20 vs 2.70±0.70 and 6.57±1.14 vs 4.30±0.95 respectively compared to group 1.

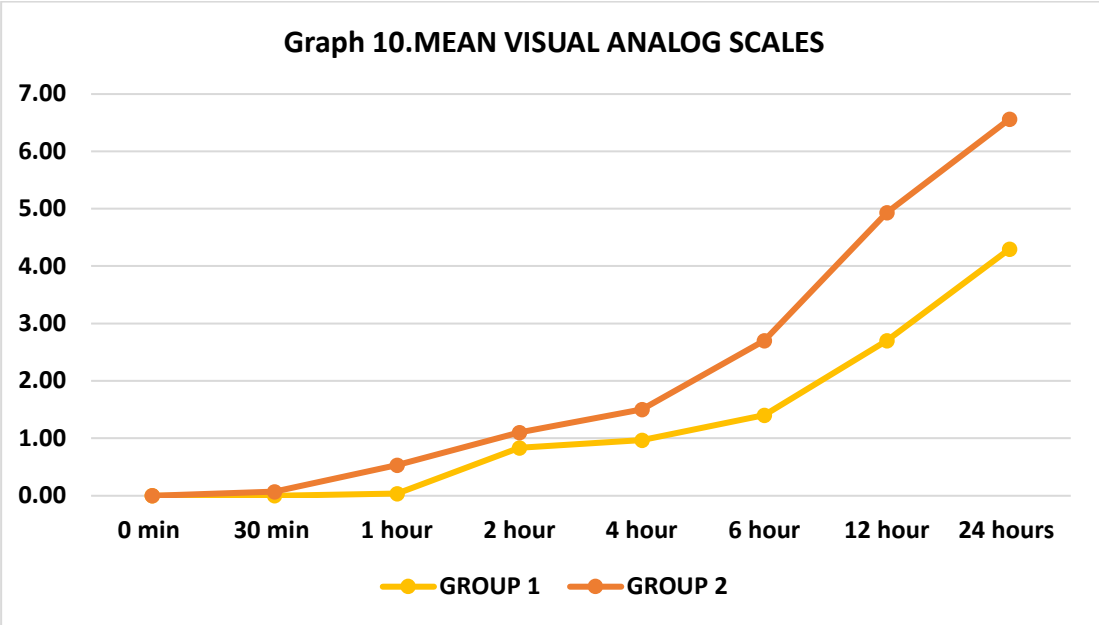
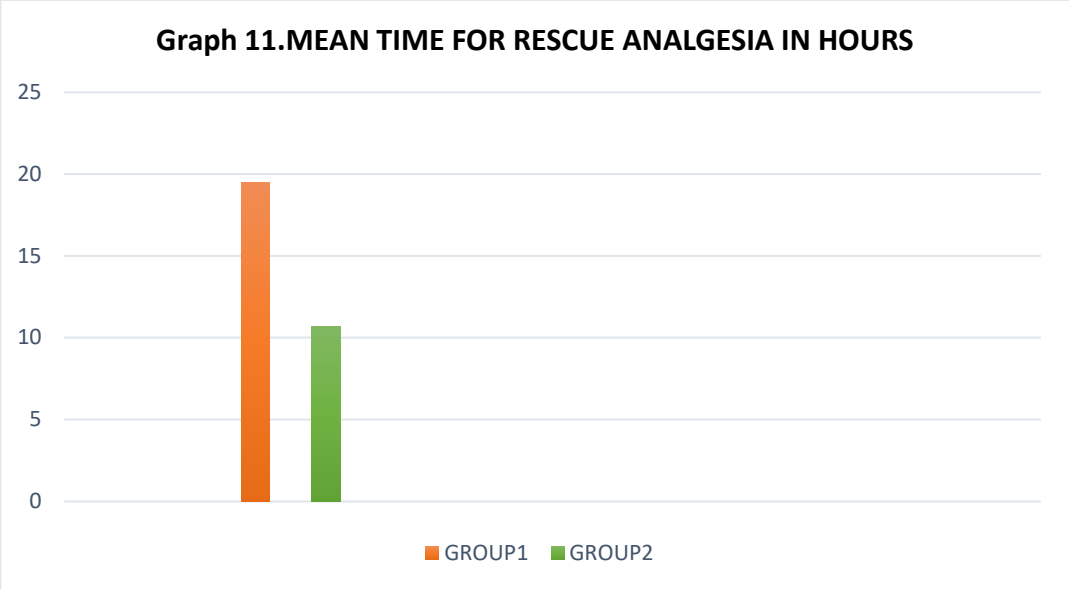


TABLE 11: Time for the request of analgesia

	GROUP 1				GROUP 2					
	MEAN	**S.D.**	**MIN**	**MAX**	**MEAN**	**S.D.**	**MIN**	**MAX**	**p VALUE**	**INFERENCE**
TIME FOR THE NEED OF RESCUE ANALGESIA	19.52	1.78	16	24	10.70	1.26	8	12	< 0.0001	HS

When comparing both groups in terms of time for the need of rescue analgesia, it was 19.52±1.78 hours in group 1 and 10.70±1.26 hours in group 2.



DISCUSSION

Currently, laparoscopic surgeries are preferred over open techniques due to various benefits which includes lesser morbidity, less postoperative pain, early ambulation, faster recovery and discharge from the hospital. However laparoscopic surgeries are not absolutely pain free [1].

Postoperative pain is the most common but yet a troublesome problem following surgeries. Poorly controlled postoperative pain has various impacts such as increased morbidity, prolonged recovery from surgery, progression to chronic postoperative pain. Pain intensity is particularly high during early postoperative period [2,3,4].

Various modalities have been used for postoperative analgesia in laparoscopic surgeries which include opioids, NSAIDS, port site infiltration with local anesthetics, intraperitoneal instillation of local anaesthetics etc [2,3,4].

Recently, Truncal blocks are more commonly used for postoperative pain management in major surgeries. Opioids have dependence and side effects like nausea, vomiting, respiratory depression. NSAIDs produce complications like gastric ulcers, anaphylaxis, renal dysfunction etc. With the advancement of ultrasound in regional anaesthesia, these blocks are more popular nowadays due to its higher success rate and minimal side effects [5].

TAP block is a novel locoregional anesthetic technique for postoperative analgesia especially in initial postoperative period. It involves injection of local anesthetic in the fascial plane between the transversus abdominis and internal oblique muscles. The neuro-fascial plane present between internal oblique and transversus abdominal muscle is traversed by intercostal nerves (T7-12), ilioinguinal and ilio-

hypogastric nerves (L1). These nerves supply part of parietal peritoneum and skin and muscles of the anterior abdominal wall [6].

Quadratus lumborum block is a type of fascial plane block which does not target a single nerve. The mechanism of analgesia and spread of local anesthetics in QL block is still not clear. The quadratus lumborum muscle is encircled in the thoracolumbar fascia which itself forms the anterior layer, the middle layer coming between the quadratus lumborum and erector spinae, the posterior layer which encloses the erector spinae. The anterior layer combines medially with the psoas major fascia and laterally with the transversalis fascia. QLB provides both somatic and visceral analgesia. It usually provides analgesia in T7-L1 dermatomes, to an extent it is believed to spread to T4-T5 cranially and L2-L3 caudally. It results in the blockade of subcostal, ilio-hypogastric, ilioinguinal nerve and, occasionally the genitofemoral and lateral femoral cutaneous nerve. The mechanism behind the block causing wide-spread analgesia is assumed that the local anesthetic injection in the anterior layer between the quadratus lumborum spreads cranially under the lateral arcuate ligament to the endothoracic fascia and reaches the inferior thoracic para-vertebral space which contains a numerous sympathetic fibers and mechanoreceptors. The target site for injection in QL2 block (quadratus lumborum 2) is a triangular structure called the lumbar inter-fascial triangle (LIFT) [6].

