PROSPECTIVE RANDOMIZED COMPARISON OF INTRATHECAL 0.5% BUPIVACAINE WITH ADDITION OF PETHIDINE, FENTANYL,TRAMADOL VERSUS PLACEBO IN PREVENTING PERIOPERATIVE SHIVERING IN ENDOSCOPIC UROLOGICAL SURGERIES

DISSERTATION submitted to

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In partial fulfilment for the award of the degree of

Doctor of medicine

(Branch – X) Anaesthesiology

April 2013

INSTITUTE OF ANESTHESIOLOGY AND CRITICALCARE

MADRAS MEDICAL COLLEGE

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DECLARATION

I hereby declare that the dissertation entitled "**PROSPECTIVE RANDOMIZED COMPARISON OF INTRATHECAL 0.5% BUPIVACAINE WITH ADDITION OF PETHIDINE , FENTANYL , TRAMADOL VERSUS PLACEBO IN PREVENTING PERIOPERATIVE SHIVERING IN ENDOSCOPIC UROLOGICAL SURGERIES"** has been prepared by me under the guidance of **PROF. DR.ESTHER SUDHARSHINI RAJKUMAR M.D.,D.A.**, Professor ,Institute Of Anaesthesiology and Critical Care ,Madras Medical College, Chennai in partial fulfilment of the regulations of the award of the degree M.D (Anaesthesiology), examination to be held in April 2013.

This study was conducted at Madras Medical College and Rajiv Gandhi Government Hospital, Chennai.

I have not submitted this dissertation previously to any university for the award of any degree or diploma.

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This is to certify that the dissertation entitled "**PROSPECTIVE RANDOMIZED COMPARISON OF INTRATHECAL 0.5% BUPIVACAINE WITH ADDITION OF PETHIDINE , FENTANYL , TRAMADOL VERSUS PLACEBO IN PREVENTING PERIOPERATIVE SHIVERING IN ENDOSCOPIC UROLOGICAL SURGERIES"** submitted by **DR.NIVEDHYAA.S** in partial fulfilment for the award of the degree of Doctor of Medicine in Anaesthesiology by the Tamilnadu Dr.M.G.R Medical University ,Chennai is a bonafide record of the work done by her at the Institute of Anaesthesiology and Critical Care , Madras Medical College, Chennai during the academic year 2010-2013.

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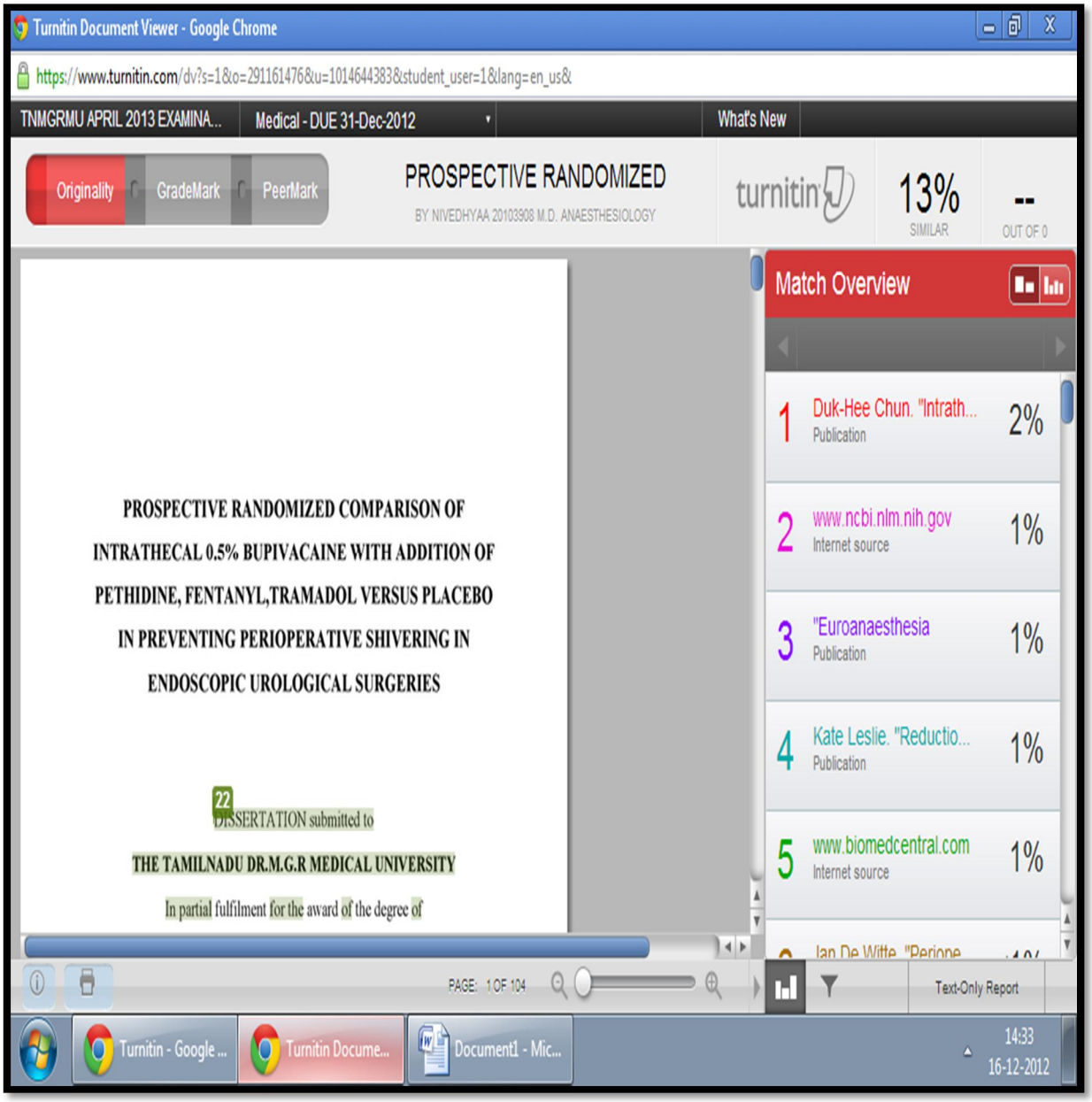
Abbreviations

CSF	-	Cerebrospinal Fluid
Inj.	-	Injection
i.v	-	intravenous
i.m	-	intramuscular
s.c.	-	subcutaneous
i.e	-	that is
eg	-	Example
G	-	Gauge
°c	-	Degree Centigrade
°F	-	Degree Fahrenheit
TURP	-	Transurethral resection of Prostate
URS	-	Ureteroscopic removal of Stone
pKa	-	Acid dissociation constant
%	-	percentage
SPSS .17	-	Statistical package for Social Sciences, 17^{th} Version
mg	-	milligram
Kg	-	kilogram
mg/Kg	-	milligram/kilogram
µg/Kg	-	microgram/kilogram
ml	-	millilitre
B.P	-	Blood Pressure
SpO_2	-	Oxygen saturation of arterial blood
ECG	-	Electrocardiogram
NIBP	-	Non Invasive Blood Pressure
HR	-	Heart Rate
SBP	-	Systolic Blood Pressure

MAP	-	Mean Arterial Pressure
FDA	-	Food and Drug Administration
CVS	-	Cardiovascular System
CNS	-	Central Nervous System
IUPAC	-	International Union Of Pure and Applied Chemistry
ASA PS	-	American Society Of Anaesthesiologist ,Physical Status
Group P	-	Group Pethidine
Group T	-	Group Tramadol
Group F	-	Group Fentanyl
Group C	-	Group Control
min	-	minutes
T0	-	the time at which spinal anaesthesia was given
T10	-	Tenth Minute from spinal anaesthesia
T20	-	Twentieth Minute from spinal anaesthesia
T30	-	Thirtieth minute from spinal anaesthesia
T40	-	Fortieth minute from spinal anaesthesia
T50	-	Fiftieth minute from spinal anaesthesia
1H	-	First Hour
2H	-	Second Hour
3H	-	Third Hour
4H	-	Fourth Hour
5H	-	Fifth Hour
6H	-	Sixth Hour
T_5	-	Fifth Thoracic Vertebra
L_1	-	First Lumbar Vertebra
L_2	-	Second Lumbar Vertebra
L_3	-	Third Lumbar Vertebra
L_4	-	Fourth Lumbar Vertebra
α	-	Alpha

β	-	Beta
μ	-	mu
κ	-	Kappa
δ	-	Delta
±	-	plus/minus
SD	-	Standard Deviation
N.S	-	Not Significant
SIG	-	Significant
wt	-	weight
Ht	-	Height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INTRODUCTION

Shivering is a common problem faced during central neuraxial blockade, both during spinal and epidural anaesthesia.

Shivering is extremely distressing to the patient, surgeon and to the anaesthesiologist. It can provoke bleeding, cause hemodynamic instability, arrhythmia and delay wound healing. Shivering increases the myocardial oxygen consumption by causing tachycardia, metabolic heat production by six hundred percent, carbon dioxide production and causes lactic acidosis [(1)].Witte et al have proved that cold sensation can be worse than surgical pain [(2)]. Shivering can increase the postoperative pain due to stretching of the incision site .It is uncomfortable for the surgeon because it can disturb the surgical field as the patient shakes vigorously, can increase bleeding and cause post operative wound infection. Shivering is also a discomfort to the anaesthesiologist because it may impede monitoring of electrocardiogram, non - invasive blood pressure and oxygen saturation, cause arterial hypoxemia and raise intraocular pressure and intracranial pressure.

Shivering is very common during endoscopic urological surgery. These procedures are performed under spinal anaesthesia and a large volume of irrigation solution is required. The use of the irrigation solution to wash of the

debris and blood during Transurethral resection of prostate (TURP) and Ureteroscopic removal of stone (URS) can also cause hypothermia and shivering. Various drugs from different groups like Opioid, N- methyl D-aspartate (NMDA) receptor antagonists, Nefopam, Physostigmine, 5-hydroxytryptamine receptor(5- HT3) ,Alpha 2 agonists like Clonidine and Dexmedetomedine, Ketanserine are being used to reduce shivering worldwide[(2)]. Adding a small dose of opioid to the intrathecal mixture could reduce shivering and make the patient extremely comfortable during surgery. Earlier studies have been conducted to reduce shivering in females undergoing caesarean delivery. In the year 2007,Davoudi and his colleagues reported a study of using intrathecal Pethidine 15 mg with 5% lignocaine to reduce shivering[(3)].

Therefore, we at our hospital designed a study to determine the efficacy of intrathecal opioids comparing three opioids in reducing shivering in endoscopic urological surgeries. These opioids included Pethidine, Fentanyl and Tramadol.

AIM OF THE STUDY

1. To evaluate the advantages of using intrathecal Opioid in the prevention of shivering in patients undergoing endoscopic urological surgeries

2. To compare the superiority and efficacy between Intrathecal Pethidine, Tramadol and Fentanyl in terms of preventing shivering in patients undergoing endoscopic urological surgeries

ANATOMY OF SUBARACHNOID SPACE

Subarachnoid block or spinal anaesthesia is the temporary interruption of nerve transmission within the subarachnoid space produced by the injection of a local anaesthetic solution into cerebrospinal fluid [(4)].

History of Spinal Anaesthesia:

1884: Carl Koller: introduced cocaine as the first topical local anaesthetic

1899: August Bier used Quincke's technique to produce operative anaesthesia in six patients

1904: Heinrich Braun used procaine for operative spinal anaesthesia.

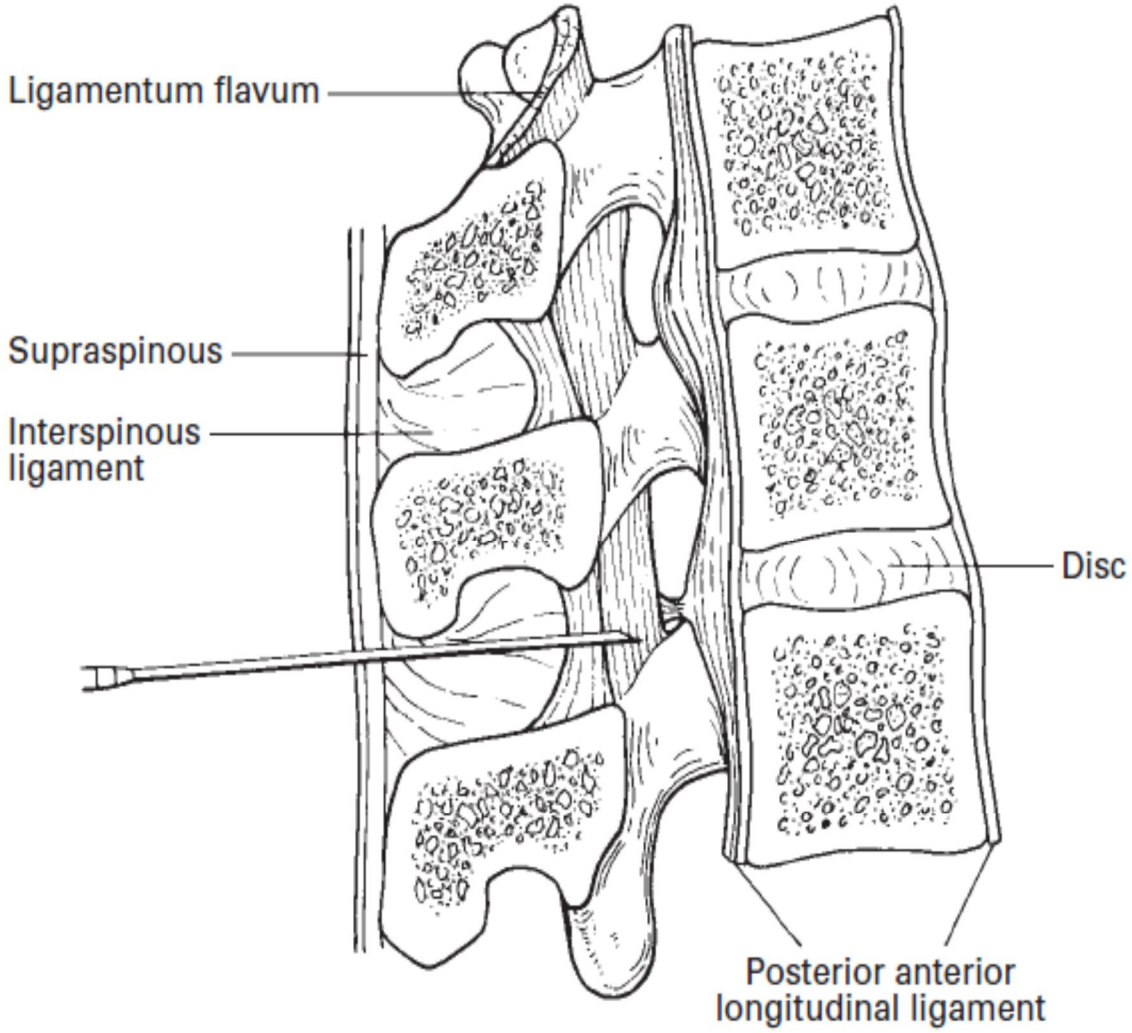
1940: Lemmon introduced the method of continuous spinal anaesthesia

1965: Renaissance period for spinal anaesthesia when Dripps proved that spinal anaesthesia was neurologically safe.

Applied Anatomy of the vertebral canal:

The vertebral column extends from the foramen magnum to the sacral hiatus. Vertebral column consists of 33 vertebrae, has four curves. The cervical and lumbar curves convex anteriorly while sacral and thoracic vertebral columns are curved convex posteriorly. The spread of local anaesthetic is influenced by the curves of the vertebral column.

Anatomy of subarachnoid block



The vertebral column is bound together by several ligaments which include:

Supraspinous ligament: It is a strong, fibrous cord connecting the spinous processes form sacrum to C_7 .It is continues upward as the ligamentum nuchae which attaches itself to the external occipital protuberance.