In 2016, Murouchi et al [12] did a study “to evaluate the analgesic effects of quadratus lumborum block after laparoscopic surgery”. The results of this study were compared with the result of their previous study on lateral TAP block. They concluded that Quadratus lumborum block produced an extensive and long-lasting analgesic effect in type 2. Hence, in our study we compared the duration of

postoperative analgesia of ultrasound guided quadratus lumborum type 2 versus lateral transverse abdominis plane block.

For ultrasound guided truncal blocks variety of local anesthetics like bupivacaine, levobupivacaine, ropivacaine are used in various concentrations to provide post operative analgesia [7,9,23].

In 2016, Sinha S et al [30] conducted a study "to evaluate the efficacy of 0.25% bupivacaine and 0.375% ropivacaine for postoperative analgesia in laparoscopic cholecystectomy in TAP block". Various other studies have also used 0.25% bupivacaine for postoperative analgesia in truncal blocks. Bupivacaine is an amide linked local anesthetic which acts for a longer duration. It is the most commonly available and widely used drug in the truncal blocks. Therefore, in our study we have used 0.25% bupivacaine as local anaesthetic.

In 2018, Yousef et al [15], did a study named "Quadratus Lumborum Block versus Transversus Abdominis Plane Block in Patients Undergoing Total Abdominal Hysterectomy: A Randomized Prospective Controlled Trial". In 60 female patients, the block was performed accordingly to evaluate total morphine needs in 24 hours, VAS for pain (at 30 min, 2, 4, 6, 12, and 24 hours postoperative), duration of postoperative analgesia, intraoperative fentanyl requirements, need for rescue analgesics. The blocks were performed using 20ml 0.25% bupivacaine bilaterally. Hence in our study also we had used 20ml 0.25% bilaterally.

Various studies [23-27] are available comparing "the efficacy of quadratus lumborum block versus transversus abdominis plane block after abdominal surgeries" performed both pre-operatively and post-operatively. In our study the main concern

was to identify the duration of postoperative analgesia, hence we performed the block postoperatively at the end of surgery.

This one-year randomized control trial was conducted on 60 ASA I and II patients aged between 18-60 years of age undergoing elective laparoscopic surgeries under general anesthesia of both the gender. They were divided into two groups based on a computer-generated randomization table. At the end of surgery before extubation, Group 1 patients received QLB 20 ml of 0.25% bupivacaine bilaterally and group 2 patients received TAPB 20 ml of 0.25% bupivacaine bilaterally. Postoperative pain was assessed using VAS score at 0mins, 30mins, 1, 2, 4,6,12 and 24 hours. If VAS score was >3 rescue analgesia with 1gram paracetamol was provided.

There is no big difference statistically among the two groups with respect to mean age (39.07±9.04 and 38.00±9.89 years respectively; p=0.7801) and mean weight (71.57±7.75 kgs, 69.63±10.00 kgs respectively; p=0.4426).

In group 1, out of 30 patients 18 were females and 12 were males. In group 2, out of 30 patients 16 were females and 14 were males. On comparison, we found that there is no statistical significance between the two groups.

In group 1, out of the total 30 patients 25 (83.33%) patients were ASA grade I and 5 (16.66%) patients were ASA grade II. In group 2, out of the total 30 patients 26 (86.66%) patients were ASA grade 1 and 4 (13.34%) patients were ASA grade II. The data was comparable in both groups.

There was no statistical significance between the groups in terms of baseline mean heart rate (78.17±6.74 beats per minute,79.20±7.87 beats per minute respectively; p= 0.7576), mean SBP (121.57±7.56 mmhg,123.17±9.29 mmhg respectively; p=0.3947), mean DBP (76.17±6.29 mmhg,74.77±5.37mmhg

respectively; p= 0.2935), mean RR (12.77 breaths per min±0.94,12.80±1.00 breaths per min respectively; p=0.9783).

In this study, we identified that the mean heart rate among the two groups at 0 min postoperatively was (77.97±6.59 bpm and 78.87±7.99 bpm respectively; p=0.8230),at 30 min postoperatively was (77.10±7.39 bpm and 78.73±7.83 bpm respectively; p=0.5563), at 1st hour postoperatively was (77.50±6.66 bpm and 77.53±8.01 bpm respectively; p=0.8484), at 2nd hour postoperatively was (79.30±6.65 bpm and 77.93±7.72 bpm respectively; p=0.3466), at 4th hour postoperatively was (80.30±7.06 bpm and 80.60±7.37 bpm respectively; p=0.8852), at 6th hour postoperatively was (83.50±7.28 bpm and 83.67±7.88 bpm respectively; p=0.8779), at 12th hour postoperatively was (87.67±7.68 bpm and 90.87±6.92 bpm respectively; p=0.1445) and at 24 hours postoperatively was (94.63±6.77 bpm and 101.07±14.94 bpm respectively; p= 0.0624). Despite the statistically insignificant difference between mean heart rate at 0 min, 30 mins, 1st hour, 2nd hour, 4th hour, 6th hour, 12th hour and 24 hours, there is an increase in mean heart rate in group 2 compared to group 1 at 12 hours (90.87±6.92 bpm vs 87.67±7.68 bpm) and 24 hours (101.07±6.77 bpm vs 94.63±4.94 bpm) postoperatively. This could have been due to uncomforting pain caused postoperatively suggesting that the patients in group 1 had a more effective postoperative analgesia due to the block given compared to group 2.

In this study, we also identified that the mean systolic blood pressure among the two groups at 0 min postoperatively was (120.80±7.42 mmhg and 121.87±8.67 mmhg respectively; p=0.5115),at 30 min postoperatively was (120.77±7.41bpm and 121.73±7.89 mmhg respectively; p=0.5688), at 1st hour postoperatively was (121.20±8.23 mmhg and 122.90±8.14 mmhg respectively; p=0.3692), at 2nd hour postoperatively was (122.20±8.07 mmhg and 123.10±7.96 mmhg respectively;

p=0.5777), at 4th hour postoperatively was (123.77±7.77 mmhg and 125.07±8.73 mmhg respectively; p=0.4644), at 6th hour postoperatively was (125.70±8.15 mmhg and 128.97±8.76 mmhg respectively; p=0.1125), at 12th hour postoperatively was (127.93±7.67 mmhg and 134.60±8.64 mmhg respectively; p=0.0017) and at 24 hours postoperatively was (131.90±7.84 mmhg and 138.60±8.61 mmhg respectively; p= 0.0019). Despite the statistically insignificant difference between mean systolic blood pressure at 0 min, 30mins, 1st hour, 2nd hour, 4th hour, 6th hour postoperatively, there is a statistically significant difference between them at 12 hours (127.93±7.67 mmhg and 134.60±8.64 mmhg respectively; p=0.0017) and 24 hours (131.90±7.84 mmhg and 138.60±8.61 mmhg respectively; p= 0.0019) postoperatively. There is a gradual increase in mean systolic blood pressure in group 2 compared to group 1 at 12 hours (134.60±8.64 mmhg vs127.93±7.67 mmhg) and 24 hours (138.60±8.61 mmhg vs 131.90±7.84 mmhg) postoperatively. This could have been due to uncomforting pain caused postoperatively suggesting that the patients in group 1 had a longer duration of postoperative analgesia due to the block given compared to group 2.

In this study, we also identified that the mean diastolic blood pressure among the two groups at 0 min postoperatively was (73.07±6.14 mmhg and 73.17±6.42 mmhg respectively; p=0.9638),at 30 min postoperatively was (73.13±5.88 mmhg and 73.27±5.55 mmhg respectively; p=0.9866), at 1st hour postoperatively was (73.97±6.08 mmhg and 73.57±5.94 mmhg respectively; p=0.6657), at 2nd hour postoperatively was (74.13±5.60mmhg and 74.00±5.99 mmhg respectively; p=0.8200), at 4th hour postoperatively was (76.27±5.93 mmhg and 75.90±6.51 mmhg respectively; p=0.7205, at 6th hour postoperatively was (77.97±5.95 mmhg and 79.77±5.68 mmhg respectively; p=0.2966), at 12th hour postoperatively was (80.13±6.08 mmhg and 84.13±5.14 mmhg respectively; p=0.0122) and at 24 hours

postoperatively was (83.07±5.96 mmhg and 87.07±4.86 mmhg respectively; p= 0.0083). Despite the statistically insignificant difference between mean diastolic blood pressure at 0 min, 30 mins, 1st hour, 2nd hour, 4th hour, 6th hour postoperatively, there is a statistically significant difference between them at 12 hours (80.13±6.08 mmhg and 84.13±5.14 mmhg respectively; p=0.0122) and 24 hours (83.07±5.96 mmhg and 87.07±4.86 mmhg respectively; p= 0.0083) postoperatively. There is a gradual increase in mean diastolic blood pressure in group 2 compared to group 1 at 12 hours (84.13±5.14 mmhg vs 80.13±6.08 mmhg) and 24 hours (87.07±4.86 mmhg vs 83.07±5.96 mmhg) postoperatively. This could have been due to uncomforting pain caused postoperatively suggesting that the patients in group 1 had a longer duration of postoperative analgesia due to the block given compared to group 2.

We found the mean respiratory rate among the two groups postoperatively at 0 min was (12.40 vs 12.50), at 30 min was (12.47 vs 12.33), at 1st hour was (12.50 vs 12.27), at 2nd hour was (12.53 vs 12.33), at 4th hour was (12.63 vs 12.80), at 6th hour was (12.73 vs 13.20), at 12th hour was (13.67 vs 15.13) and at 24 hours was (15.00 vs 16.07). The mean respiratory rate at the end of 12 and 24 hours is slightly on the higher side when compared to group 1 with statistical significance (p=<0.0001 and 0.0028 respectively). This shows that mild increase in respiratory rate in group 2 could have been due to ineffective analgesia as pain causes tachycardia, tachypnea and increased blood pressure.

In this study, we found the mean VAS score among the two groups postoperatively at 0 min was (0.00±0.00 and 0.00±0.00 respectively), at 30 min was (0.00±0.00 and 0.07±0.25 respectively; p=0.1626), at 1st hour was (0.03±0.18 and 0.08±0.15 respectively; p=0.1324), at 2nd hour was (0.83±0.38 and 1.10±0.80 respectively; p=0.1482), at 4th hour was (0.97±0.18 and 1.50±0.97 respectively;

p=0.1528), at 6th hour was (1.40±0.81 and 2.70±1.29 respectively; p= 0.1851), at 12th hour was (2.70±0.70 and 4.93±1.20 respectively; p=<0.0001) and 24 hours was (4.30±0.95 and 6.57±1.14 respectively; p=<0.0001). The data was comparable between both the groups from the 6th hour postoperatively showing slight increase in mean VAS score in group 2 compared to group 1 (2.70±1.29 vs 1.40±0.81), also 12th hour postoperatively (4.93±1.20 vs 2.70±0.70) and 24 hours (6.57±1.14 vs 4.30±0.95).

The mean VAS score at 12th hour and 24 hours postoperatively in group 2 was 4.93±1.20 vs 2.70±0.70 and 6.57±1.14 vs 4.30±0.95 respectively compared to group 1. The data suggests that the mean VAS score at the end of 12 hours postoperatively in group 2 is 4.93±1.20 and 24 hours postoperatively is 6.57±1.14 which requires the need for rescue analgesia at the end of 12 hours in group 2 which was quite earlier when compared to group 1.

When comparing both groups in terms of time for the need of rescue analgesia it was 19.52±1.78 hours in group 1 and 10.70±1.26 hours in group 2. This shows that analgesia was more effective and acted longer in QL block than TAP block

From the above-mentioned data, it can be concluded that the mean duration of postoperative analgesia of patients in group 1 was more than 12 hours (around 19.52±1.78 hours) postoperatively whereas patients in group 2 was between 8-12 hours (10.70±1.26 hours) postoperatively.

We did not find any side effects such as a case of block failure, hypotension, LA toxicity, arrhythmias or other untoward complications.

Murouchi et al [12], in 2016 did a study on "Quadratus Lumborum Block Analgesic Effects and Chronological Ropivacaine Concentrations comparing with lateral TAPB After Laparoscopic Surgery". The blocks were given using 0.375%

ropivacaine on patients before surgery and results came out that the median analgesic duration of QLB was more than 24 hours and a bit longer than lateral TAPB. The results of this study are near to our study.

Blanco et al [13], in 2016 conducted a study titled "Quadratus Lumborum Block Versus Transversus Abdominis Plane Block for Postoperative Pain After Cesarean Delivery - A Randomized Controlled Trial". The blocks were given in 76 patients who had undergone elective cesarean section accordingly at the end of surgery using 0.125% bupivacaine. They found that QLB group had significantly lesser morphine needs than TAPB group. They concluded that the QLB is more effective in contrast to TAPB. The results are comparable to our study.

Oksuz et al [14], in 2017 did a study named "Quadratus Lumborum Block Versus Transversus Abdominis Plane Block in Children Undergoing Low Abdominal Surgery-A Randomized Controlled Trial". Since it was children, they used FLACC scores for pain assessment. They found out that the children requiring analgesia postoperatively in the first 24 hours was significantly lower in QLB, also the time for first analgesic need was found to be 15 hours in the QLB group and 10 hours in the TAPB group. They concluded saying QLB group had longer and effective analgesia compared to TAPB. The results are comparable to our study.

Yousef et al [15], in 2018 did a study named "Quadratus Lumborum Block versus Transversus Abdominis Plane Block in Patients Undergoing Total Abdominal Hysterectomy: A Randomized Prospective Controlled Trial". In 60 female patients, the block was performed accordingly to evaluate total morphine needs in 24 hours, VAS for pain (at 30 min, 2, 4, 6, 12, and 24 hours postoperative), duration of postoperative analgesia, intraoperative fentanyl requirements, need for rescue analgesics. Their evaluation revealed that the dose of fentanyl required

intraoperatively was higher in TAPB group, morphine needs in 24 hours postoperatively was less in QLB group and the duration of analgesia postoperatively was 15.1±2.12 longer in QLB group when compared with the TAPB group (8.33±4hours). Their findings are similar to our study.