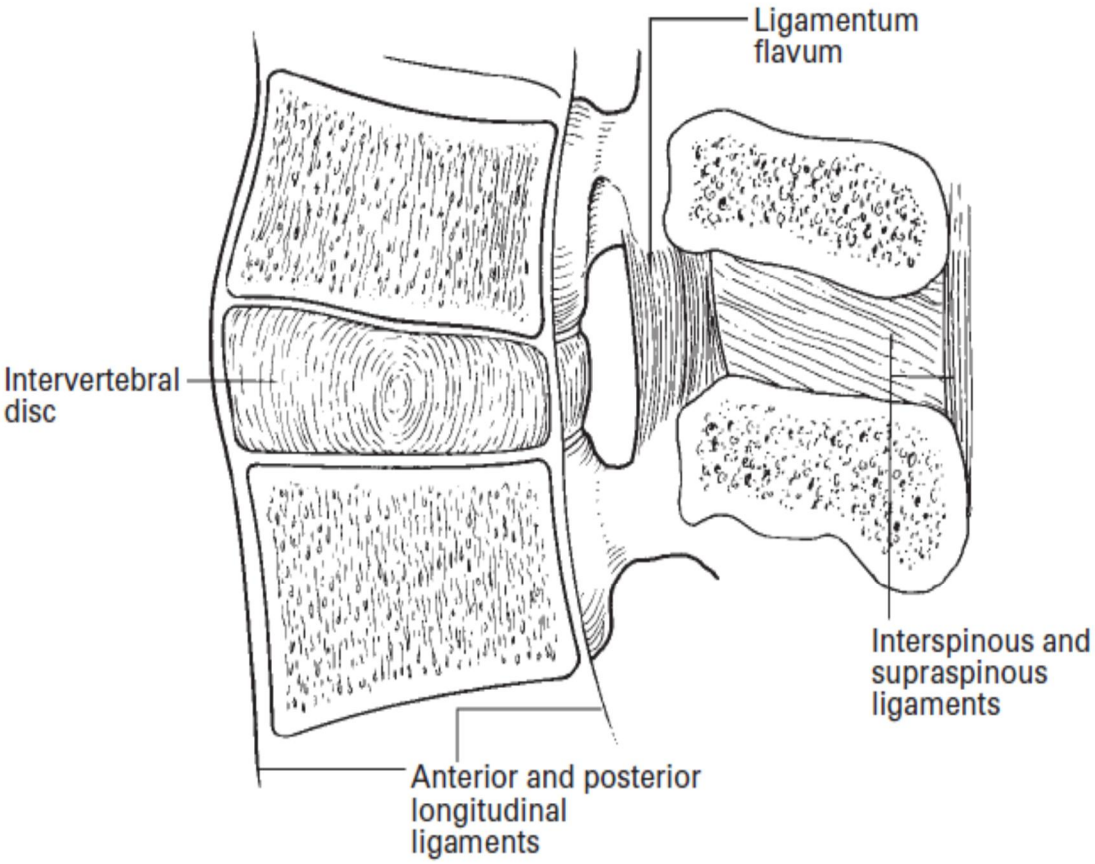
Interspinous ligament: It is a thin, membranous ligament that connects the spinous processes together. Both the interspinous ligament and the supraspinous ligament are thickest and broadest at the lumbar region.

Ligamentum Flavum: This comprises of yellow elastic fibres and hence called the Yellow ligament. It connects the caudal edge of the vertebra above to the cephalad edge of the lamina below. The ligament also runs laterally.

Longitudinal ligaments: The vertebral bodies are bound together by the anterior and posterior longitudinal ligaments. The anterior longitudinal ligament runs along the front of the vertebral bodies while the posterior runs along the posterior surface of the bodies of the vertebra.

The Epidural space surrounds the spinal meninges and extends from the foramen magnum to the sacral hiatus. The contents in the epidural space include fat, areolar tissue, lymphatics, arteries, nerve roots and extensive internal vertebral venous plexus of Batson. These are valveless vertebral venous plexus that connect the pelvic veins and the thoracic veins. This can allow the spread of

Vertical section of the vertebral column showing various ligaments



infection and metastatic spread of cancer including carcinoma Prostate. The most ubiquitous substance in the epidural space is the epidural pad of fat.

Spinal Meninges: The spinal cord is protected by both the bony vertebral column and three connective tissue coverings, the meninges.

Dura mater is a tough fibroelastic tube, the fibres run longitudinally. It can be divided into two parts the cranial dura and the spinal dura. Caudally the dural sac ends at S_2 level. The dura mater is largely acellular except for a layer of cells forming a border between the dura and the arachnoid mater.It is made up of collagen and elastin fibres running longitudinally and circumferentially.

Subdural space: The space between the dura mater and the arachnoid mater is the subdural space. This potential space consists of serous fluid that moistens the two membranes. The importance of the subdural space is during the performance of a myelogram. It may account for a few of the failed spinal anaesthesia despite aspiration of cerebrospinal fluid [(4)].

Arachnoid mater: It is an avascular covering close to the dura mater. The dura and the arachnoid mater end at the lower border of S_2.

Pia mater: It is a highly vascular membrane unlike the arachnoid membrane.The space between the arachnoid and the pia is thus the subarachnoid space. This is closely applied to the spinal cord.

Subarachnoid space: This space lies in between the inner piamater and outer arachnoid mater. It is filled with cerebrospinal fluid and arachnoid trabeculae. The subarachnoid space has three parts: the cranial, the spinal and the roots consisting of the cerebrospinal fluid, spinal nerves and trabeculae running between the two membranes. All the three parts freely communicate with each other .The subarachnoid space extends along both ventral and dorsal roots to the level of the dorsal root ganglion where the arachnoid and the pia continue as the perineural epithelium of the peripheral nerve.

Cerebrospinal Fluid is an ultra filtrate of the blood plasma with which it is in hydrostatic and osmotic equilibrium [(4)].

The specific gravity of CSF is 1.006 and the pH of CSF is 7.27-7.37.It contains Bicarbonate of around 23meq/l, Sodium: 133- 145meq/l, Calcium: 2-3 meq/l, Phosphorus: 1.6 mg/dl, Magnesium: 2.0- 2.5mEq/l, Chloride: 15-20mEq/l and Proteins 28-38mg/dl. Spinal cord lies within a bony vertebral canal. It is a direct continuation of the medulla oblongata, extending from the upper border of atlas to the first lumbar vertebra below which it spreads out as nerve roots called as cauda equina. There are 31 pairs of spinal nerves which are segmentally distributed. There are eight pairs of cervical nerves, 12 thoracic, 5 lumbar, 5 sacral, one coccygeal. Each nerve is attached to the spinal cord by an anterior root and posterior root joining at the intervertebral foramen forming a nerve trunk.

Spinal cord is protected by three membranes which include the duramater, arachnoid mater and the pia mater. The blood supply is from the anterior spinal artery which arises from the vertebral artery and a pair of posterior spinal arteries. They are drained by the spinal veins which further drain into vertebral, azygos and lumbar veins.

PHYSIOLOGY OF SUBARACHNOID BLOCK

The blockade of nerve fibres occur in the order of autonomic preganglionic b fibres, temperature, pain, proprioception, and then motor fibres. The factors that could influence the height of the block include the site of injection, angulation of needle, the density, specific gravity and baricity and the dose of the local anaesthetic. The position of the patient, height of the patient, increased abdominal pressure due to obesity, ascites, and pregnancy also affect the level of block. The volume of CSF can get affected by dehydration and pregnancy.

There are multiple effects of spinal anaesthesia on different systems of our body:

Cardiovascular system:

The effects on cardiovascular system include a sympathetic denervation. The effect is also contributed by the local anaesthetic, its dose and volume, the level of neural block. The sympathetic denervation produces arteriolar dilatation and vasodilatation in the venous circulation producing a fall in blood pressure. Due to Bainbridge reflex the fall in blood pressure is associated with bradycardia. Cardiac sympathetic fibres from T_1 to T_4 could also get blocked causing bradycardia.

Respiratory system: High spinal blockade can paralyse the intercostals muscles, can cause difficulty in breathing. Hypoxia can occur following a hypotension which is corrected by oxygen administration via a face mask.

Hepatic and Renal system: The hepatic blood flow decreases due to a decrease in blood pressure. However renal blood flow is maintained by auto regulation up to 50mm Hg.

Gastrointestinal system: Preganglionic fibres from T_5 to L_1 are inhibitory to the gut. Subarachnoid block up to a midthoracic level causes small intestinal contraction. This is mainly due to the unopposed activity of vagus nerve. Sphincters remain relaxed while peristalsis is normally active. Thus a contracted bowel and relaxed muscle wall make it easy for the surgeon to perform intra abdominal procedures.

Genitourinary system: The sphincters of bladder are not relaxed and urinary retention can occur. Penis becomes engorged. Uterine tone remains unchanged in pregnancy. The volume of fluid infusion during spinal anaesthesia can cause diuresis.This can precipitate urinary retention despite bladder distension. Bladder catheterisation can prevent urinary retention, although the risks of nosocomial infection related to the urinary catheter have to be considered.

Metabolic and hormonal effects: Surgical stress can cause a rise in the stress hormones like catecholamine, cortisol and glucagon and have an inhibitory effect on insulin. Thus hyperglycemia is invariably seen even in a well controlled diabetic in the preoperative period .Spinal anaesthesia and epidural anaesthesia transiently blocks the hormonal and metabolic responses to the nociceptive stimuli from the operative site. It minimises the rise in blood sugar, cortisol, catecholamines, renin and aldosterone levels associated with stress.

Physiological treatment of hypotension during central neuraxial blockade mainly focuses on restoring the preload by rapid infusion of large volumes of crystalloid such as Ringer lactate. Restoration of myocardial tissue oxygenation is the goal behind restoration of hypotension.

OPIOIDS

"Among the remedies which it has pleased Almighty God to give man to relieve his sufferings; none is so universal and as efficacious as opium".

Sydenham (1680)

There is a clear distinction between the two terms *opioid* and *opiate*. The former is a more general term for agents with morphine like properties while the latter refers to agents derived from opium, most commonly from the Poppy plant, *papaver somniferum*.In 1803,a German pharmacist Serturner isolated Morphine from opium. He named it Morphine after Morpheus, Ovid's god of dreams, the son of sleep. Opioid compounds can be classified as naturally occurring, semisynthetic and synthetic opioids.

Classification of Opioids [6]:

Naturally occurring opioids are divided into two chemical classes

1. Phenanthrenes: eg. Morphine and Codeine
2. Benzylisoquinolones: eg. Papaverine

Semi synthetic opioids result from relatively simple modification of morphine molecule eg. Diacetylmorphine.

Synthetic opioids: contain Phenanthrene nucleus. They are classified into four subdivisions.

1. Morphinian derivatives – eg.Levorphanol
2. Methadone derivative – eg. Methadone
3. Benzomorphan derivative eg.Pentazocine
4. Phenylpiperidine derivative eg. Meperidine (Pethidine), Fentanyl, Sufentanyl, Alfentanyl

Opioid receptors

Characteristic of Opioid Receptors: **Table no.1**

	μ 1(Mu)	Delta (**δ**)	**Kappa(k)**
Endogenous opioid	Beta endorphin	Leucoencephalin, metenkephaline	Dynorphine
Agonist	Morphine, fentanyl	Deltorphin	Buprenorphine Pentazocine
Antagonist	Naloxone, Naltrexone	Naloxone	Naloxone
Adenylate cyclase	Inhibition	Inhibition	Inhibition
Effect	Analgesia Supraspinal/ Spinal, Respiratory depression, Euphoria, Constipation, Bradycardia	Analgesia, Respiratory depression, Constipation	Analgesia, Miosis, Dysphoria, Sedation, Diuresis

PHARMACOLOGY OF PETHIDINE:

History:

Pethidine was the first synthetic opioid to be used to provide analgesia in humans. The properties of Pethidine were discovered by Eisleb and Schaumann in the year 1939.It was also shown to have local anaesthetic properties comparable with that of cocaine. Pethidine was first used as an antimuscarinic agent before being used as an analgesic agent. It is also known as Meperidine.

Pharmacology:

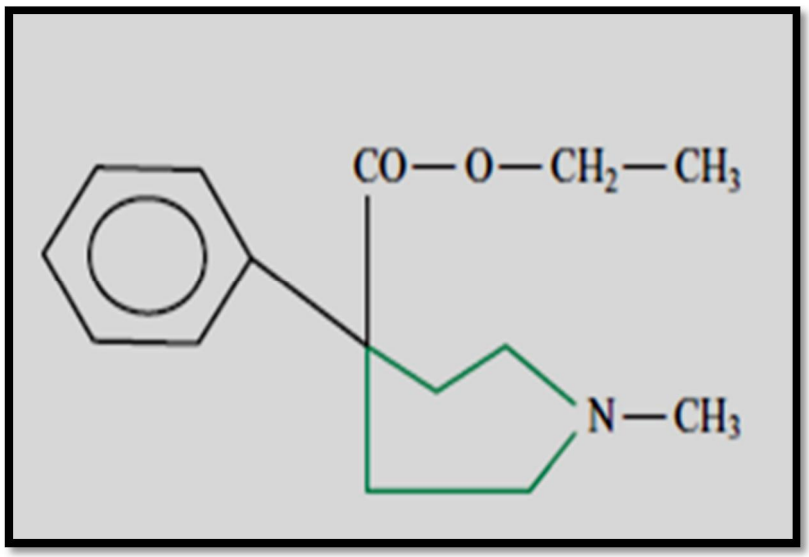
Pethidine is a synthetic opioid, predominantly agonist of Kappa receptor, a phenylpiperidine derivative. Other analogues of Pethidine include Fentanyl, Sufentanyl, Alfentanyl and Remifentanyl.

Structure of Pethidine: It has a similar structure of a local anaesthetic with a tertiary amine group, an ester group and a lipophilic phenyl group.

Structurally pethidine is similar to atropine and hence has anti-muscarinic properties.

Pharmacokinetics: Ninety percent of the drug undergoes metabolism in the liver to Normeperidine by demethylation and 10% gets metabolised to meperidinic acid by hydrolysis. The pKa of pethidine is 8.5.It is 70% protein

Structure of Pethidine



bound. The elimination half life is around 3-5 hours. Half life of Normeperidine is 15-40 hours, thus may accumulate with prolonged Pethidine administration.

Pharmacodynamics: Pethidine is about one-tenth as potent with 100mg of IM being equivalent to 10mg of Morphine. The action of Pethidine lasts for 2-4 hours. This opioid agonist has anticholinergic, seratonergic and noradrenergic effects. Pethidine causes tachycardia unlike other opioids because of its antimuscarinic effect and structural similarity to atropine. The only other opioid causing tachycardia is Pentazocine.

Metabolism and Excretion: Normeperidine gets further metabolised to Meperidinic acid. The principal route of elimination is through the kidney and it is urinary pH dependent. Acidification of urine can hasten the elimination of Pethidine. Thus decreased renal function can cause accumulation of Normeperidine. Normeperidine toxicity can cause seizures and myoclonus.The elimination half time of Pethidine is about 3 – 4 hours

Spasmodic effect on smooth muscles is less marked, thus it produces less constipation, miosis and urinary retention than morphine. Adverse effects of intrathecal pethidine include hypotension, bradycardia, sedation, nausea, vomiting, pruritus, respiratory depression

Uses of Pethidine:

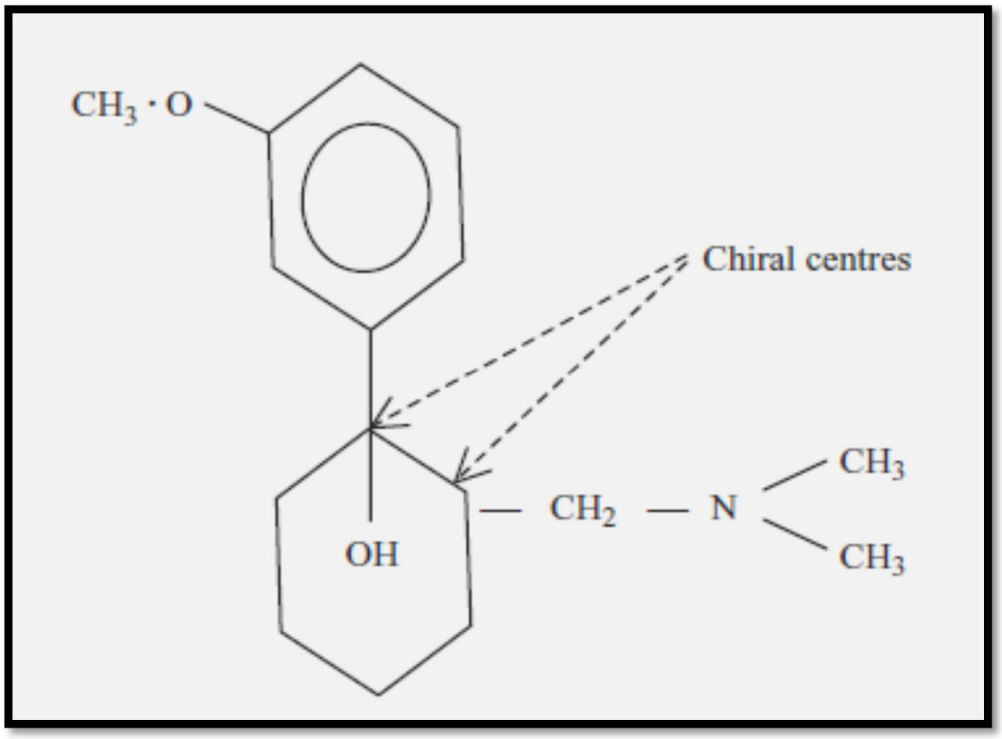
It is primarily used as an analgesic

Doses of spinal anaesthesia for Pethidine ranged from 0.5mg to 1mg/kg. Pethidine has properties of a hyperbaric agent when injected intrathecally. Pethidine has high lipid solubility, so it diffuses rapidly into lipid rich areas of the spinal cord.

Pethidine has got unique anti-shivering properties. This property may be attributed to its action on κ opioid receptors [(8)].The analgesic concentration of Pethidine can produce 5-HT reuptake inhibition [(9)]. Pethidine also has a non competitive NMDA receptor antagonist activity in the rat spinal cord [(10)]. Pethidine has also got anti shivering properties via the α_2 adrenoreceptors in the locus coeruleus [(11)].Pethidine decreases the shivering threshold twice as much as the vasoconstriction threshold[(12)].These properties of Pethidine can make it a unique anti shivering agent

Pethidine is available as ampoules: 50mg/2ml or 25mg/ml solution.

Structure of Tramadol



PHARMACOLOGY OF TRAMADOL:

History: It was created by a German pharmaceutical company in the year 1970 after the Second World War.

Pharmacology:

It is a synthetic analogue of codeine

Structure of Tramadol: The IUPAC name of Tramadol is *Trans-2-dimethylaminomethyl-1-(3-methoxyphenyl) cyclohexanol* and chemically it is $C_{16}H_{25}NO_2$.Tramadol is a derivative of Cyclohexanol that occurs as a racemic mixture of two enantiomers. It inhibits the reuptake of nor-adrenaline and serotonin thus activates monoaminergic spinal inhibition of pain. One enantiomer inhibits the reuptake of noradrenaline and the other inhibits the reuptake of serotonin.

Pharmacokinetics: It is converted to N- and O-demethylated metabolites in the liver and O-desmethyltramadol is an agonist with a higher affinity of almost 200 times for μ receptors than the parent compound. O-desmethyltramadol has a half life of nine hours, although the half life of Tramadol alone is six hours.

Pharmacodynamics: Injected intravenously 100mg of Tramadol is equianalgesic to 10 mg intramuscular morphine. The half life is 4-6 hours. Tramadol has moderate affinity for μ receptor of opioid. The analgesic action of

Tramadol can be partially reversed by Naloxone. Tramadol exhibits 20% plasma protein binding and has a half life of 5-7 hours.

Metabolism and Excretion: It undergoes phase II hepatic metabolism to become water soluble.90% of the metabolites are excreted by the kidney while 10% gets excreted in the faeces

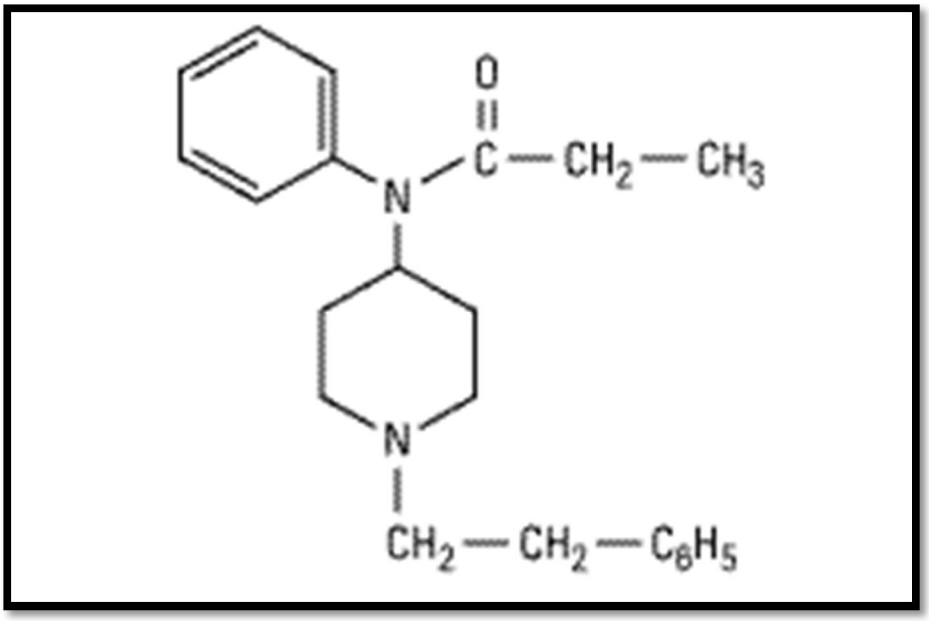
Uses: Tramadol 3mg/kg can be administered orally, i.m, i.v and is the effective treatment for moderate to severe pain, chronic pain as it does not cause tolerance or addiction. It can be administered through oral, sublingual, rectal, subcutaneous, intramuscular, intravenous, epidural, intrathecal and caudal routes. Tramadol is available as ampoules: 100mg/2ml solution

It has also been used in the treatment of perioperative shivering. Tramadol is another antishivering agent that can inhibit the reuptake of 5-hydroxytryptamine, nor- epinephrine and dopamine and facilitate 5-HT

release [(13)].

Adverse effects: Tramadol can cause nausea, vomiting, ambulatory dizziness and drowsiness. Tramadol should not be used in patients using monoamine oxidase inhibitors and tricyclic anti depressants. It is contraindicated in patients with epilepsy because Tramadol can precipitate seizures in such individuals.

Structure of Fentanyl



Metabolism and Excretion: Fentanyl is extensively metabolised by N-demethylation producing Norfentanyl, which is structurally similar to Normeperidine. It is excreted by the kidney.

Routes of administration: Oral, parenteral (IV/IM), transmucosal, transdermal and neuraxial (subarachnoid / epidural).

Uses: Intravenous Fentanyl: Low doses of Fentanyl 1-2 µg/Kg IV are injected to provide analgesia. Dose range of around 50- 150µg/Kg IV have been used alone to produce surgical anaesthesia. Fentanyl is available as ampoules of 100µg/2ml

Adverse effects: Fentanyl can cause pruritus. It causes itching over the face. It can also cause nausea and vomiting. Large dose of Fentanyl (>50µg/Kg) can cause chest wall rigidity and bradycardia [(7)].

PHARMACOLOGY OF BUPIVACAINE:

All local anaesthetics contain an aromatic ring and an amide at either end of the molecule, separated by a hydrocarbon chain, either an ester or an amide bond.

History: It was synthesized by Ekenstam in 1957

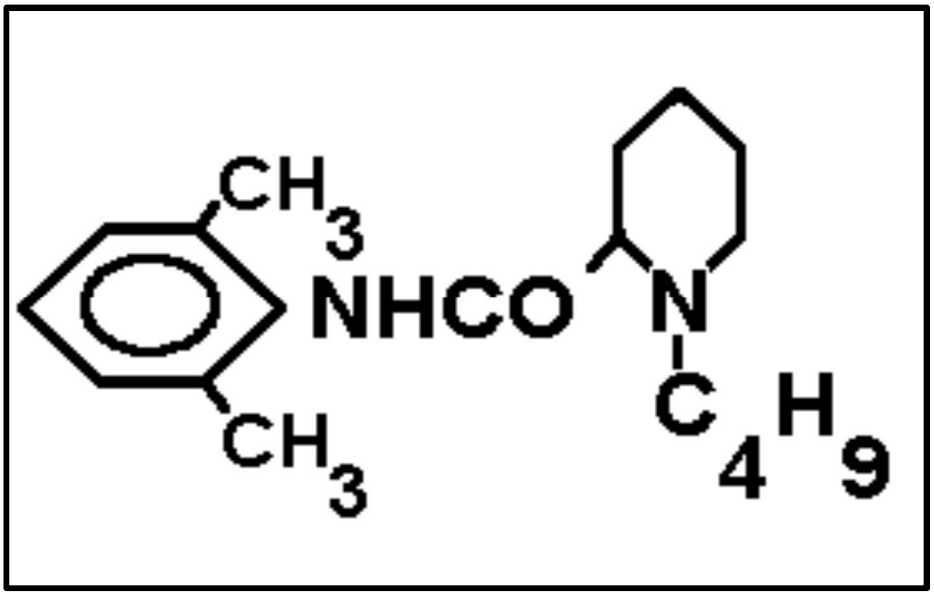
Structure: Bupivacaine is an amide linked local anaesthetic. It is a hydrochloride salt of 1-butyl-N-(2, 6-dimethylphenyl) piperidine-2carboxamide and is presented as a racemic mixture.

Pharmacokinetics:It is derived from Mepivacaine and is a very stable compound. The properties of Bupivacaine include a Pka of 8.1 and a molecular weight of 288.It is 95% protein bound and has an elimination half time of 210 min. Toxic plasma concentration of Bupivacaine is >1.5mg/ml. Its duration of action is about 175minutes.

Once the drug is injected intrathecally,it will get absorbed by the rootlets from the site of injection and the rate of absorption depends on the vascularity.

Metabolism: Possible pathways of metabolism of bupivacaine include aromatic hydroxylation and conjugation. Only the N-dealkylated metabolite, N-desbutyl bupivacaine has been measured in blood (or) urine after epidural (or) spinal anaesthesia. Alpha-1 acid glycoprotein is the most important plasma protein binding site of bupivacaine and its concentration is increased by many clinical

Structure of Bupivacaine



situations including post operative trauma. The drug is mainly excreted by the kidney.

Mode of Action: The drug mainly acts at:

i) Peripheral nerve rootlet, fine nerve filaments

ii) The spinal nerve rootlet fine nerve filaments having a large surface area are exposed to the local anaesthetics

iii) Posterior and lateral aspects of the spinal cord itself.

b) Sodium Channel blockade: They impede sodium ion access to the axon interior by occluding the transmembrane sodium channels thus delaying the process of depolarization and axon remains polarized. It is a nondepolarization blockade.

Pharmacodynamics:

Cardio vascular system: It depresses myocardial automaticity (spontaneous phase IV depolarization) and reduces the duration of the refractory period. The ensuing combination of bradycardia, heart block and hypotension may culminate in cardiac arrest.

Respiratory System: Apnea can results from phrenic and intercostal nerve paralysis or depression of the medullary respiratory center following direct exposure to drug.

Toxicity is related to plasma level of free drug and more likely due to an inadvertent intravenous injection. Systemic toxicity reactions primarily involve central nervous system and cardiovascular system. The blood level required to produce central nervous system toxicity is less than that required to produce circulatory collapse.

Central Nervous System Toxicity: Early symptoms are circumoral numbness, tongue paresthesia, and dizziness. Sensory complaints include tinnitus and blurred vision. Excitatory signs (eg, restlessness, agitation, nervousness, paranoia) often precede central nervous system depression (eg, slurred speech, drowsiness, unconsciousness). Muscle twitching heralds the onset of tonic clonic seizures. Respiratory arrest often follows. The excitatory reactions are a result of selective blockade of inhibitory pathways.

Cardiovascular System Toxicity: Extremely high concentration of the drug causes sinus bradycardia, hypotension, atrioventricular heart block, and life threatening arrhythmias such as ventricular tachycardia, ventricular fibrillation and cardiac arrest.

Available as

1.Ampoules – 0.5% Bupivacaine hydrochloride with dextrose(Heavy) 4cc and 0.5% Bupivacaine hydrochloride (plain)

2. Vials – 0.25% and 0.5% Bupivacaine hydrochloride

Dosage and Uses: Maximum dosage is 3mg/kg body weight. The drug is used in spinal anaesthesia, epidural anaesthesia, caudal anaesthesia and peripheral nerve block, continuous epidural block.

PHYSIOLOGY OF THERMOREGULATION

Body temperature is determined by a relationship between heat produced and heat lost to the environment. Heat is produced as an end product of the entire cellular metabolism taking place in the body. This heat produced within the body helps to maintain the normal body core temperature between 36℃ and 37.5℃.The core body temperature undergoes a circadian fluctuation being lowest in the morning and highest in the evening.

Heat is lost from the body by radiation, conduction, convection and evaporation. Almost 60% of the heat is dissipated out of the skin in the form of radiation, which forms the majority of heat loss [(5)]. When a patient is placed unclothed in the cold operation theatre he radiates heat to external atmosphere. Conduction is also another form of heat loss, wherein heat is lost when the body comes in direct contact with a cooler object. For example, a patient is placed on a cold operation table; the body looses heat in the form of conduction. Convection depends on the velocity of air and movement of air around the object or the body. Convection accounts for 15% to 30% of heat loss [(5)].

Evaporation is yet another form of heat loss. This occurs when bowel is exposed to the external atmosphere, or while preparing the skin with spirit before surgery. This form of heat loss occurs even though the temperature of the external atmosphere is higher than that of the skin.

A small amount of heat is lost from the urine and faeces also. There is also heat loss during panting and during exercise, where rapid shallow breathing increases the amount of heat lost by evaporation

Normal regulation of body temperature: Normal thermoregulation consists of an afferent input, central processor and an efferent response.

Afferent: Different receptors for cold and warmth send their signals via Aδ and C fibres respectively. These fibres travel via the anterior spinothalamic tract to the preoptic nucleus of the hypothalamus. The hypothalamus, deep tissues of the thorax and abdomen, spinal cord and skin surface also contribute to the input [(2)]. The extra hypothalamic brain stem, the Nucleus Raphe Magnus and the nucleus Subcoeruleus are also important relay stations in the transmission of thermal information from the skin to the hypothalamus [(14)].

Integration of the input: The hypothalamic thermostat detects body temperature changes. These initiate autonomic, somatic, endocrine and behavioural responses to the input. The level of activity in the preoptic neurons is modulated by arousal state and suprachiasmatic nucleus activity, which is why there are changes in the body temperature associated with sleep and circadian rhythm.

Efferent pathway: The principal defences against hypothermia include skin vasomotor activity, non shivering thermogenesis, shivering and sweating. Thermoregulatory vasoconstriction reduces heat loss and constrains metabolic

heat to the core. This will prevent the body from shivering. Shivering is the last resort that is activated when behavioural responses and vasoconstriction have failed to maintain core temperature.

Here are a few terminologies which have to be defined before we discuss the topic further:

Hyperthermia: It is defined as core body temperature greater than 38°c.

Hypothermia: Core temperature less than 36°c occurs is termed as hypothermia

Interthreshold range of temperature: The core temperature not triggering autonomic thermoregulatory responses, which is bound by the sweating threshold at its upper end and by the vasoconstriction threshold at the lower end. This interthreshold range is higher in women than in men.

Thermoregulation during anaesthesia:

The causes of decrease in body temperature during anaesthesia can be due to the following reasons [(5)]:

Resetting of the hypothalamic thermostat

The operation theatre temperature is less than 21°c

The administration of unwarmed fluid intraoperatively

The majority of anaesthetic drugs cause vasodilatation like volatile anaesthetics.

Reduction in basal metabolic rate

Behavioural response and shivering are attenuated

Core temperature gets exposed to the ambient temperature.

Hypothermia during General anaesthesia:

During general anaesthesia the interthreshold range is increased from the normal value of approximately 0.3°c to about 2°c to 4°c .During general anaesthesia, the core temperature decreases in three phases.

Phase I: There will be transfer of heat from the body core to the periphery. Thus there will be loss of 1°c to 5°c of core body temperature. This occurs due to the attenuation of vasoconstrictor tone during general anaesthesia

Phase II: There is continuous heat loss to the outside environment which exceeds the heat production. There is a linear decrease in core temperature.

Phase III: A thermal plateau is reached which occurs because heat lost and heat produced are in equilibrium after three to five hours of anaesthesia.

Temperature changes during regional anaesthesia: An initial redistributive temperature drop occurs but it is less severe than in general anaesthesia because vasodilatation is restricted to the blocked area only. However phase III that is the plateau phase of general anaesthesia does not occur in regional anaesthesia because of the loss of reflex vasoconstriction response that is lost below the

level of the block. Also shivering during regional anaesthesia is restricted to the unblocked areas, so the heat produced by shivering is ineffective. Combined regional and general anaesthetic technique can lead on to further heat loss than due to general or regional anaesthesia alone.

The ill effects of hypothermia include :

Hypothermia can increase the intraoperative blood loss. This could be due to coagulopathy and platelet dysfunction that occurs during hypothermia [15].There is an increased risk of arrhythmia and myocardial ischemia in a patient who have had diminished cardio respiratory reserve. Shivering can induce tachycardia and increase the myocardial oxygen demand causing myocardial ischemia [16.17].There is also an increased risk of infection due to hypothermia. Thus perioperative temperature monitoring is mandatory during anaesthesia.

Methods to monitor temperature: Temperature can be monitored at different sites based on the availability of the resources, patient and our convenience. The core temperature can be monitored using disposable thermistor probes at various sites like tympanic membrane, nasopharynx, oesophagus, urinary bladder and rectum.Core temperature recorded by pulmonary artery catheter is the gold standard [18]. The methods of monitoring peripheral temperature would include axillary and sublingual temperature.

Post anaesthetic shivering

Post anaesthetic shivering is usually defined as detectable fasciculation or tremor of the face, jaw, head, trunk or extremities lasting longer than 15 seconds [19]. Electromyography has revealed that it is composed of two distinct patterns of muscular activity: a tonic pattern 4-8 cycles/min, resembling thermoregulatory shivering and a clonic pattern, 5-7 Hz resembling uninhibited spinal reflexes [19].

TRANSURETHRAL RESECTION OF THE PROSTATE

Benign prostatic hyperplasia (BPH) is a pathologic process that contributes to lower urinary tract symptoms (LUTS) in ageing men.It is mainly due to an age related detrusor dysfunction. All BPH nodules develop either in the transition zone of the prostate or in the periurethral zone of prostate

Transurethral resection of the prostate involves the resection of the hyperplastic tissue by means of a movable cutting wire loop electrocautery that is located at the end of a resectoscope. The resectoscope is passed through a sheath that has been positioned within the patient's urethra. As the surgical field is visualised the cutting wire loop is moved back and forth, shearing away a small piece of prostatic tissue [20].

Irrigation solution used in TURP

An irrigation solution is made to flow into the surgical site via a channel in the resectoscope to distend the bladder,to wash away blood and debris and thus a clear operative field is maintained for the surgeon. An ideal safe irrigating solution is one that is isotonic, non- haemolytic,non- toxic, not metabolised and excreted rapidly if absorbed. It should be transparent to allow clear visibility and should be cheap and easily available as we need large volumes.

Distilled water: Distilled water has been used in the past as an irrigation solution for TURP. Though it is transparent, on reactive, available everywhere,

it is highly hypotonic,has an osmolality 0 mosm/l which when absorbed can cause fluid overload, intravascular hemolysis, hemoglobinuria and renal failure.

Transient visual disturbances have been noted with the use of glycine (1.5%) as the irrigating solution. Other irrigating solution used include glycine 1.2%, sorbitol 3.5%,mannitol 5%,cytal,urea 1% and glucose 2.5%.