In 2020, Liu et al [19], did a metanalysis on "Quadratus lumborum block versus transversus abdominis plane block for postoperative analgesia in patients undergoing abdominal surgeries: a systematic review and meta-analysis of randomized controlled trials". They analyzed 8 RCTs to find out analgesic efficacy of blocks to determine the better regional technique to manage early postoperative pain. QLB was found to be better technique than TAPB for early postoperative pain as it provided longer effect. QLB also reduced postoperative opioid needs to a markable point than TAPB. The results are comparable with our study.

Limitations of our study are may be the blocks could have been performed at the commencement of surgery for better control of hemodynamics and pain peri-operatively, also VAS scores were assessed only during rest not at movement. Also, a fixed amount of the drug was injected rather than per kg body weight which could have given clear idea of the drug required for such truncal blocks.

Future scope includes further studies can done by placing catheters at the injection site to deliver infusions continuously for providing extensive time period of postoperative analgesia. Monitoring of patients via telecommunication, audio-visual aids to have frequent access to patients or for ease of the patients to report their problems immediately to the investigator/care giver and to promote these techniques in day care surgeries to reduce NSAIDS, opioids, etc. needs and dependence

CONCLUSION

Ultrasound guided QL type 2 block using 0.25% bupivacaine produces a more effective and longer duration of postoperative analgesia when compared to lateral TAP block in patients undergoing laparoscopic surgeries. The mean duration of postoperative analgesia in QLB is around 18-20 hours whereas in TAPB is around 10-12 hours.

SUMMARY

This randomized control study was conducted at KLES Prabhakar kore charitable hospital and MRC, Belagavi in the Anesthesia department for a period of one year following ethical committee clearance. It was done on 60 patients belonging to both ASA I and II within age group of 18-60 years of both the genders undergoing elective laparoscopic surgeries after the written informed consent being given. A detailed PAE was done and patients were allocated into group 1 and 2 according to a computer -generated randomization table. Patients were given general anesthesia and surgery was performed. At the end of the surgery before extubation, patients in group 1 received QLB with 20 ml 0.25% bupivacaine bilaterally and patients in group 2 received TAPB with 20 ml 0.25% bupivacaine under ultrasound guidance following which routine extubation was done.

Post-operatively pain was assessed at various intervals (0 min, 30 min, 1 hr, 2 hr, 4hr, 6hr, 12hr, 24hrs) with VAS scores. Inj. Paracetamol 1 gm was given as a rescue analgesic if VAS score was >3. Failed blocks (VAS>3 at 0 min, 30 min), LA toxicity and side effects if any were also noted. The response of pain in HR, RR, SBP and DBP were also documented and analyzed.

On analysis, the mean VAS scores were comparable between both the groups at various intervals post-operatively. Also, the mean HR, RR, SBP, DBP was comparable between both the groups. The data was statistically significant between both at the end of 12 and 24 hours. The mean VAS scores at 12 hrs was (2.70±0.70 vs 4.93±1.20 hrs respectively; p= <0.0001 – HS) and at 24 hrs was (4.30±0.95 vs 6.57±1.14 respectively; P=<0.0001-HS). The time required for first rescue analgesia was 19.52±1.78 hours in group 1 and 10.70±1.26 hours in group 2

In this study based on our results, we conclude that the QL block produces a more effective and longer duration of postoperative analgesia (around 18-20 hours) than the TAP block (around 8-12 hours) in patients undergoing laparoscopic surgeries.

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ANNEXURE I. ETHICAL CLEARANCE.

K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed - to-be University)
Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (GoI)

JAWAHARLAL NEHRU MEDICAL COLLEGE,
NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)

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Principal: 2471701
Fax No. +91 (0)831 – 2470759

Ref: MDC/DOME/ 175 **Date: 24/12/2019**

To

REG NO.BA0119005

PG student in Anaesthesiology,
J.N.Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"COMPARISON OF DURATION OF POSTOPERATIVE ANALGESIA OF ULTRASOUND GUIDED QUADRATUS LUMBORUM BLOCK VS TRANSVERSUS ABDOMINIS PLANE BLOCK USING 0.25% BUPIVACAINE IN LAPAROSCOPIC SURGERIES – A ONE YEAR HOSPITAL BASED RANDOMISED CLINICAL TRIAL".** is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

(Dr. Anita Dalal)
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

(Dr. Roopa M Bellad)
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

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ANNEXURE II

INFORMED CONSENT

PRINCIPAL INVESTIGATOR: **REG NO.BA0119005**
Post Graduate student
Department of Anaesthesiology
JNMC, Belagavi.

CO- INVESTIGATOR: **DR. _____**
Professor
Department of Anaesthesiology
JNMC, Belagavi.

INTRODUCTION AND PURPOSE:

The present study is conducted among patients aged between 18-60 years scheduled for elective laparoscopic surgeries in the department of Anaesthesiology at KLE's Dr. Prabhakar Kore Charitable Hospital and Medical Research Centre, Belagavi. You are requested to participate in the study and your participation is completely voluntary.

The aim of the study is to compare the duration of postoperative analgesia of ultrasound guided quadratus lumborum block vs transeversus abdominis plane block using 0.25% bupivacaine in laparoscopic surgeries. This will help to compare both the techniques.

PROCEDURE:

If you agree to participate in the study, the relevant data will be collected as per the proforma. Once you are inducted in the study you will be randomly allocated to either one of the study groups and blocks will be performed based on the assigned

group. Analgesic duration for both group will be assessed by visual analog scale for pain and vital parameters at 0, 30minutes, 1, 2, 4, 6, 12, 24 hours postoperatively.

BENEFITS:

If you agree to participate in the study, you will be given either one of the blocks for postoperative pain, from which you will benefited in the postoperative period comfortably without pain and distress.

RISKS:

Methods applied to do the study are safe. Rare complications such as drug allergy, toxicity might occur.

COST OF PARTICIPATION:

The cost of the investigation will be done by the study subject. The other indirect expenses will be borne by the investigator.

PRIVACY AND CONFIDENTIALITY:

The results of the study may be published in journals for scientific purposes. However, your identity will not be revealed. All information collected will be coded so that no one other than the investigator will know your identity.

WITHDRAWAL FROM THE STUDY:

You can withdraw from the study at any time if you wish to do so.

ALTERNATIVES:

In case you opt out of the study, it will not affect your relationship with KLE's Dr. Prabhakar Kore Hospital.

AUTHORIZATION TO PUBLISH RESULTS:

The researcher may use the information gathered from this study for presentation in scientific meetings. However, your identity will not be revealed.

INSTITUTIONAL/ SPONSORS POLICY:

In the event of any injury related to this study, no reimbursement or compensation will be given by law. However, treatment will be made available at KLE's Hospital & MRC, Belgaum. If you face any untoward event, you may contact **REG NO.BA0119005** at Department of Anaesthesiology, KLE's Hospital & MRC. Dr._____ Professor at Department of Anaesthesiology, KLE's Hospital & MRC.