Table No 2

Irrigating Solution	Osmolality
Glycine 1.5%	220
Glycine 1.2%	175
Sorbitol 3.5%	165
Mannitol 5%	275
Glucose 2.5%	139
Urea 1%	167
Cytal	178

Complications of TURP: The complications of TURP are mainly due to irrigation fluid used. One of the most dangerous complications of TURP is TURP syndrome. The extensive network of venous sinuses in the prostate remain open that allows the systemic absorption of the irrigating fluid when the hydrostatic pressure exceeds the venous pressure of the plexus [(21)]

An irrigating solution at a rate of 300ml/min is required during TURP for proper surgical field. The average rate of absorption being 20ml/min may be as high as 200 ml/min [22]. Amount of absorption depends on the duration of the procedure (45-60 minutes), the height of the irrigation solution stand (<60cm) and the venous pressure. Other factors that predict the absorption of irrigating fluid includes the size and the number of open venous sinuses This can result in fluid overload and dilutional hyponatraemia[23].

Clinical features of TURP syndrome include restlessness, confusion, headache, dyspnea, arrhythmias, hypotension, pulmonary edema, cardiac failure, cerebral edema, seizure and coma. It can be diagnosed clinically and confirmed by doing an arterial blood gas analysis and serum sodium.

Treatment: Inform the surgeon and stop the surgery immediately.

Injection Furosemide is given IV

If the patient develops hypoxia and pulmonary edema, patient is intubated and given positive pressure ventilation. Invasive monitoring of blood pressure and central venous pressure may be helpful.

Based on ABG values of serum sodium, we can start a slow iv infusion of 3% hypertonic saline at a rate of 20ml/hr when serum sodium < 120meq/l. If serum sodium level > 120meq/l the condition can be treated with loop diuretic and fluid restriction.

If the patient develops seizures, we can administer 2-4mg midazolam IV,50-100mg of Thiopentone sodium or Phenytoin 10-20 mg/Kg IV can be given. Packed red cells can be transfused if blood loss is more.

The other major complications during TURP include blood loss during TURP which can be 2-4 ml/min, which is from the open venous sinuses. Usually the arterial bleed is controlled using electro coagulation. Once the urinary catheter is inserted at the end of the procedure, the irrigation fluid returned should be light pink in colour. If the irrigation fluid is bright red in colour, we should suspect an arterial bleed. Venous bleeding can be controlled by filling the bladder with 100 ml of irrigating fluid and place the catheter on traction for 7 minutes at the operating table after inflating the balloon of the catheter up to 50 ml [(21)].

Surgical perforation of the prostatic capsule occur in 2% procedure[(23)].The body temperature decreases at around 1°c/hour and thus shivering occurs, causing hypothermia.

Fever related to TURP can be due to bacteraemia due to the spread of bacteria through the prostatic venous sinuses [(24)]. This can also cause rigor in the post operative period.

Anaesthetic implications of Endoscopic Urological surgeries

Neuroanatomy of the penis,prostate and urinary bladder Table no 3

Organ	Sympathetic	Parasympathetic	Spinal level of pain conduction
Bladder	T_{11}- T_{12}	S_2 –S_4	T_{11}-$T_{12(}$dome) S_2-S_4(neck)
Prostate	T_{11}-T_{12}	S_2-S_4	T_{11},T_{12},S_2-S_4
Penis and urethra	L_1-L_2	S_2-S_4	S_2-S_4

The bladder stretch sensation are carried by the afferent parasympathetic fibres, while pain, touch and temperature are carried away by the sympathetic fibres. Sympathetic fibres are mainly α-adrenergic in the base of the bladder and urethra and β- adrenergic in the bladder dome and lateral wall. Thus spinal anaesthesia is better for endoscopic urological surgeries. The sensory supply of the bladder is from T_{11} and T_{12}, hence a block upto T_{10} is necessary for TURP surgery.

Regional anaesthesia is also preferred over general anaesthesia due to several reasons in TURP. One of the main reasons is that there can be early recognition of the TURP syndrome which is of paramount importance .Spinal or Epidural

anaesthesia in a patient allows early detection of signs and symptoms of the syndrome, especially confusion, irritability. Spinal anaesthesia also reduces the blood loss by maintaining hypotension and provides for post operative analgesia .It also reduces the incidence of deep vein thrombosis by causing peripheral vasodilatation.

Spinal anaesthesia is preferred over epidural due to the technical ease of spinal anaesthesia in the elderly.

Lithotomy position during endoscopic urological surgeries

The position of the patient during endoscopic urological surgeries is lithotomy position. Where in the patient lies supine with arms crossed on the trunk or with one or both arms extended laterally to less than ninety degrees. Then each lower limb is flexed at the hip and knee, both the limbs are simultaneously elevated, separated so that the perineal region becomes accessible [25]. The degree of thigh elevation during urological surgeries is usually 30°-45° [25].Elevation of the legs can result in an increased venous return and can exacerbate a congestive cardiac failure. The other main disadvantage of lithotomy position is the cephalad movement of the diaphragm which can reduce the lung compliance and thus reduce the tidal volume [25].It can reduce the functional residual capacity.

One should also be cautious in repositioning the patient back to supine. There can be a sudden hypotension at that time .

REVIEW OF LITERATURE

De Witte and Sessler [2] in their landmark study reviewed the organization of the thermoregulatory system, the physiology of perioperative shivering and discussed the site and mechanism of action of various anti shivering drugs like Nefopam, Tramadol, Physostigmine, Pethidine, Fentanyl, Alfentanyl, Magnesium sulphate and Doxapram. The monoamine theory of thermoregulation proposed by Feldbergh and Myers and the special anti shivering properties of Pethidine were described in detail. They deciphered that both pain and thermoregulation are closely linked and that the rostral ventromedial medulla can modulate pain and temperature input ascending from the dorsal horn of spinal cord

According to **Buggy and Crossley** [19], hypothermia could cause shivering which causes sympathetic nervous stimulation, metabolic acidosis and prolonged drug metabolism. They also mentioned that post anaesthetic shivering affects 5%-65% of patients in general anaesthesia and 33% of patients in epidural anaesthesia. They stressed on the importance of maintaining normothermia perioperatively.

Kiekkas et al [26] studied the effect of hypothermia and shivering on standard PACU monitoring of 170 patients, above 18 years, who had undergone orthopaedic procedures. They monitored the incidence of hypothermia, shivering, and its effects on heart rate, mean arterial blood pressure and oxygen

saturation. They found that 73.5% patients had hypothermia and 24.7% patients shivered post operatively. Both the mean arterial pressure and heart rate were increased due to shivering, while oxygen saturation remained unchanged.

Sessler[27] reviewed the importance of temperature monitoring and normothermia during neuraxial blockade .Though fever is less likely, inadvertent hypothermia is major reason for monitoring temperature during neuraxial blockade. He deduced that core temperature is the single best indicator of the thermal status in human beings, and that it can be monitored from the pulmonary artery, nasopharynx, the tympanic membrane and the distal oesophagus. Other reasonably accurate areas of temperature monitoring would include oral, axillary and bladder temperature.

Alex Macario, Matthew Weinger and associates [28] conducted a survey amongst anaesthesiologist about which problems during anaesthesia are common and important to avoid .The outcomes which scored highly in both the scales were prioritized for measurement and improvement in ambulatory clinical practice. In this study shivering was a moderately important outcome occurring in high frequency that needed to be avoided.

Frank and Fleisher [17] in their study assessed the importance of maintenance of perioperative normothermia which could reduce any morbid cardiac outcomes. In this randomised controlled trial, three hundred patients undergoing different procedures with documented history of coronary artery disease were

monitored for any cardiac morbidity. Hypothermia was an independent predictor of morbid cardiac events by multivariate analysis (relative risk 2.2, 95% confidence interval) indicating a 55% reduction in risk when normothermia was maintained. The incidence of post operative ventricular tachycardia was less in the normothermic group than in the hypothermic group.

Leslie and Sessler [(29)] tested a hypothesis that whether any reduction in the shivering threshold was proportional to the spinal height. Eleven men aged 62 +/- 6 undergoing urologic surgery were studied. Ice cold Ringer Lactate solution was administered intravenously before spinal blockade and shivering threshold was established. Spinal anaesthesia was then given using a randomly assigned dose of 0.5% Bupivacaine 2-4 ml. Again sufficiently cold lactated Ringer's solution was given to induce shivering. The presence of shivering was noted. Temperature of the tympanic membrane, ambient and skin temperature were observed and the extent of block was defined by loss of temperature discrimination. The mean upper body temperature and ambient temperature, cooling rates or intravenous fluid volume were comparable between the control and the study group .Spinal anaesthesia reduced the shivering threshold in direct relation to the number of dermatomes blocked. Thus they concluded that one can anticipate tremendous core hypothermia during extensive spinal anaesthesia.

LI Okeke [30] studied the effect of warm intravenous fluid and irrigation fluids on body temperature during TURP . One hundred and twenty patients with benign prostatic hyperplasia posted for transurethral resection of the prostate were randomly assigned into three groups. The first group received intravenous fluid and irrigation fluid at room temperature, the second group received warm irrigation fluid at 38°c along with intravenous fluid at room temperature and the third group received warmed irrigation fluid and warmed intravenous fluid at 38°c.Their perioperative body temperatures were monitored and analysed. The mean decrease in body temperature was greater in the first group than in the second group. The patients in group I developed shivering .But in group 3,there was no significant change in the mean body temperature($p > 0.005$) and none of them felt cold or shivered. Thus they concluded that the use of warm intravenous fluids with isothermic irrigation fluid during TURP prevented the occurrence of perioperative hypothermia

Duk –Hee Chun, Hae Keum Kil, Hyun- Joo Kim, Chunghyun Park and Kum Hee Chung [31] studied about the effects of intrathecal pethidine in reducing intraoperative shivering in TURP in elderly patients .Study was performed on 50 patients posted for TURP, randomly allocated into two groups of 25 each. They added 0.2mg/kg of intrathecal pethidine with 0.5 % hyperbaric bupivacaine in one group and normal saline to 0.5% hyperbaric bupivacaine to the other group. The incidence and intensity of shivering, sublingual

temperature, hemodynamic parameters, level of block, irrigation fluid, pruritus, nausea and vomiting were monitored. According to their study, the incidence (P = 0.012) and intensity of shivering (P =0.008) were significantly less in the Pethidine group than in the control group. Pruritus was more in the Pethidine group than in saline group. This study was published in 2010

Maryam Davoudi,Sayed Habib Mousavi- Bahar, Afsin Farhanchi [(3)] conducted a study on the effects of intrathecal Pethidine in prevention of shivering during TURP .80 patients posted for TURP were assigned into two groups of forty each.15mg of Pethidine along with 75mg 5% hyperbaric lignocaine to study group and the same dose of lignocaine plus normal saline to the control group were given intrathecally. They recorded shivering episodes and hemodynamic parameters and axillary temperature. They found that Pethidine was effective in reducing shivering (P = 0.001).

Aditi.A.Dhimar , Mamta .G. Patel, V.N.Swadia [(32)] did a comparative, double blinded study of the effect of intravenous Pethidine and Tramadol in reducing shivering at a dose of 1 mg/kg iv after the appearance of shivering post spinal anaesthesia .They included 60 ASA PS I,II and III patients undergoing neuraxial blockade including spinal, epidural and combine spinal- epidural technique and peripheral nerve blocks. They monitored the time of disappearance of shivering in both the groups. They found that the disappearance of shivering was found to be at 1 minute in Tramadol group and

5 minutes for pethidine group. Thus it was concluded, in their study, that intravenous Tramadol is more efficacious to pethidine in controlling shivering.

Muralidhara.D.Patel, Hemavathi Balachander, Ravindra Bhat [33] compared between intravenous Fentanyl and intrathecal Pethidine the prevention of intraoperative shivering during LSCS . One hundred and fifty ASA I and II patients were included in the study. They divided the patients into three groups of fifty patients each. One group was given intrathecal Bupivacaine 0.5% with i.v Fentanyl 25 micrograms, second group received intrathecal 0.5% Bupivacaine plus 25 micrograms Fentanyl and the third group received i.v normal saline 5ml and intrathecal 0.5% Bupivacaine. They monitored all the parameters at an interval of ten minutes including grades of shivering, hemodynamic parameters , temperature , level of sedation .Core temperature was monitored using a nasopharyngeal probe. They found that intrathecal Fentanyl reduced shivering better than intravenous Fentanyl. Also intrathecal Fentanyl caused less sedation than Intravenous Fentanyl.

Hocker and Bein [18] studied the correlation, accuracy, precision, and practicability of perioperative temperature monitoring using sublingual temperature in comparison with tympanic membrane temperature in awake and anaesthetised patients .One hundred and seventy-one patients between the age group of 18 and 75 years scheduled for surgery where the duration of general anaesthesia was less than one hour were enrolled in the study. The sublingual

temperature was significantly higher than the tympanic membrane temperature by 0.1 - 0.2 °c. The coefficient of determination r^2 was between 0.50 and 0.59.Thus they detected that the sublingual temperature was accurate for clinical use and there was a high correlation with tympanic membrane temperature monitoring.

J.A Alhashemi and A.M Kaki [(35)] performed a study on the effect of intrathecal Tramadol administration on postoperative pain after TURP.Sixty-four patients undergoing TURP were randomised to receive 0.5% Bupivacaine 3ml premixed with either Tramadol 25 mg or saline 0.5ml.Postoperatively, morphine 5 mg IM was given based on the analgesic requirements. They deducted that intrathecal Tramadol was no different from saline in reducing the post operative morphine requirements.

Srikanta Gangopadhaya,Krishna Gupta ,Smita Acharjee [(36)] compared the effect of i.v Ketamine 0.5mg/kg , i.v. Pethidine 0.4mg/kg and i.v Tramadol 1 mg/kg in reducing shivering , given just before spinal anaesthesia. Perioperative monitoring of shivering, sedation and oesophageal temperature was done on ninety patients (30 patients in each group) .They concluded that ketamine was a better drug owing to its hemodynamic stability.

Dyer and Heathcote [37] conducted a prospective study in hundred patients to reduce heat loss during TURP under spinal anaesthesia by using blankets and heated 1.5% glycine as a bladder irrigation solution .They noted that there was a marked decrease in the incidence of shivering when the patient received blanket cover and heated 1.5% glycine as a bladder irrigant.

Jaffe, McCullough and their associates[38] conducted a research on the effect of irrigation fluid temperature on core body temperature during TURP .Fifty six male patients scheduled to undergo TURP were randomised into two groups. Group I consisted of 27 patients who received room temperature irrigation fluid at 70 degree Fahrenheit throughout TURP, while Group II consisted of 29 patients where only warmed irrigation fluids at 91.5°F was given. In both the groups glycine was used as the irrigating solution. Their baseline temperature, final temperature, the total time spent in the theatre and the amount of irrigation fluid used were analysed. In Group I, of the 27 patients, 15 of them had a decrease in body temperature and in Group II out of the 29 patients, 21 of them had a decrease in temperature. So their results proved that the irrigation fluid temperature was not a factor responsible for reduction in core body temperature. There was also no significant difference in the duration of stay in the operation theatre and in the total irrigation fluid used.

Rama Wason,Nikhil Jain and their colleagues[39] have done a study recently on the use of prophylactic IV Ketamine, Clonidine or Tramadol for control of

shivering under neuraxial blockade on 200 patients. This was published in August 2012, Indian Journal of Anaesthesia . They used IV Ketamine 0.5mg/kg, or Clonidine 75micrograms IV or IV Tramadol 0.5mg/kg all diluted to 10 ml. They monitored sedation along with shivering. But in this study, the drugs were given IV before the subarachnoid block Their results claimed that in the placebo group ,27 patients of the 50 patients developed grade 3 shivering. But in the other groups, Group Ketamine 5/50 and Group Clonidine 2/50 and Tramadol Group 4/50 patients developed shivering.The incidence of grade 3 shivering showed statistical significance (P= 0.001). There were no major hemodynamic changes in between the different groups. The study proved that either Ketamine ,Clonidine or Tramadol given i.v before spinal anaesthesia could reduce the incidence of shivering. The sedation score was higher in Ketamine group ,as compare to other groups (P< 0.05)

Susmita chakraborthy,Jayantha chakrabarthy and their associates[(40)] have studied the effect of intrathecal Tramadol 0.25mg/Kg along with 3ml 0.5%Bupivacaine in reducing post operative pain following gynaecological surgeries .They monitored the hemodynamic parameters, the duration of analgesia and level of sensory block and concluded that intrathecal Tramadol was useful in reducing pain following gynaecological surgeries.We decided to use the same dose for reducing shivering.

Sreshta BR, Maharajan SK and Thapa C [41] have done a comparative study between Bupivacaine Heavy and Pethidine intrathecally to study the early hemodynamic changes and postoperative analgesia for lower segment caesarean section in 60 patients .They used intrathecal Pethidine at a dose of 1mg/kg as sole anaesthetic and compared it with 0.5% Bupivacaine 2.2 ml. After giving spinal anaesthesia, heart rate, blood pressure, duration of post operative analgesia, APGAR scores of the baby at 1 and 5 minutes were noted. The total duration of analgesia for pethidine was 8 hours and 30 minutes while that for Bupivacaine alone was 2hours and 36 minutes. Around 6 patients of the thirty patients receiving pethidine developed pruritus and no patients in the Bupivacaine group developed pruritus.

Techanivate A, Rodanant O, Tachawattanawisal and Somsiri [42]from Thailand conducted a study comparing intrathecal Fentanyl 20 micrograms and normal saline 0.4 ml along with Bupivacaine 0.5% 2.2ml and 0.2 mg Morphine to either groups for prevention of shivering in LSCS .They conducted the study on sixty healthy patients scheduled for LSCS. The incidence of shivering in the Fentanyl group was 20% while that of the control group was 50%.They also monitored the core temperature during the study for three hours. They proved that adding 20 micrograms of Fentanyl could reduce the incidence and severity of intraoperative and postoperative shivering ($P < 0.05$)

MATERIALS & METHOD

This study was approved by the Institutional Ethical Committee, Madras Medical College,Chennai. The study was a Prospective, Randomised, Single blinded study conducted on 120 patients who were scheduled for Endoscopic Urological surgeries namely Transurethral Resection of Prostate (TURP) and Ureterescopic removal of calculi (URS). Informed consent was obtained from patients regarding the study.

Block randomisation by allotting patients into four groups was done by giving spinal anaesthesia with Intrathecal Bupivacaine with Pethidine (Group P), Intrathecal Bupivacaine with Fentanyl (Group F), Intrathecal Bupivacaine with Tramadol (Group T) and Intrathecal Bupivacaine with Saline (Group C) or Control Group.

INCLUSION CRITERIA FOR THE STUDY:

- Age :18 years to 60 years
- ASA : I & II
- Surgery: Elective Endoscopic Urological surgeries namely Transurethral Resection of Prostate (TURP) and Ureterescopic removal of calculi (URS).
- Height > 145 cm

EXCLUSION CRITERIA:

- Spinal abnormalities
- Patients with Chronic kidney disease
- Pregnant females
- Any contraindication to spinal anaesthesia like abnormal coagulation profile, sepsis.
- Emergency surgery

Materials:

- Spinal needle Quincke needle of size 25G
- Drugs – 0.5% preservative free bupivacaine for spinal anaesthesia: Inj. Fentanyl ,Inj .Pethidine ,Inj. Tramadol, normal saline (all these drugs were preservative free) ,Inj.Ephedrine ,Inj.Atropine and other emergency drugs and Inj.2% lignocaine for local anaesthesia of the skin
- 2 cc syringe and 5 cc syringe
- Povidone iodine solution
- 18G intravenous cannula and 0.9% Normal saline and Ringer lactate

PRIMARY OUTCOME MEASURED: 1.Shivering present or not

Grading of shivering

2. Temperature in degree Celsius

SECONDARY OUTCOME MEASURED:

Heart rate, systolic blood pressure and diastolic blood pressure, mean arterial pressure, arterial oxygen saturation(Spo2),other parameters like the adverse effects of the drug and level of sensory block,intravenous fluid and irrigation fluid.

DATA ANALYSIS:

Sample size determination:

We obtained the sample size for the study by determining the **power of study** using the two proportion method. With an alpha error of 5%, the sample size for a power of 80% was 25 and for 90% was 33.Hence we took a sample of 30 each for four groups.

All patients were preloaded with 500 ml of 0.9% Normal saline/Ringer lactate, before the spinal anaesthesia. The patients were placed under standard monitoring using non invasive blood pressure, electrocardiogram, pulse

oximeter and sublingual temperature. Their baseline parameters were obtained. The theatre temperature was maintained a constant at around 23°celsius.

The drug mixture was freshly prepared using a sterile technique by an anaesthesiologist. The drug mixture was plain 0.5% bupivacaine 8mg for intrathecal use and preservative free **Pethidine hydrochloride** 5% **0.2mg/kg** in group P,0.5% bupivacaine 8mg with preservative free **Tramadol 0.5mg/kg** in group T ,0.5% bupivacaine 8mg with preservative free **Fentanyl 0.5µg/kg** in group F and 0.5% bupivacaine 8mg with **normal saline 0.5 cc** for group C.The total volume used in each of the following preparation was **2.5 ml**.

Spinal anaesthesia was performed under sterile precautions in the lateral decubitus position using a 25 gauge Quincke needle at L_3- L_4 or L_4 – L_5 interspinous space. Drug was administered after confirming free flow of CSF. Patient was immediately placed supine and covered with a cotton blanket to prevent hypothermia. The level of sensory and motor block were assessed .The patient was placed in lithotomy position using the strap stirrups or the Bier-Hoff s stirrups. The temperature of the warmer was set at 37° Celsius .Only warm intravenous fluids at a temperature of 37°celsius were used. The time at the end of the intrathecal injection of the drug was taken as T0 and thereafter the primary and secondary parameters were monitored every ten minutes till the end of the procedure and hourly monitoring up to six hours postoperatively in the urology post operative ward.

All patients although were monitored every five minutes during the procedure, we recorded the parameters every tenth minute for study purpose during the surgical procedure.

The patients were also monitored for hypotension, bradycardia, nausea, vomiting, respiratory depression, pruritus, intraoperatively and postoperatively for six hours.

Hypotension was defined as a decrease in blood pressure of more than 20% from the baseline. Hypotension was treated with i.v infusion of Ringer lactate or 6mg of Ephedrine if required.

If patients developed nausea and vomiting i.v Metoclopramide 10mg was administered.

If the patient developed shivering during the procedure, the patient was given i.v Inj. Pethidine 10mg stat dose as a rescue drug.

The amount of irrigation fluid used by the urologists for the surgery was also noted. Although the irrigation fluid was not warmed.

At the end of the procedure the patient was observed for thirty minutes in the observation room and shifted to the ward. Thereafter in the ward the patient was monitored for the primary and secondary outcomes on an hourly basis.

Statistical analysis

All parameters were analysed using the SPSS 17.0 for *Windows.* The data like age, weight and height were compared amongst the four groups using ANOVA. The incidence of shivering and the side effects of different drugs were compared using the chi- square test.

The data comparison between two groups within the four groups i.e., for temperature, blood pressure ,heart rate were analysed using the *post-hoc testing.* The data was expressed as mean ± standard deviation.

A P value < 0.05 was considered statistically significant .

A P value > 0.05 was not considered as statistically insignificant.

OBSERVATION AND RESULTS

This prospective randomised, single blinded study, case control study analyses first the efficacy of intrathecal opioid over normal saline in controlling shivering. Secondly, to know and to compare which drug amongst the three opioids effectively reduces shivering. The study was conducted on 120 patients of which 90 were male and 30 female. The study was conducted from June 2012 to August 2012, for a period of three months.

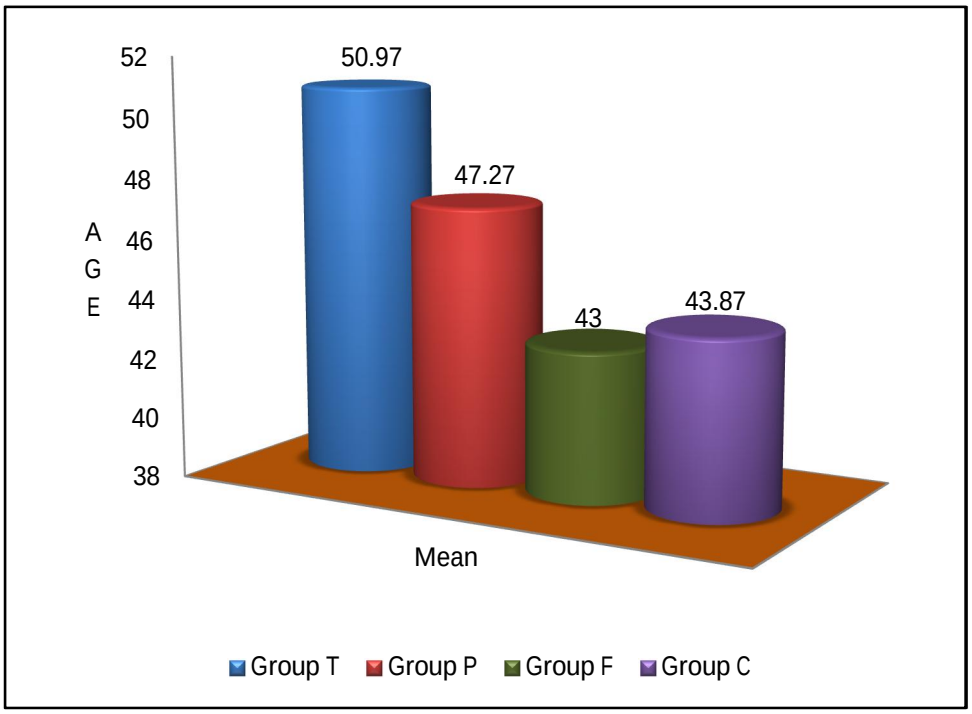
All the patients completed the study. There was no difference between the four groups with respect to age, gender, height, weight or procedure. 34 out of 120 patients underwent TURP for BPH and 86 patients underwent URS for ureteric calculus.

Table 4.Demographic profile: Age

Group	Number	Mean	SD	P value
Tramadol(T)	30	50.97	14.547	0.132
Pethidine(P)	30	47.27	14.800	N.S
Fentanyl(F)	30	43.00	14.800	
Control(C)	30	43.87	13.315	

Graphical representation of mean age among the four groups

Graph no.1



The mean age for Group T is 50.97, for Group P is 47.27, Group F 43.00 and Group C is 43.87.The P value is 0.132,it is not statistically significant. All the four groups are comparable in terms of age. The graphical representation of this age wise distribution for different drugs is given in Graph No: 1.

Sex distribution in the study group: Table 5

Group	Male		Female		P value
	No	%	No	%	
T	24	80	6	20	0.659
P	23	76.7	7	23.3	N.S
F	23	76.7	7	23.3	
C	20	66.7	10	33.3	

The percentage of male patients in Group T is 80%, in group P and group F is 76.7 and in group C is 66.7%.The percentage of female patients in group T is 20,in group P and F is 23.3,in the control group is 33.3%.The P value is 0.659,which is not statistically significant. Both the groups were comparable.

PHARMACOLOGY OF FENTANYL

History: It was first synthesised by Paul Janssen. In the early 1960, Fentanyl was introduced as an intravenous anaesthetic under the trade name *Sublimaze*.

Structure of Fentanyl: It is structurally related to Pethidine. Fentanyl is a phenylpiperidine derivative.

Pharmacology:

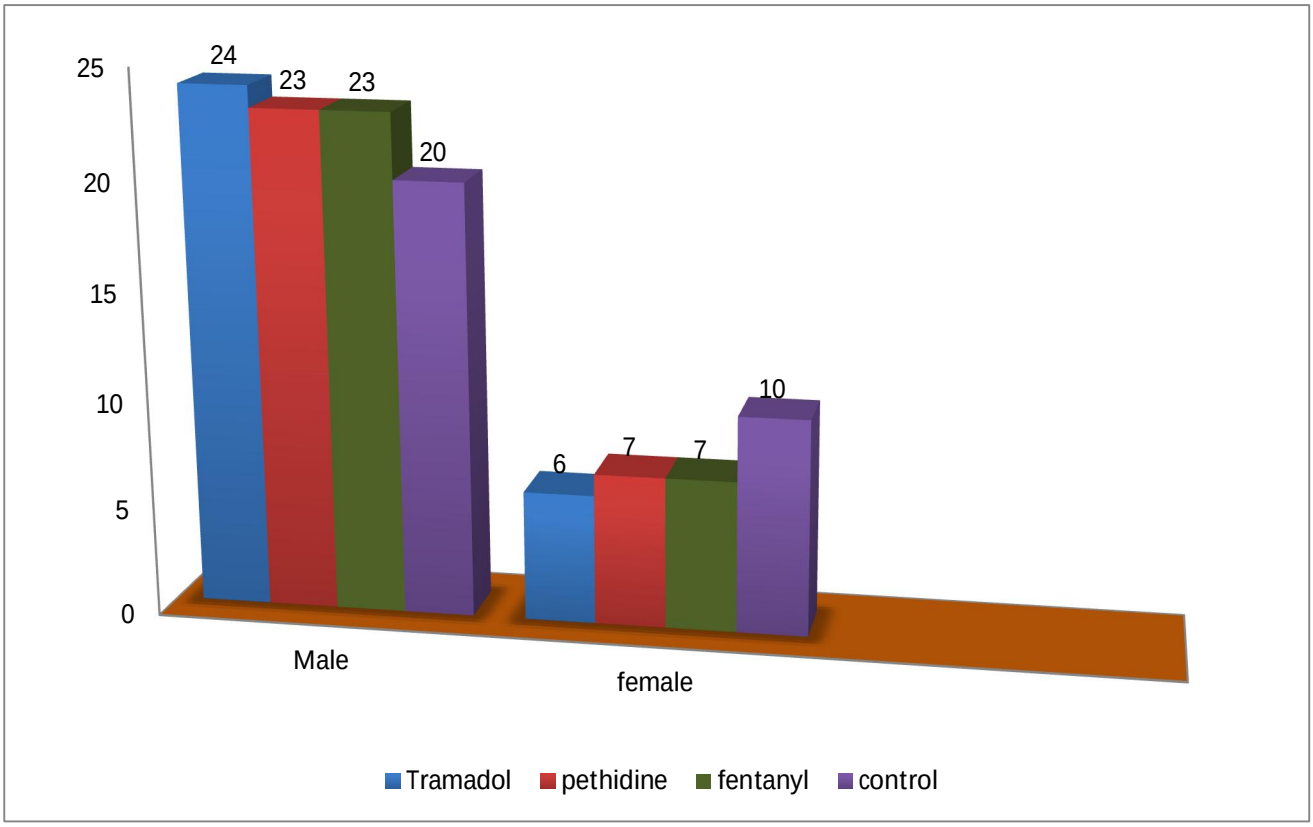
It is a synthetic opioid. As an analgesic, Fentanyl is 75 to 125 times more potent than morphine. Fentanyl is available as ampoules of 100µg/2ml

Pharmacokinetics: It is 84% protein bound. It has a clearance of 1530ml/min. Its pKa is 8.4, percentage of unionized form at pH 7.4 is < 10, octanol / water partition coefficient is 813 and the percentage bound to plasma protein is about 84 % [(6)]. The lung also takes up approximately 75% of the injected dose of the fentanyl exhibiting first pass effect.

Pharmacodynamics: Fentanyl has a more rapid onset of action and short duration of action than morphine. The greater potency and more rapid onset of action are due to the greater lipid solubility of Fentanyl compared with that of Morphine.

Sex distribution in the study groups:

Graph No: 2



Distribution of TURP and URS in different groups: Table no: 6

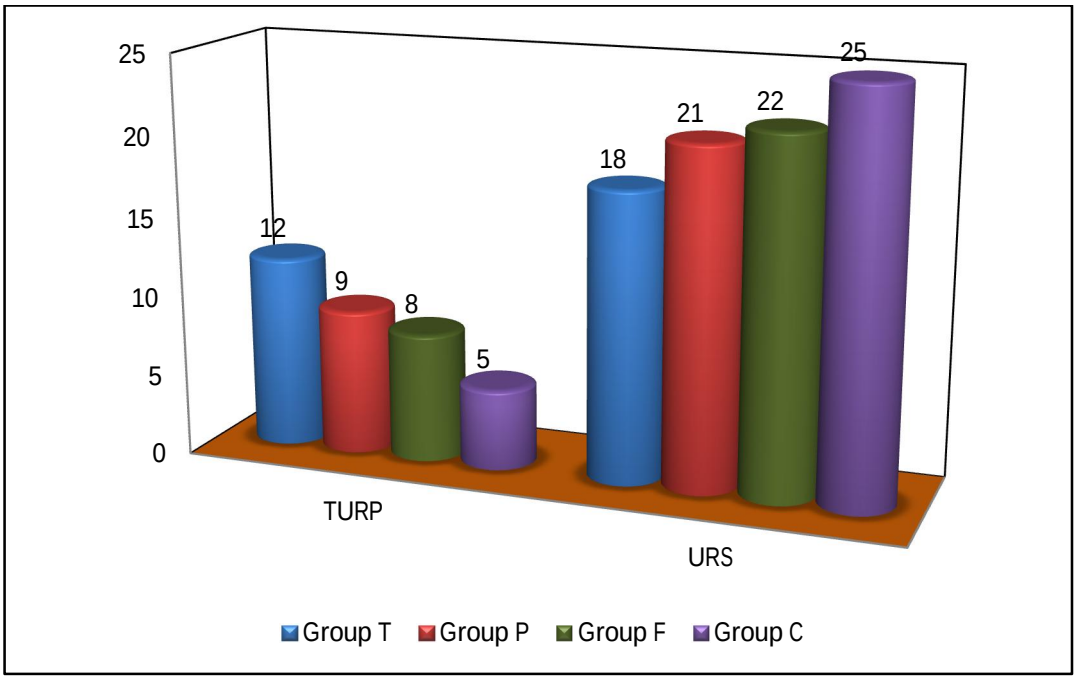
Group	TURP		URS		P value
	No	%	No	%	
T	12	40	18	60	0.250 N.S
P	9	30	21	70	
F	8	26.7	22	73.3	
C	5	16.7	25	83.3	

40% of patients in group T,30% in group P,26.7% in group F and 16.7 in group C were posted for TURP.60% of patients in group T,70% in group P,73,3% in group F and 83.3% in group C were posted for URS. Statistical analysis revealed a P value of 0.250 which is not statistically significant. Both the groups were comparable in terms of the procedure done.