LEGAL RIGHTS:

By signing this consent form, you are not waiving any of your legal rights.

QUERIES AND CONTACT:

If you have any queries regarding to the study, you can contact Dr. Dharanya Chandrasekaran, Department of anesthesiology, J.N.Medical College by and the guide Dr._____ M.D, Professor, Dept of Anaesthesiology, J.N Medical College, Belagavi.

If you have any queries about your rights as research participant, you can contact Dr. Roopa Bellad M.D, Professor, Dept of Paediatrics and chairman, J.N Medical College Institutional Ethical Committee for Human Subjects Research.

CONSENT SUMMARY:

I have been explained all the contents of this consent form in my local language and having understood and clarified all my queries about the study to the best of my knowledge, I hereby give my voluntary consent for participation in the study. I do sign the informed consent form in front of an eye witness whom I recognize.

Name of the participant:

Signature/ left thumb impression of the participant:

Name and Signature of the investigator:

Name of the eye witness (Relative):

Signature/ left thumb impression of the eye witness (Relative):

Signature of the Guide: Date:

Date: Place:

CONSENT STATEMENT TO PARTICIPATE IN RESEARCH STUDY

I, Mr/Mrs _____voluntarily agree for the participation of myself as a subject for the study, by signing this consent form I am not giving up any of my legal rights, I may withdraw from the study anytime. I am signing the consent form after having read or been read to me in the vernacular language, including the risk and the benefits and having all my queries cleared.

Name of study participant:

Signature or the left thumb impression of the participant:

Name and signature of witness: _____

_____

Name and signature of investigator: _____

_____

ANNEXURE III

PROFORMA

Title: "COMPARISON OF DURATION OF POSTOPERATIVE ANALGESIA OF ULTRASOUND GUIDED QUADRATUS LUMBORUM BLOCK VS TRANSVERSUS ABDOMINIS PLANE BLOCK USING 0.25% BUPIVACAINE IN LAPAROSCOPIC SURGERIES – A ONE YEAR HOSPITAL BASED RANDOMISED CLINICAL TRIAL"

Patients Name : I.P No. :

Age : Weight :

Gender : Date of operation:

Address : Anaesthesiologist:

Pre-anaesthetic evaluation

Chief complaints:

H/o present illness:

Past History:

Family History:

General physical examination

Weight (Kg) : Temperature (^{0}F) : Pallor :

Cyanosis : Pedal oedema : Clubbing:

PR : RR : BP :

Systemic examination

RS : CNS :

CVS : GIT :

Airway Assessment: **spine:**

Investigations

Hb(gm/dl): Platelet count: creat:

Diagnosis

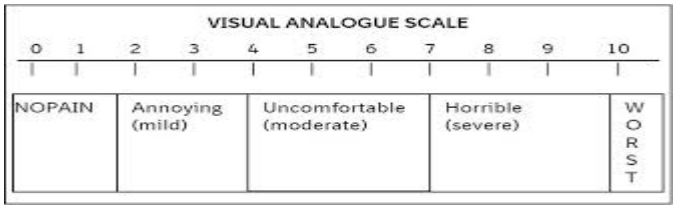
Proposed surgery

Preoperative physical status ASA Grade I II III IV V

Pre-op post-op

	0 min	30min	1hr	2hr	4hr	6hr	12hr	24hrs	
Pulse rate (/min)									
Blood pressure (mm/hg)									
Respiratory Rate (breaths/min)									

VISUAL ANALOG SCALE FOR PAIN (POST OPERATIVE PAIN)



Postoperatively:

0 min	30 min	1 hr	2 hr	4hr	6hr	12hr	24hrs

Rescue analgesia if used:

Selection Criteria:

Inclusion Criteria:

- ASA grade I and II patients.
- 18-60 years of age patients posted electively for laparoscopic surgeries under general anesthesia.

Exclusion Criteria:

- ASA grade III or IV patients.
- Patients who are not willing / not giving consent for the study.
- Patients undergoing emergency surgeries.
- Patients with known allergy to local anesthetics.
- Patients with infection at injection site.
- Patients with anticipated difficult airway
- Patients with diseases which can alter interpretation of pain scores.

After approval from the Institutional ethics committee, this one year randomized clinical trial was conducted at KLES Dr. Prabhakar Kore Hospital and MRC, Jawaharlal Nehru Medical College, Belagavi.

With the inclusion and exclusion criteria being rule out and having obtained the consent, patients were randomized based on computer generated randomization table into one of the two groups.

GROUP 1:

Patients (n=30) in whom quadratus lumborum (QL) block was performed.

GROUP 2:

Patients (n=30) in whom transversus abdominis plane (TAP) block was performed.

A detailed PAE was done for all patients and routine investigations were also reviewed. Peri-operatively routine vital monitors (Spo2, ECG, NIBP, ETco2) were all applied. Baseline readings of vitals including HR, RR, SBP, DBP and Sp02 were noted. Intravenous (IV) line will be secured and IV fluid was started.

In all patients, Pre-medications were given.GA was induced with IV Inj. fentanyl (1 μg/kg), propofol (2 mg/kg), and atracurium (0.5 mg/ kg) was administered. Pre-oxygenation was done for 3-5 minutes, then endotracheal intubation was carried out and put on mechanical ventilation. Anesthesia was maintained with oxygen, nitrous oxide, isoflurane titrated according to the MAC values. Intra-operatively routine analgesics were given.

Before extubation and at the end of the surgery, either quadratus lumborum or transversus abdominis block was performed under strict aseptic precautions using ultrasound guided technique.

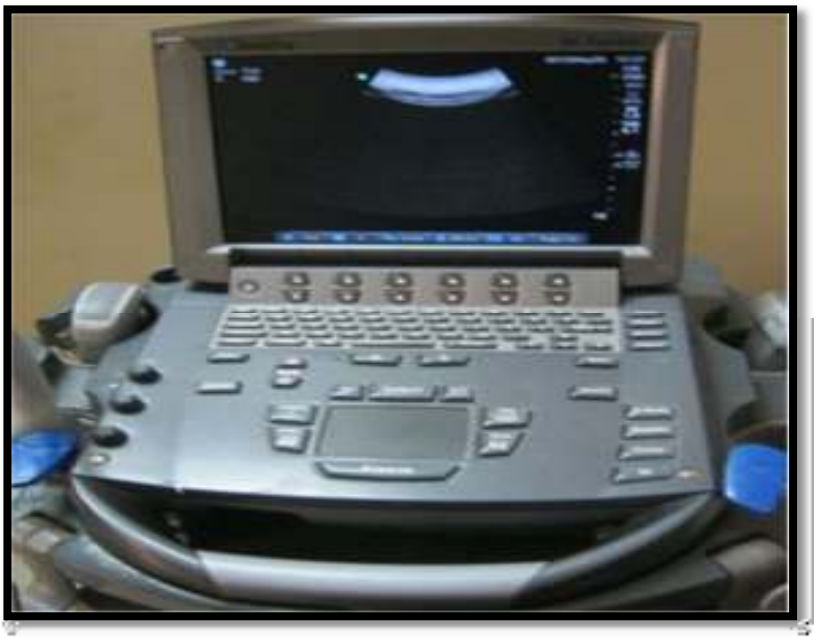
In TAPB group, blocks were performed with patient in supine position, the probe was placed between the iliac crest and the sub-costal margin in the anterior axillary line at the level of umbilicus. The abdominal wall layers were visualized (EO, IO and TP muscles). The needle insertion was done using in-plane technique with tip lying between the IO and TA muscles. After confirmation with negative aspiration which rules out vascular injection, 20 mL of 0.25% bupivacaine on each side was injected.