Observation of shivering with different drugs:

Of 120 patients, 62 patients did not shiver at all. Sixty percent (18/30) in the Group T, Ninety percent of patients (27/30) in Group P, twenty percent of patients (6/30) in the Group F and 36.6% of patients (11/30) in the Group C did not develop shivering at all.

<u>Graphical Representation of BPH and URS in the study group:</u>Graph No. 3



Of the total 120 patients,24 patients in the Group F developed shivering, while 19 patients developed shivering in the Group C. Only three patients in the Group P developed shivering and 12 patients in the Group T developed shivering.

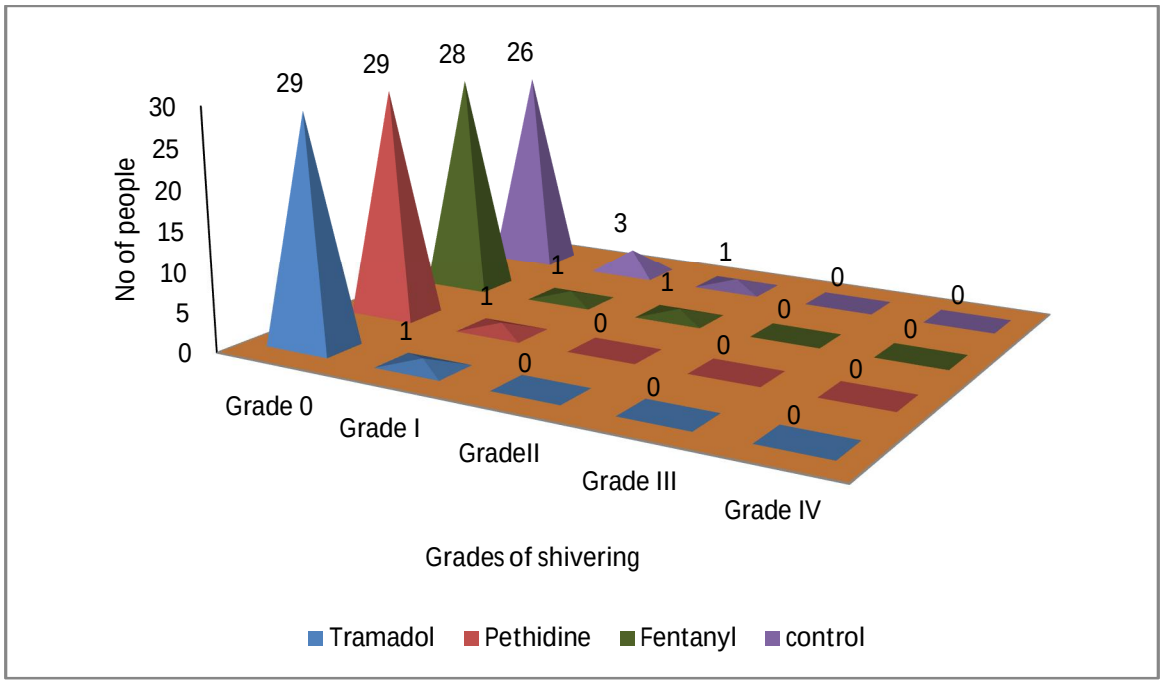
AT **T0**, i.e. the time at which spinal anaesthesia was given, 112 patients of the 120 patients did not shiver at all. Of the 8 patients who developed shivering, 6 patients had piloerection or grade I shivering. One patient each from Group T, Group P, Group F and three patients from the Group C had grade I shivering or piloerection. Two of the eight patients had shivering of intensity grade II; they were each from the Group C and the Group F. However the values were not significant using the Pearson chi square test. (p =0.648)

Table no.7

	Group T	Group P	Group F	Group C	P value
Grade 0	29	29	28	26	
Grade I	1	1	1	3	0.648
GradeII	0	0	1	1	N.S
Grade III	0	0	0	0	
Grade IV	0	0	0	0	

Graphical representation of grades of shivering at T 0

Graph no.4



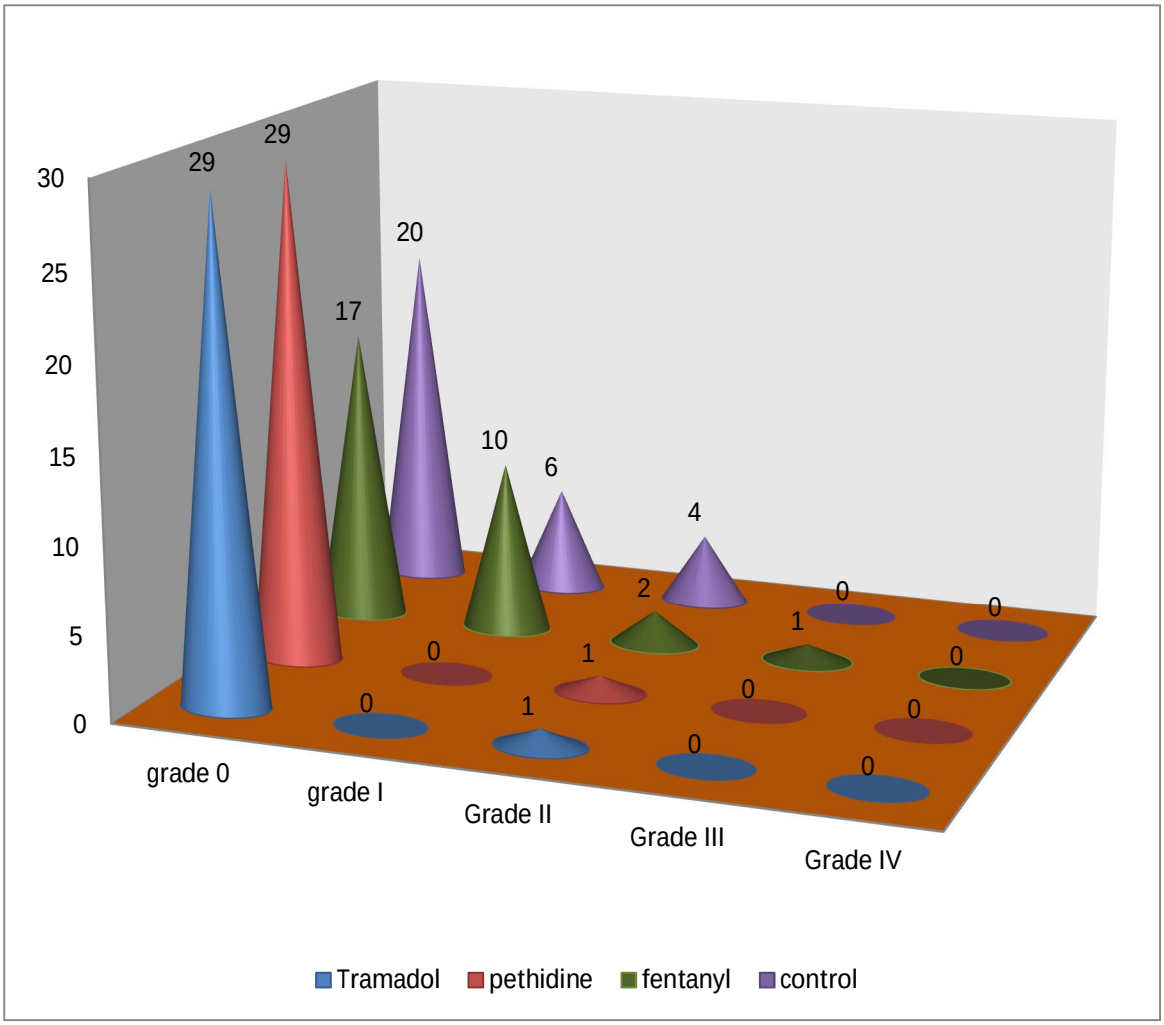
At **T10**, that is ten minutes after giving spinal anaesthesia, ninety-five patients of the one hundred and twenty patients did not shiver at all. Ten patients of the Group F (33.3%) and six patients of the Group C (20%) developed grade I shivering. One patient from Tramadol and Group P, two patients of the Group F and four patients of the Group C developed grade II shivering at the tenth minute .One patient of the Group F still had grade III shivering at the end of ten minutes. The patients in the other groups had shivering of grade II intensity by the end of ten minutes**. The P value was 0.001, which was statistically significant.**

Table No. 8

	Group T	Group P	Group F	Group C	P value
Grade 0	29(96.7%)	29(96.7%)	17(56.7%)	20 (66.7%)	0.001 SIG
Grade I	0	0	10(33.3%)	6 (20%)	
Grade II	1 (3.3%)	1 (3.3.%)	2(6.7%)	4(13.3%)	
Grade III	0	0	1 (3.3%)	0	
Grade IV	0	0	0	0	

At **T20**, i.e., twenty minutes after giving spinal anaesthesia, 77(64.2%) patients did not shiver at all. Thirty (25%) patients of 120 patients had grade I shivering of which 16 were from the Group F, 10 from the Group C, and 3 patients from

Graph No 5.Graphical Representation of grades of shivering at T10



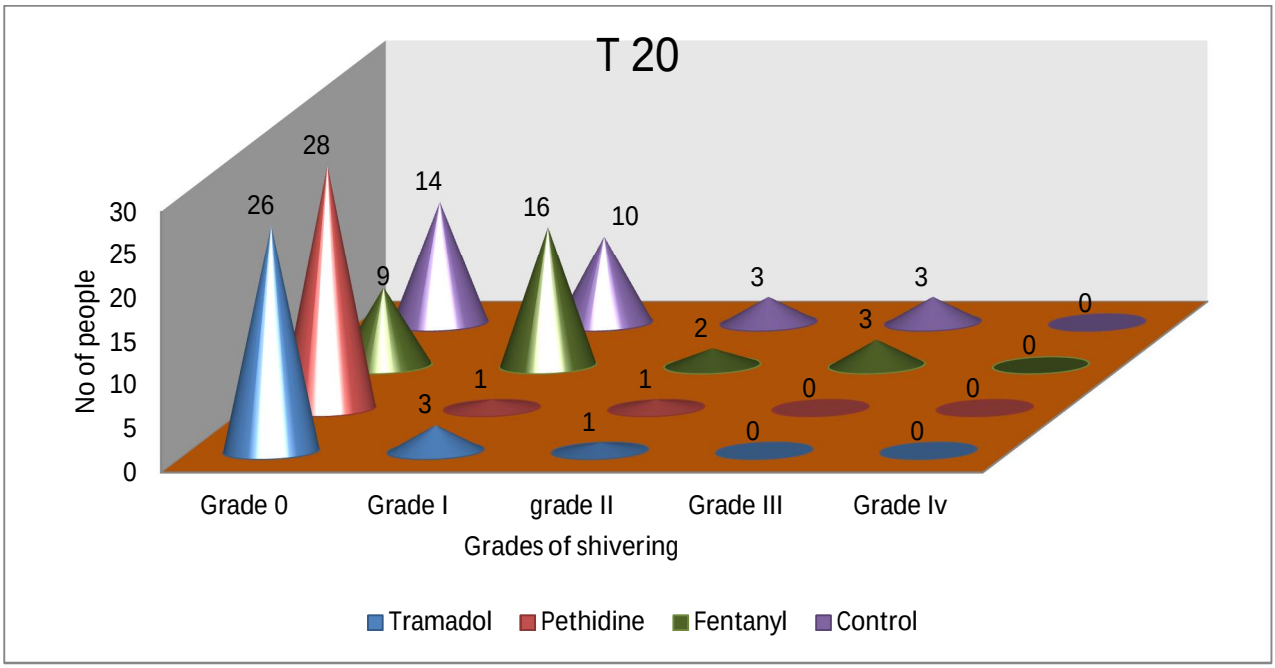
the Group T and one patient from the Group P. Seven patients at T20(5.8%) had grade II shivering and 6 (5%) patients had grade III shivering. Of the patients who had grade III shivering, 3 were from the Group C and 3 from the Group F. The data were analysed by Pearson chi square test and the values were significant (P = 0.000).The tabular representation of this at T 20:

Table No.9

	Group T	Group P	Group F	Group C	P value
Grade 0	26(86.7%)	28(93.3%)	9(30%)	14(46.7%)	0.000 SIG
Grade 1	3(10.0%)	1(3.3%)	16(53.3%)	10(33.3%)	
Grade 2	1(3.3%)	1(3.3%)	2(6.7%)	3(10.0%)	
Grade 3	0(0%)	0(0%)	3(10%)	3(10%)	
Grade 4	0(0%)	0(0%)	0(0%)	0(0%)	

At **T30**, seventy patients (58.3%) of patients did not shiver at all. 27 patients of the 120 developed grade I shivering. Two patients of the Group P, five patients from the Group T, twelve patients of the Group F and eight patients of the Group C developed grade I shivering.13 patients had grade III shivering and 9 patients had grade III shivering, of which one belonged to the Tramadol and Group P each, two belonged to the Group F and 5 belonged to the Group C. One

Graph No 6.Graphical Representation of grades of shivering at T20



patient belonging to Group F had grade IV shivering at T 30.Using the Pearson chi square testing the P value was statistically significant (P=0.000).

Table:10

	Group T	Group P	Group F	Group C	P value
Grade 0	23(76.7%)	27(90%)	8(26.7%)	12(40%)	0.000 SIG
Grade 1	5(16.7%)	2(6.7%)	12(40%)	8(26.7%)	
Grade 2	1(3.3%)	0(0%)	7(23.3%)	5(16.7%)	
Grade 3	1(3.3%)	1(3.3%)	2(6.7%)	5(16.7%)	
Grade 4	0(0%)	0(0%)	1(3.3%)	0(0%)	

At **T40** 71 patients did not shiver, of which 30 patients were from the Group P.23 patients of the 120 patients developed grade I shivering, of which 12 were from the Group F.19 patients had grade II shivering of which one patient was from the Group T, 10 from the Group F and 8 patients from the Group C. Five patients at T40 had grade III shivering and 2 patients had grade IV shivering, both were from the Group F. **The values were statistically significant using the Pearson Chi Square Test with a P value of 0.000.**

Graphical Representation of grades of shivering at T30

Graph No 7.

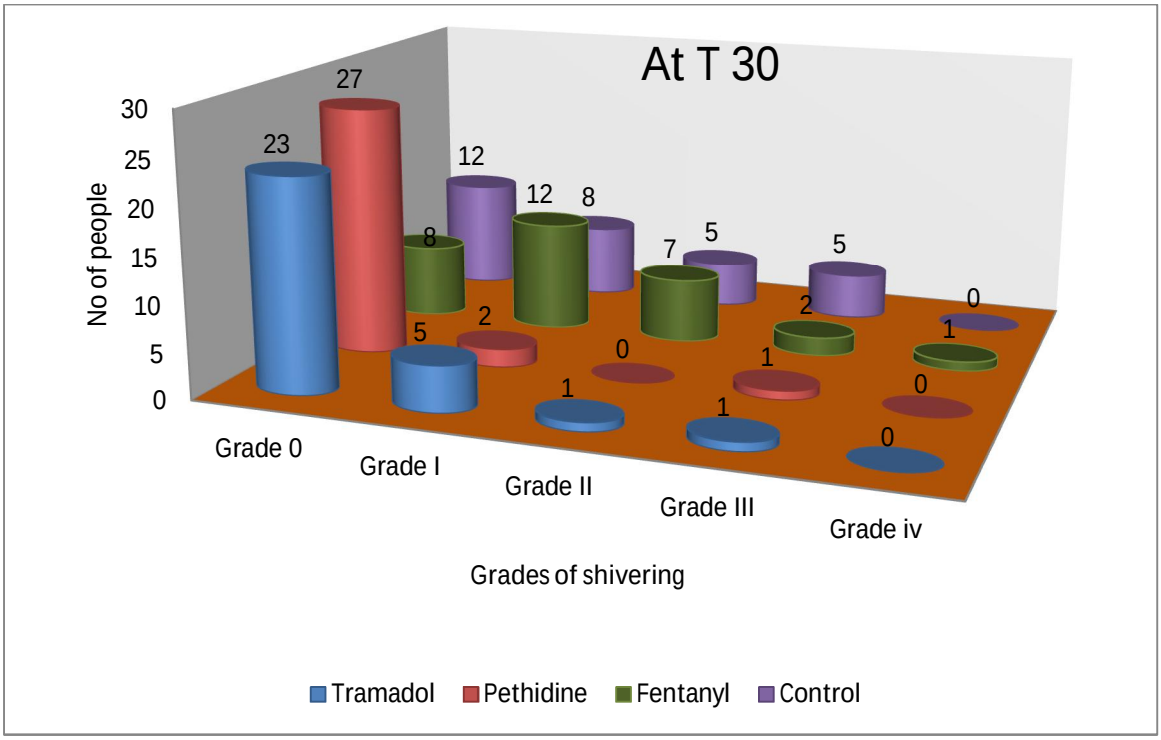


Table No.11.Incidence and Grades of shivering at T 40

	Group T	Group P	Group F	Group C	P value
Grade 0	23(76.7%)	30(100%)	6(20%)	12(40%)	0.000 SIG
Grade 1	5(16.7%)	0(0%)	12(40%)	6(20%)	
Grade 2	1(3.3%)	0(0%)	10(33.3%)	8(26.7%)	
Grade 3	1(3.3%)	0(0%)	0(0%)	4(13.3%)	
Grade 4	0(0%)	0(0%)	2(6.7%)	0(0%)	

At **T50**, 81 patients did not shiver. About 19.2%(23/120) developed grade I shivering of which 2 were in the Group T, 11 from the Group F and 10 from the Group C. Over 13 patients(10.8%) patients developed shivering of grade II intensity of which 7 belonged to the Group F and 6 patients of the Group C.2 patients of developed grade III shivering and one patient, belonging to Fentanyl had grade IV shivering at T50 .It is to be noted that no patients in Group P developed shivering. **The values were statistically significant using the Pearson chi square test (P=0.000).**

Graphical Representation of grades of shivering at T40

Graph No 8.