In QL group, blocks were performed with patient in supine position with lateral tilt, with probe at the level of the ASIS and shifted cephalad until the 3 abdominal wall muscles were visualized. The EO muscle was traced postero-laterally until its posterior border is visualized (hook sign), with the IO muscle being a roof over the QL muscle. Then probe was traced down to see a bright hyperechoic line that denotes the middle layer of the TLF. The needle insertion was done using in-plane technique directed from antero-lateral to postero-medial. The tip of the needle was positioned between the TLF and the QL muscle. After confirmation by negative aspiration to rule out vascular injection,20 mL of 0.25% bupivacaine was injected on each side.

Patients were reversed with neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg. Routine extubation was done and after the patients were responding to comments, fully conscious and oriented they were shifted to the PACU. Visual analog scale (VAS) was used to identify VAS score which evaluated the pain in the postoperative period. If VAS scores >3 in the postoperative period, rescue analgesic 1gm Paracetamol was used. Side effects such as hypotension (SBP <90 mmHg), arrhythmia, LA toxicity, bradycardia (HR <50 beats/min), nausea or vomiting, numbness, or other complications were noted.

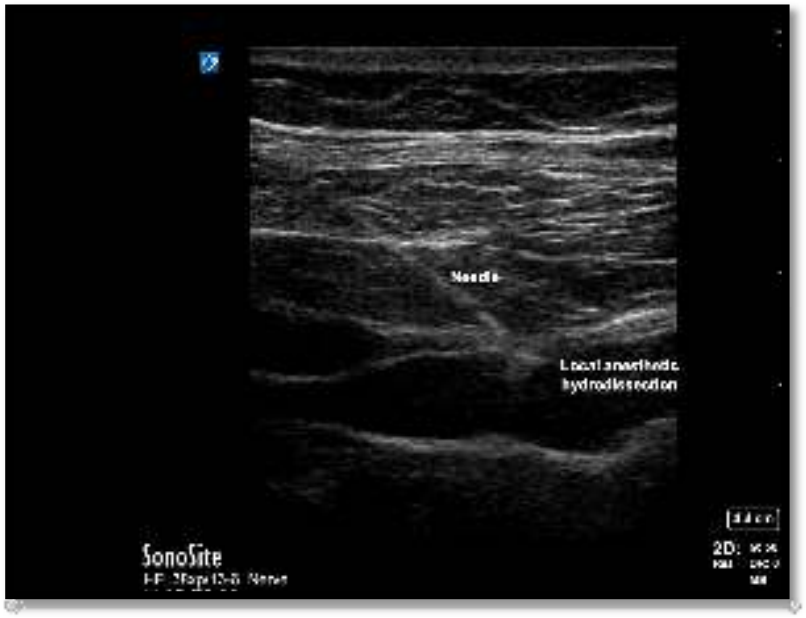
ANNEXURE IV - PHOTOGRAPHS

PHOTOGRAPH 1 –- Showing drug used 0.25% Bupivacaine

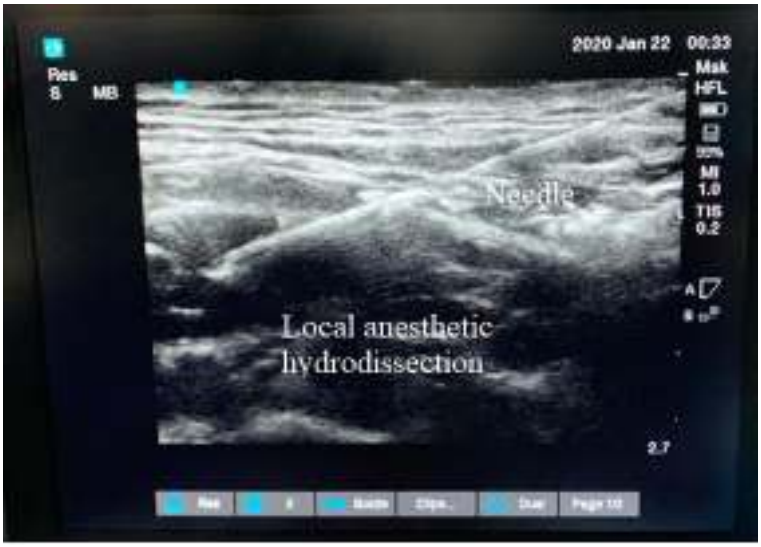


PHOTOGRAPH 2- showing SONOSITE USG machine

PHOTOGRAPH 3 Showing block performance method



PHOTOGRAPH 4 Showing QLB



PHOTOGRAPH 5 Showing TAPB

ANNEXURE V- KEY TO MASTERCHART

ASA	-	American Society of Anaesthesiologist
bpm	-	Beats per minute
BPM	-	Breaths per minute
Kgs	-	Kilograms
VAS	-	Visual analogue scale
Hrs	-	Hours
Yrs	-	Years
mg	-	milligram
Group 1	-	Quadratus lumborum block
Group 2	-	Transversus Abdominis Plane block
Hb	-	Hemoglobin

Serial number	Randomisation Number	In patient number	Age in years	Sex	ASA Grade	Baseline Data					Visual Analog Scale								Heart Rate								Systolic Blood Pressure								Diastolic Blood Pressure								Respiratory Rate								Rescue analgesia used	Time for the need of rescue analgesia
						Weight (Kgs)	HR (bpm)	SBP (mm Hg)	DBP (mm Hg)	Respiratory rate (BPM)	0 min	30 min	1 hour	2 hour	4 hour	6 hour	12 hour	24 hour	0 min	30 min	1 hour	2 hour	4 hour	6 hour	12 hour	24 hours	0 min	30 min	1 hour	2 hour	4 hour	6 hour	12 hour	24 hour	0 min	30 min	1 hour	2 hour	4 hour	6 hour	12 hour	24 hour	0 min	30 min	1 hour	2 hour	4 hour	6 hour	12 hour	24 hour		
1	1	982960	40	male	1	80	90	120	70	14	0	0	0	0	0	1	3	5	91	92	90	92	90	94	96	98	122	124	120	125	126	128	130	132	70	72	70	73	74	76	78	80	13	14	14	14	14	14	14	16	yes	18
2	1	991260	45	male	1	88	68	130	80	14	0	0	0	0	1	1	1	3	72	68	66	70	68	74	76	84	130	132	130	128	135	134	136	140	78	80	76	74	80	82	84	86	14	14	13	14	14	14	14	16	yes	16
3	1	994212	32	female	2	68	88	110	70	14	0	0	0	1	1	1	1	3	86	88	84	87	82	85	90	96	108	106	110	106	112	114	116	118	68	64	62	64	70	72	74	76	14	14	14	13	14	14	13	14	yes	16
4	1	997342	45	female	2	70	86	130	80	12	0	0	0	1	1	1	3	5	84	86	88	86	88	87	89	97	127	125	129	130	132	134	138	142	80	76	77	80	82	84	86	90	13	14	14	14	14	14	16	18	yes	24
5	1	995102	49	female	2	62	72	108	70	13	0	0	0	1	1	1	3	5	74	76	78	74	75	76	80	86	110	108	106	107	110	112	115	120	60	62	64	66	64	68	70	72	14	14	13	13	14	14	14	14	yes	20
6	1	1000252	38	male	1	75	66	120	80	14	0	0	0	1	1	1	3	3	64	60	62	64	64	67	68	75	118	117	115	113	114	116	120	126	72	76	74	72	70	76	80	86	13	14	13	14	14	14	14	14	yes	18
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9	1	1015991	55	female	2	68	74	130	90	14	0	0	0	1	1	1	3	3	74	72	73	75	76	78	80	86	128	126	127	130	132	135	137	140	82	80	81	80	84	86	88	90	14	14	13	14	14	14	15	17	yes	16
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11	1	1025343	34	female	1	64	86	110	70	14	0	0	0	1	1	3	3	5	86	84	82	84	82	80	87	96	110	108	107	112	115	113	116	118	62	60	61	64	67	65	68	70	13	14	13	12	12	12	14	14	yes	18
12	1	1027371	29	male	1	75	80	120	80	12	0	0	0	1	1	1	3	3	82	80	83	85	81	84	86	88	118	116	120	115	122	120	124	126	72	74	76	72	71	72	74	78	12	12	12	11	12	12	13	14	yes	20
13	1	1030175	33	female	1	72	74	120	70	12	0	0	0	1	1	3	3	5	76	74	72	76	80	86	92	96	118	120	122	123	127	130	128	132	74	80	82	78	84	82	86	88	11	12	12	12	13	13	14	14	yes	18
14	1	1029894	39	female	1	65	72	130	80	12	0	0	0	1	1	1	3	5	74	72	76	78	80	84	90	94	128	126	128	130	132	134	136	140	78	76	78	80	82	84	84	86	12	11	12	12	12	11	13	14	yes	20
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18	1	1034364	48	male	1	84	88	120	80	12	0	0	0	1	1	1	3	5	86	88	85	87	89	92	98	104	122	118	116	119	123	125	127	132	78	76	74	78	81	82	86	88	12	12	12	12	12	13	13	14	yes	20
19	1	1035155	45	female	1	67	86	130	80	14	0	0	0	1	1	1	3	3	84	82	80	83	85	90	94	98	130	128	132	131	127	132	134	138	80	78	82	81	78	82	84	86	13	13	14	14	14	14	14	16	yes	18
20	1	1035178	36	female	1	68	82	120	70	13	0	0	0	1	1	1	3	5	84	82	80	83	86	88	94	102	118	120	117	122	124	126	128	130	68	70	69	70	72	74	78	80	12	13	13	13	12	13	15	17	yes	18
21	1	1034024	45	female	1	74	80	110	70	12	0	0	0	1	1	3	3	5	80	78	82	84	86	88	92	110	108	112	110	114	116	118	120	122	70	68	70	69	72	71	70	74	11	12	12	12	12	12	13	15	yes	20
22	1	1035882	40	male	1	90	84	130	80	13	0	0	0	1	1	1	3	5	82	80	84	86	88	94	98	130	128	132	130	134	132	136	138	142	80	78	82	80	82	84	86	90	13	12	12	12	12	12	14	16	yes	22
23	1	1046901	29	female	1	60	76	120	80	12	0	0	0	1	1	1	2	3	74	72	75	77	79	82	85	122	120	121	123	125	126	128	130	134	76	78	73	74	77	78	80	82	12	12	12	12	12	12	12	14	yes	16
24	1	1038762	28	male	1	74	78	110	80	12	0	0	1	1	1	3	3	5	76	74	78	80	84	90	96	108	110	112	110	114	116	118	120	122	74	76	78	75	78	77	80	84	12	11	12	12	12	12	13	14	yes	20
25	1	1044492	38	female	1	62	80	120	80	12	0	0	0	1	1	1	3	5	82	78	80	82	84	88	94	118	116	118	120	122	118	120	124	128	78	74	78	80	82	80	84	86	11	12	12	12	12	12	14	14	yes	18
26	1	1043648	57	male	1	75	80	130	80	14	0	0	0	1	1	1	3	5	80	82	84	88	90	94	98	128	130	132	134	132	134	136	138	142	76	80	81	82	80	82	84	88	13	12	12	12	12	12	14	14	yes	16
27	1	1043102	32	female	1	68	84	120	70	14	0	0	0	1	1	1	3	5	84	82	80	84	88	94	98	122	120	118	120	124	122	126	130	136	74	76	72	76	74	80	82	84	13	14	13	12	12	12	13	14	yes	20
28	1	1043214	26	female	1	64	74	120	80	12	0	0	0	1	1	1	3	3	76	74	72	74	76	80	86	118	120	122	116	118	120	122	124	128	72	74	74	72	74	76	74	80	12	11	12	12	12	12	13	14	yes	16
29	1	1042283	28	female	1	67	70	110	60	12	0	0	0	0	1	1	3	4	72	70	71	73	75	77	84	108	110	112	111	113	110	114	116	120	60	62	64	63	65	66	68	70	12	11	12	12	12	12	14	16	yes	20
30	1	1043718	50	male	2	75	65	130	70	12	0	0	0	0	1	1	1	3	64	63	66	68	64	70	75	128	130	126	128	130	132	134	136	140	68	70	66	68	70	72	74	80	11	12	12	12	12	12	13	15	yes	18