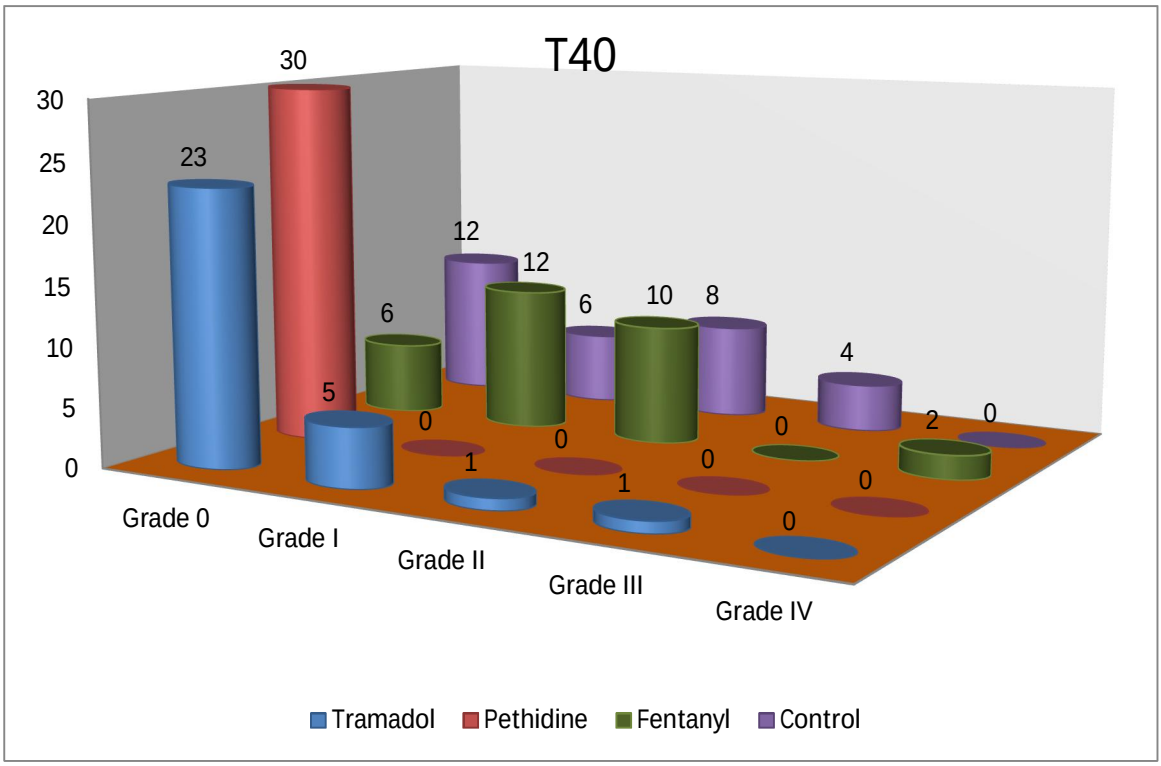


Table No.12. Incidence and Grades of shivering at T 50

	Group T	Group P	Group F	Group C	P value
Grade0	28(93.3%)	30(100%)	10(33.3%)	13(43.3%)	0.000 SIG
Grade 1	2(6.7%)	0(0%)	11(36.7%)	10(33.3%)	
Grade2	0(0%)	0(0%)	7(23.3%)	6(20%)	
Grade3	0(0%)	0(0%)	1(3.3%)	1(3.3%)	
Grade4	0(0%)	0(0%)	1(3.3%)	0(0%)	

At the end of first hour, 99/120 i.e. 82.5% of patients had no shivering.18 patients had grade I shivering of which 9 belonged to the Group F and 9 belonged to the Group C. Three patients of the 120 had grade II shivering, two belonged to the Group F and one belonged to the Group C. No patients in Group P and Group T developed shivering. **The values were statistically significant with a P value of 0.000.**

Graphical Representation of grades of shivering at T50

Graph No 9.

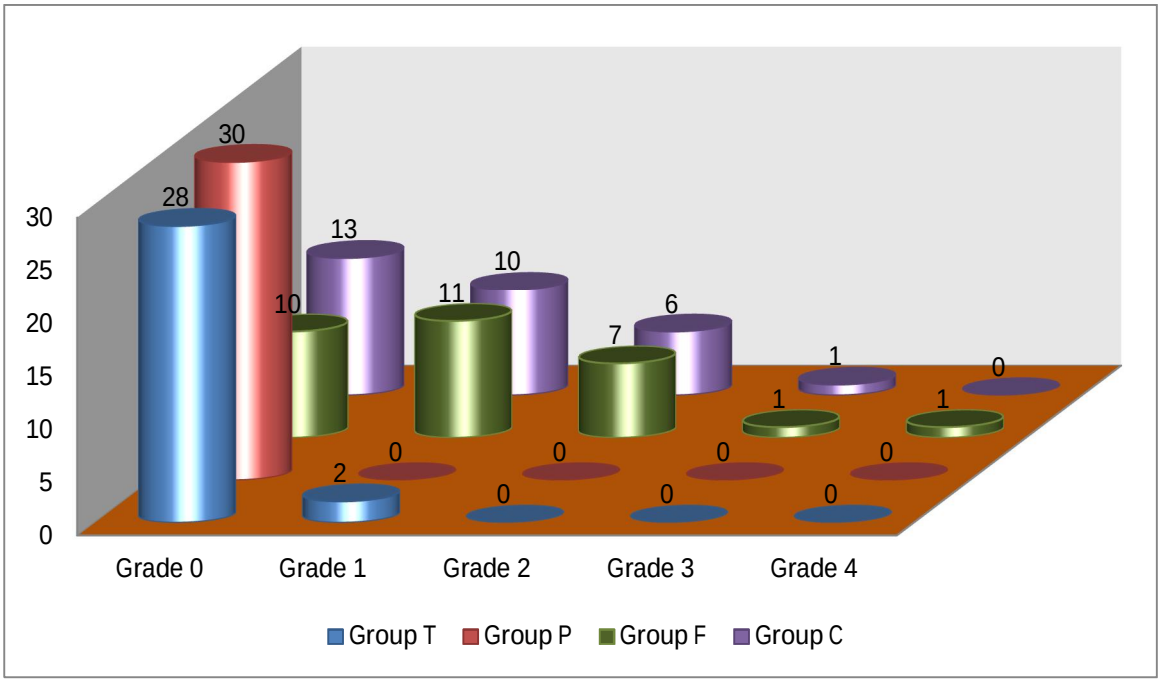


Table No. 13**. Incidence and Grades of shivering at T 1H**

	Group T	Group P	Group F	Group C	P value
Grade 0	30(100%)	30(100%)	19(63.3%)	20(66.7%)	0.000 SIG
Grade 1	0(0%)	0(0%)	9(30%)	9(30%)	
Grade 2	0(0%)	0(0%)	0(0%)	2(6.7%)	
Grade 3	0(0%)	0(0%)	0(0%)	0(0%)	
Grade 4	0(0%)	0(0%)	0(0%)	0(0%)	

At the T2H, 6 patients had grade I shivering (5%).Three belonged to the Group F and three to the Group C. However the values were not statistically significant. AT T3H, 4H, 5H, 6H no patients had shivering. Their values were not significant statistically

Temperature Monitoring

The sublingual temperature was measured for all patients using a thermometer, every ten minutes, hourly after the first hour up to six hours. At the end of forty minutes the mean temperature recorded was 36.093°c for the Group T; 36.423°c for the Group P ;36.583 for the Group F and 36.440 for the Group C. Using Pearson chi square test, values were statistically significant (P=0.000).The

Graphical Representation of grades of shivering at T1H

Graph no.10

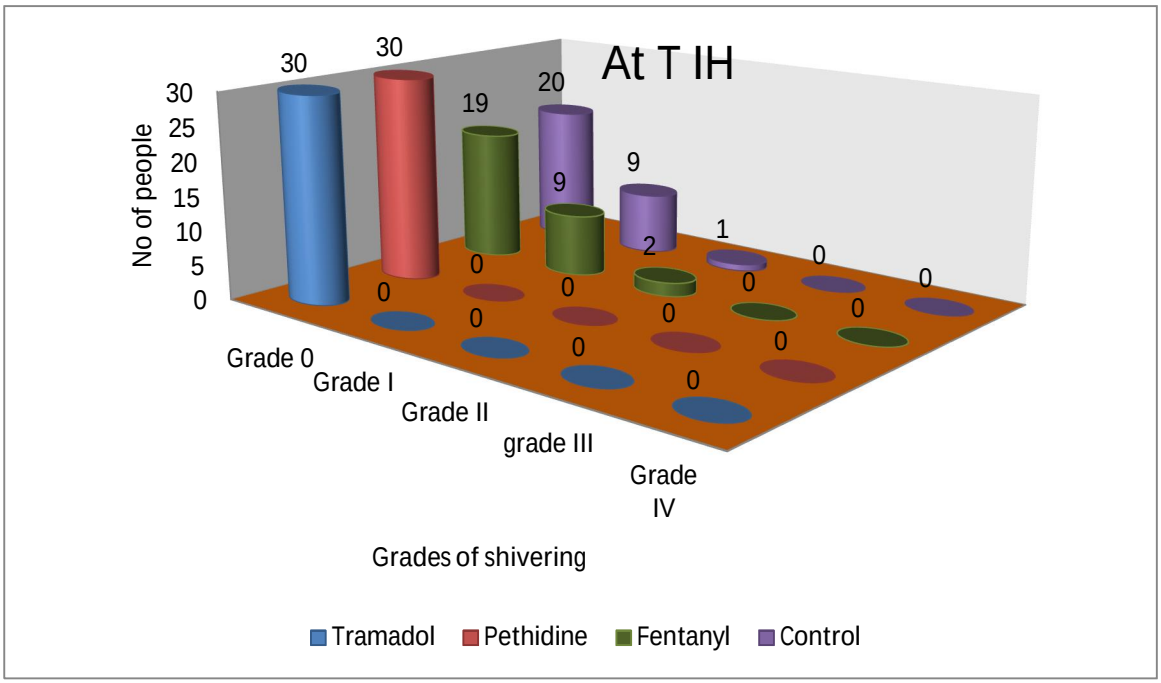


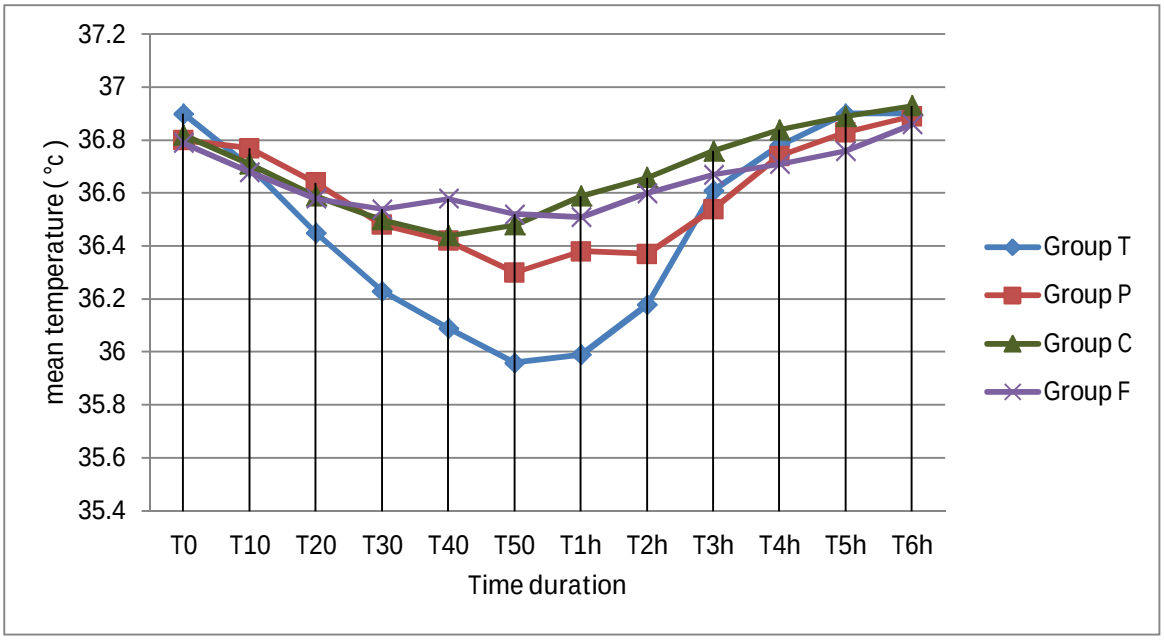
Table No: 14 Mean Sublingual Temperatures at different time intervals

	Group T	Group P	Group C	Group F	Total	P value	SIG/NS
T0	36.92	36.8	36.82	36.79	36.85	0.042	NS
T10	36.70	36.77	36.71	36.68	36.719	0.537	NS
T20	36.45	36.64	36.59	36.58	36.569	0.178	NS
T30	36.23	36.48	36.50	36.54	36.443	0.010	NS
T40	36.09	36.42	36.44	36.58	36.385	0.000	SIG
T50	35.96	36.30	36.48	36.52	36.318	0.000	SIG
T1H	35.99	36.38	36.59	36.51	36.369	0.000	SIG
T2H	36.18	36.37	36.66	36.60	36.454	0.001	SIG
T3H	36.61	36.54	36.76	36.67	36.64	0.200	NS
T4H	36.78	36.74	36.84	36.71	36.77	0.284	NS
T5H	36.90	36.83	36.89	36.76	36.85	0.088	NS
T6H	36.90	36.89	36.93	36.86	36.90	0.433	NS

The other hemodynamic parameters including systolic, diastolic , mean arterial pressures, heart rate, arterial oxygen saturation were comparable between groups at all groups at all time intervals. However the mean arterial pressure at T0 was significant using the post hoc tests between Group T and Group F (P=0.001).

Mean Temperature at various time intervals following spinal anaesthesia

Graph No:11



minimum sublingual temperature recorded was for Group T and was 35°c at forty minutes. For Group P, Group F and Group C it was 36°c, 35.2°c and 35.8°c respectively. At the end of 50 minutes the temperature values using the Pearson chi square test were statistically significant (P=0.000). The minimum temperature recorded was for Tramadol and Pethidine each being 34.8°celsius.For Group C and Group F, it was 35.8°c and 35.5°c respectively.

Post Hoc test were done to compare temperature between any two groups within the four groups, using Turkey HSD. All groups were comparable. At 40 minutes when compared between group T and group F, the temperature values were statistically significant (P=0.000).Looking at Pearson chi square test, the values were also significant at 40 minutes. The mean temperature recorded for group T was 36.093 °c, for group F being 36.583, and Group C being 36.440.

At T50 also ***Post hoc test*** were significant in between group T and group F and group T and group C .The mean body temperature recorded for Group T was 35.967°c , Group P was 36.303°c ,for Group F being 36.520°c and Group C being 36.483°c.