Serial number	Randomisation Number	In patient number	Age in years	Sex	ASA Grade	Baseline Data					Visual Analog Scale								Heart Rate								Systolic Blood Pressure								Diastolic Blood Pressure								Respiratory Rate								Rescue analgesia used	Time for the need of rescue analgesia
						Weight (Kgs)	HR (bpm)	SBP (mm Hg)	DBP (mm Hg)	Respiratory rate (BPM)	0 min	30 min	1 hour	2 hour	4 hour	6 hour	12 hour	24 hour	0 min	30 min	1 hour	2 hour	4 hour	6 hour	12 hour	24 hours	0 min	30 min	1 hour	2 hour	4 hour	6 hour	12 hour	24 hour	0 min	30 min	1 hour	2 hour	4 hour	6 hour	12 hour	24 hour	0 min	30 min	1 hour	2 hour	4 hour	6 hour	12 hour	24 hour		
1	2	987066	25	female	1	55	86	120	70	12	0	0	0	0	0	1	4	5	84	86	82	78	80	86	98	84	126	120	124	120	122	122	140	130	72	70	72	70	74	72	80	76	12	12	14	12	14	12	16	14	yes	12
2	2	987279	48	female	1	65	70	130	76	12	0	0	0	1	1	1	5	5	70	74	72	74	76	74	86	78	128	120	126	124	124	128	136	134	80	76	70	72	74	76	90	86	12	12	12	12	12	12	14	14	yes	12
3	2	988553	46	female	1	68	92	132	78	13	0	0	0	1	1	2	3	4	94	92	90	92	94	96	102	106	128	130	130	128	130	132	144	142	76	78	80	78	76	74	84	80	12	12	12	12	12	12	14	14	yes	11
4	2	989003	45	female	1	70	74	126	74	12	0	0	0	0	0	1	3	4	70	74	72	72	74	76	78	88	126	124	128	126	124	126	128	136	72	72	74	72	70	72	74	82	12	12	12	12	12	12	14	14	yes	12
5	2	989148	43	male	1	86	80	120	72	12	0	0	0	0	1	2	4	5	82	84	80	78	82	84	88	94	122	118	120	120	122	124	126	128	70	70	72	72	70	72	74	82	12	12	12	12	12	14	14	14	yes	10
6	2	989387	30	female	1	66	74	110	70	12	0	0	0	1	1	2	5	6	72	74	68	70	72	74	90	88	112	116	114	112	114	118	128	126	70	70	72	70	70	72	82	80	12	12	12	12	12	12	16	14	yes	10
7	2	990240	45	female	1	65	86	110	60	14	0	0	1	1	1	3	6	7	86	82	84	82	84	92	96	98	100	110	106	108	104	112	120	128	60	62	60	64	62	72	76	84	13	12	12	13	13	15	18	16	yes	8
8	2	997262	30	female	1	72	76	110	68	12	0	0	1	1	2	2	5	7	74	76	76	74	80	84	92	90	110	108	111	110	112	120	122	127	64	62	62	60	64	72	82	88	13	14	12	12	13	14	16	18	yes	10
9	2	997986	49	female	2	75	78	130	88	12	0	0	0	1	1	2	4	6	76	72	74	72	76	80	94	96	130	132	128	130	134	136	144	150	88	86	84	82	86	88	90	92	14	13	12	13	13	14	16	18	yes	12
10	2	998976	20	female	1	52	86	110	70	14	0	0	1	1	1	3	5	7	86	84	88	86	84	82	90	94	110	112	114	116	114	118	124	130	60	64	62	68	72	76	82	86	14	12	13	12	12	12	14	16	yes	12
11	2	1025040	33	male	1	85	82	126	76	13	0	0	1	1	1	2	6	8	86	84	82	84	86	88	96	92	124	120	122	123	124	126	128	136	72	70	72	71	74	80	88	94	14	12	13	12	12	12	14	16	yes	12
12	2	1024564	27	male	1	78	86	130	72	14	0	0	1	1	1	3	5	7	84	86	82	84	86	84	92	98	128	126	128	126	127	130	134	143	76	74	72	73	72	86	88	92	12	12	13	12	12	12	16	18	yes	10
13	2	1024557	31	female	1	67	88	110	74	14	0	0	1	1	2	3	6	8	86	88	84	82	84	86	94	98	110	114	112	116	118	120	122	128	62	68	64	62	64	70	72	78	14	13	13	12	12	13	15	16	yes	12
14	2	1025343	40	female	1	68	84	130	80	12	0	1	1	1	1	3	4	6	84	86	86	84	88	86	96	102	128	130	132	128	130	140	144	148	80	82	80	80	82	84	92	96	12	13	12	12	12	13	16	16	yes	10
15	2	1025272	22	female	1	65	74	126	72	14	0	0	1	1	1	3	5	7	76	74	72	76	78	84	92	96	126	124	120	122	126	130	136	138	74	72	72	74	80	84	86	90	14	13	12	13	13	12	15	16	yes	10
16	2	1025040	39	female	1	60	78	132	76	12	0	0	1	1	2	3	6	8	76	74	74	75	76	80	88	94	130	128	126	128	130	134	140	144	70	72	70	72	72	82	80	86	13	12	12	12	12	13	14	16	yes	11
17	2	1025379	31	female	1	63	74	120	78	14	0	0	1	1	2	3	5	7	76	74	72	73	75	82	86	92	118	120	114	117	122	125	134	138	76	74	72	72	72	80	86	88	14	13	12	12	13	14	16	18	yes	10
18	2	1023238	54	male	2	79	68	130	80	11	0	0	0	1	1	2	4	6	66	65	63	64	68	64	78	88	128	125	126	128	130	135	140	146	80	76	78	82	84	88	90	92	11	12	12	11	12	12	14	16	yes	12
19	2	1026816	47	male	2	85	58	132	78	12	0	1	1	2	3	3	6	8	60	57	59	60	62	64	70	84	130	128	132	130	133	140	146	150	80	78	82	84	86	85	88	90	12	12	12	12	13	14	16	16	yes	8
20	2	1027535	51	female	1	70	74	130	75	13	0	0	0	1	1	2	4	6	74	78	76	73	79	80	86	92	128	126	130	132	130	136	142	148	76	74	76	78	80	82	84	86	12	12	11	12	13	14	15	17	yes	10
21	2	1041541	31	female	1	59	92	110	80	14	0	0	0	0	1	1	3	6	92	90	90	92	94	96	98	106	112	110	115	113	114	120	126	130	80	78	78	80	82	84	86	88	14	13	12	14	14	14	16	16	yes	12
22	2	1029135	24	male	1	74	76	120	70	12	0	0	1	1	3	4	5	7	74	72	70	72	76	84	88	92	118	116	119	117	120	122	127	130	70	68	72	70	74	78	82	84	11	12	12	12	13	14	14	16	yes	11
23	2	1030425	30	female	1	58	76	110	70	12	0	0	1	3	3	5	7	7	78	76	74	80	86	90	94	96	111	110	113	115	120	123	126	132	68	70	72	74	76	78	82	84	12	12	12	12	14	14	14	16	yes	8
24	2	1026403	47	male	1	79	72	130	80	12	0	0	0	1	1	3	6	8	74	72	72	76	80	86	90	94	126	128	127	126	130	134	142	150	78	80	79	78	82	86	88	90	12	12	12	12	13	14	14	16	yes	10
25	2	1030474	48	male	1	84	78	135	72	12	0	0	0	0	1	1	3	6	76	78	80	78	82	84	92	96	132	134	135	136	140	146	148	150	72	76	78	74	75	82	86	90	11	12	12	12	12	13	15	16	yes	11
26	2	1030080	30	female	1	57	78	120	80	14	0	0	0	1	1	2	4	7	76	78	74	72	72	82	90	95	120	122	124	123	128	130	135	140	76	78	76	72	80	82	84	86	12	13	12	14	14	14	16	17	yes	12
27	2	1030425	35	female	1	65	84	126	74	14	0	0	1	2	3	5	6	7	82	80	84	82	86	88	96	102	124	126	128	130	134	138	142	146	72	74	76	80	82	86	88	92	12	12	13	13	14	14	16	18	yes	10
28	2	1030857	43	female	1	63	94	110	70	12	0	0	1	3	3	5	7	8	94	90	92	91	90	96	102	108	110	112	115	117	118	120	126	132	68	70	72	74	76	80	84	88	11	12	12	12	13	13	14	16	yes	11
29	2	1027312	50	female	2	66	74	130	80	14	0	0	1	3	4	6	7	7	74	76	72	74	78	84	88	96	126	125	128	130	134	138	140	146	77	78	80	82	84	86	90	92	13	12	12	13	14	14	16	16	yes	10
30	2	1029126	46	male	1	90	84	140	80	14	0	0	0	1	1	3	5	7	84	86	82	88	90	94	96	102	135	138	140	142	144	146	148	152	76	76	78	80	82	84	86	90	13	13	14	14	14	14	16	18	yes	12