Mean heart Rate at different time intervals

Graph No 12

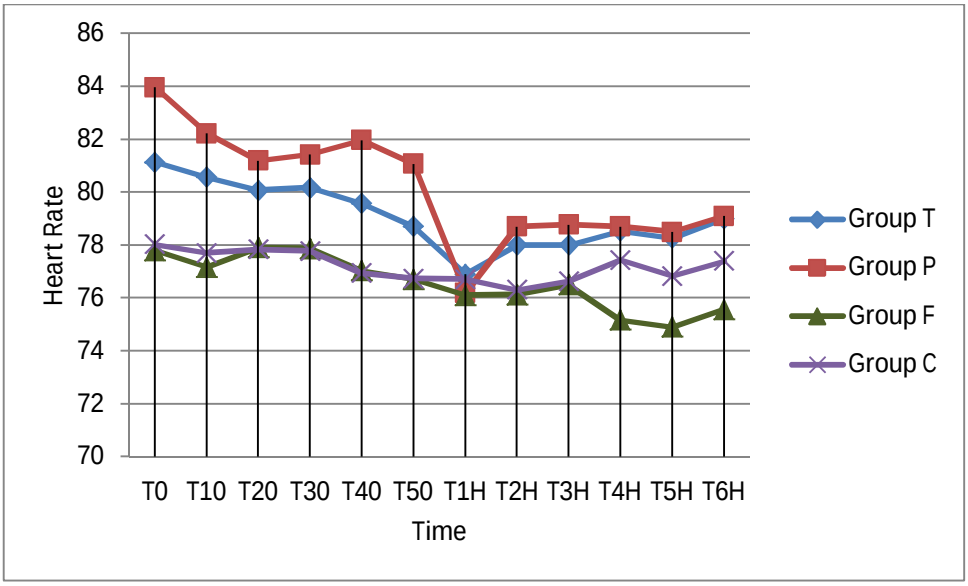


Table No: 15 Tabular Representation of Heart Rate and time duration

	Mean Heart Rate				Standard deviation				
	Group T	Group P	Group F	Group C	Group T	Group P	Group F	Group C	P value
T0	81.13	83.97	77.8	78.03	13.261	13.518	13.852	10.950	0.212
T10	80.57	82.23	77.17	77.7	12.891	14.004	14.582	10.340	0.390
T20	80.07	81.2	77.9	77.83	11.169	13.576	12.794	9.538	0.623
T30	80.17	81.43	77.87	77.77	10.639	13.485	13.472	10.030	0.570
T40	79.57	81.97	77.03	76.93	10.679	13.019	13.150	10.448	0.307
T50	78.70	81.07	76.7	76.73	11.783	12.054	12.577	10.732	0.422
T1H	76.90	76.2	76.1	76.7	12.007	12.169	12.606	12.889	0.761
T2H	78.00	78.7	76.13	76.3	11.371	11.972	12.314	10.879	0.786
T3H	78.00	78.77	76.5	76.63	11.030	11.688	13.271	11.078	0.855
T4H	78.53	78.7	75.17	77.43	10.211	11.002	12.731	11.097	0.602
T5H	78.27	78.5	74.9	76.83	11.543	11.410	11.923	11.390	0.607
T6H	79.00	79.1	75.57	77.4	11.940	10.970	11.667	11.239	0.597

Mean Systolic Blood Pressure at different time interval:

Graph No:13

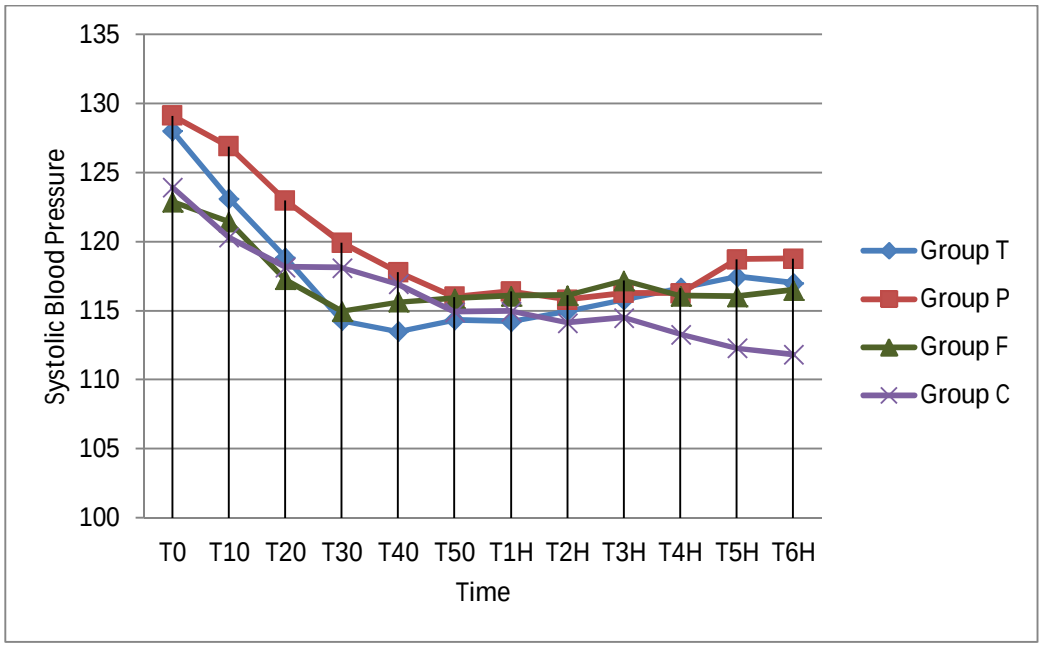


Table No:16 Mean Systolic Blood Pressure at different times

	Mean systolic blood pressure				Standard deviation				P value
	Group T	Group P	Group F	Group C	Group T	Group P	Group F	Group C	
T0	128.03	129.13	122.9	123.93	12.283	11.319	15.098	11.974	0.168
T10	123.13	126.9	121.47	120.33	12.037	12.433	12.506	12.033	0.183
T20	118.87	123	117.27	118.17	13.323	12.660	12.509	13.481	0.335
T30	114.3	119.93	114.97	118.13	12.720	10.448	13.780	13.434	0.271
T40	113.5	117.8	115.63	116.93	11.884	12.637	14.684	12.326	0.598
T50	114.33	116	115.9	114.93	10.646	12.534	14.618	11.435	0.945
T1H	114.23	116.4	116.07	114.97	10.438	11.000	12.676	11.604	0.878
T2H	115	115.8	116.13	114.13	9.233	12.596	12.486	10.261	0.903
T3H	115.8	116.3	117.2	114.5	8.751	11.552	11.975	10.388	0.803
T4H	116.67	116.27	116.07	113.3	7.112	12.572	10.524	10.964	0.588
T5H	117.47	118.73	116.03	112.3	9.584	11.803	10.682	10.942	0.118
T6H	117	118.77	116.5	111.83	8.350	11.389	11.530	10.815	0.077

Mean diastolic blood pressure at different time intervals

Graph No 14

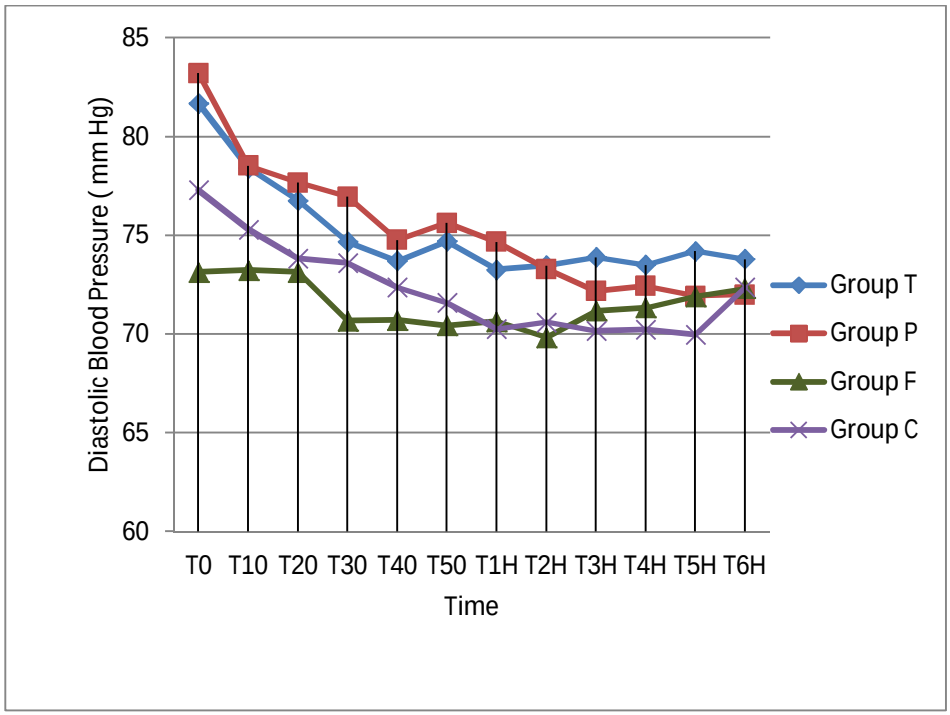


Table No.17 Mean Diastolic Blood Pressure for each of the different groups

	Mean Diastolic Blood Pressure				Standard Deviation				
	Group T	Group P	Group F	Group C	Group T	Group P	Group F	Group C	P value
T0	81.7	83.23	73.13	77.3	6.412	8.161	11.506	9.469	0.000
T10	78.43	78.53	73.23	75.3	6.882	9.130	9.989	9.422	0.063
T20	76.77	77.67	73.13	73.83	7.295	9.163	11.069	8.765	0.164
T30	74.67	76.97	70.67	73.6	7.457	9.817	9.098	9.328	0.059
T40	73.7	74.77	70.7	72.37	8.284	10.030	9.628	8.049	0.339
T50	74.7	75.63	70.43	71.6	8.238	10.480	9.365	9.339	0.107
T1H	73.27	74.67	70.63	70.27	8.170	8.739	10.931	8.761	0.198
T2H	73.47	73.3	69.83	70.6	6.996	9.308	9.270	8.633	0.247
T3H	73.9	72.17	71.17	70.17	6.702	8.694	10.069	9.752	0.414
T4H	73.5	72.43	71.33	70.23	7.328	8.131	10.370	9.975	0.538
T5H	74.2	71.93	71.9	69.97	6.488	8.733	10.525	10.053	0.358
T6H	73.8	72	72.3	72.37	6.499	8.630	9.879	7.511	0.619

MAP at different time intervals

Graph 15

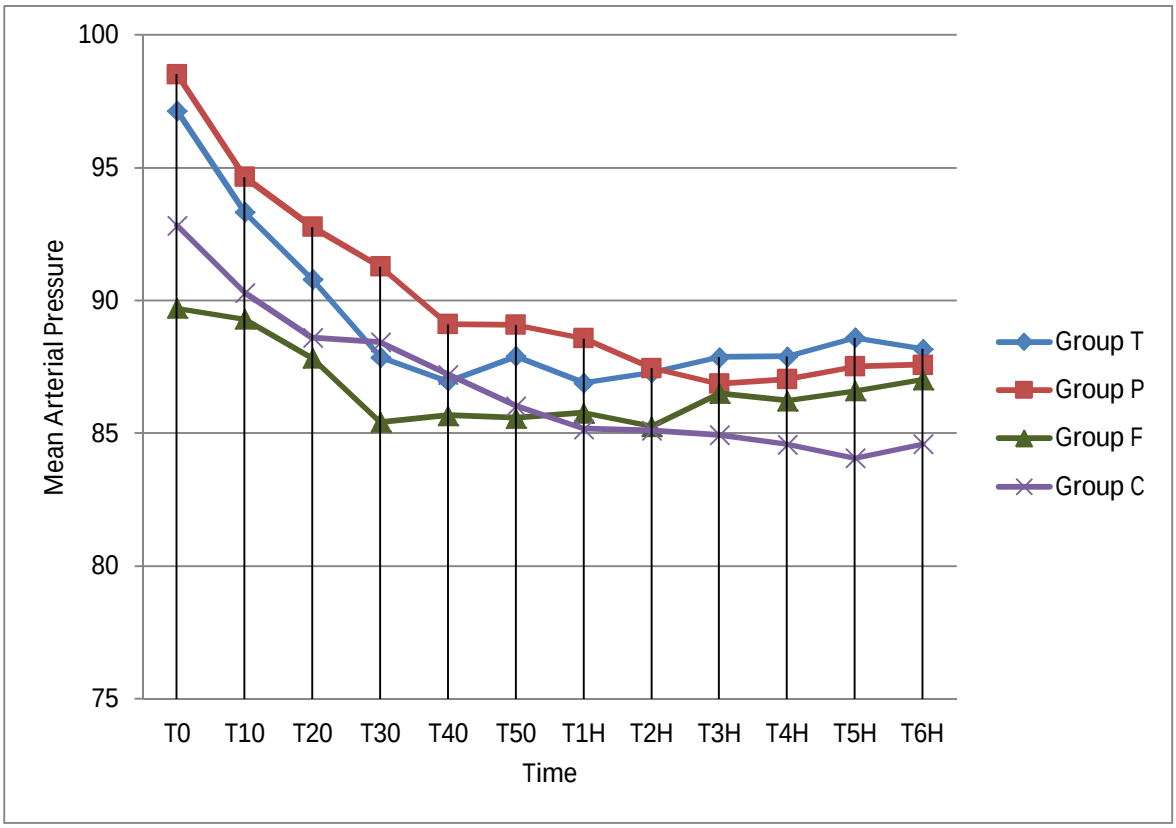
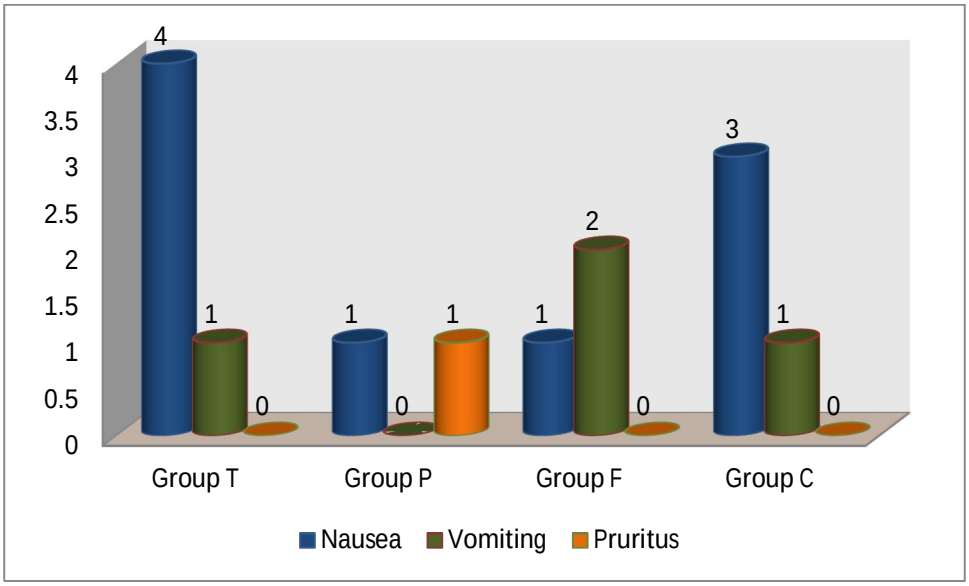


Table No.18 Mean Arterial Pressure in different groups

	Mean of MAP				Standard Deviation				
	Group T	Group P	Group F	Group C	Group T	Group P	Group F	Group C	P value
T0	97.16	98.53	89.72	92.84	6.412	8.161	11.506	9.469	0.000
T10	93.34	94.66	89.31	90.31	6.852	9.130	9.989	9.422	0.040
T20	90.8	92.78	87.84	88.61	7.295	9.163	11.069	8.765	0.095
T30	87.87	91.29	85.43	88.44	7.457	9.817	9.098	9.328	0.065
T40	86.97	89.11	85.68	87.22	8.284	10.030	9.365	9.339	0.050
T50	87.91	89.09	85.59	86.04	8.238	10.480	9.268	8.049	0.357
T1H	86.91	88.58	85.78	85.17	8.170	8.739	10.931	8.761	0.395
T2H	87.3	87.47	85.27	85.11	6.996	9.308	9.270	8.633	0.510
T3H	87.87	86.88	86.51	84.94	6.702	8.694	10.069	9.752	0.574
T4H	87.9	87.04	86.24	84.59	7.328	8.131	10.370	9.975	0.441
T5H	88.61	87.53	86.61	84.08	6.488	8.773	10.525	10.053	0.184
T6H	88.19	87.59	87.03	84.61	6.499	8.630	9.879	7.511	0.291

Graphical Representation Of Adverse effects due to different drugs

Graph No: 16



Observation On adverse effects

One patient of the Group P developed pruritus (1/30) i.e. 0.8% especially of the trunk and the face which subsided after giving i.v Inj Pheniramine 25mg stat dose. No other patients developed pruritus. The values were not statistically significant .Nine patients (7.5%) developed nausea and 4 patients (3.3%) had vomiting. 4 patients who received Tramadol developed nausea, one patient of the Pethidine and Group F developed nausea. Three patients of the Group C also had nausea. Two patients of the Group F and one patient of the control and Group T developed vomiting. But none of these were statistically significant. No patients developed respiratory depression at any point of time.

Table No 19

	Total	Group T	Group P	Group F	Group C	P value	SIG/NS
Nausea	30	4(13.3%)	1(3.3%)	1(3.3%)	3(10%)	0.356	NS
Vomiting	30	1(3.3%)	0(0%)	2(6.7%)	1(3.3%)	0.417	NS
Pruritus	30	0(0%)	1(3.3%)	0(0%)	0(0%)	0.388	NS

The duration of procedure, intravenous fluids, highest level of sensory block were also comparable between all four groups.

Mean volume of irrigation fluid used for Group T was 6.10 litres, for the group P was 6.40 litres for group F was 6.35 litres and for the Group C was 6.50 litres. Using the ***one way ANOVA,*** values were found to be comparable between the four groups.

Table no 20<u>Tabular representation of these observations</u>:

	Mean					
	Group T	Group P	Group F	Group C	P value	SIG/NS
Duration of procedure(min)	45.57	48.00	46.53	44.07	0.125	NS
Irrigation Fluid(l)	6.10	6.40	6.35	6.50	0.283	NS
IVF(ml)	756.67	866.33	770.00	778.83	0.289	NS
Highest level of block	9.00	8.2	9.00	8.67	0.026	NS

DISCUSSION

Spinal anaesthesia is a safe method of regional anaesthesia used worldwide for endoscopic urological procedures. The incidence of shivering in spinal anaesthesia is around 40 -70% [1,2].Though shivering can increase the metabolic heat production up to 600% above the basal level ,the heat produced by shivering is ineffective. Approximately half the numbers of patients undergoing TURP become hypothermic and shiver at the end of the procedure [43]. The decrease in body temperature during transurethral resection of the prostate (TURP) is related to the temperature of the irrigating solution and to the duration of surgery [43] .Several litres of fluid passed through the bladder can reduce the body temperature at the rate of 1°Celsius per hour during TURP [23]. Shivering drastically increases the oxygen consumption by 200 -600% and the carbon dioxide production and decreases the mixed venous oxygen saturation [1, 44, 54].So shivering has become a moderately important outcome to be avoided during the perioperative period. This was affirmed in a survey conducted by Macario and his collegues among anaesthesiologists [45]. There is an age related impairment of thermoregulatory function .The decrease in muscle mass also reduces the incidence of shivering. Yet the incidence of shivering in elderly patients undergoing regional anaesthesia has been reported as 68.5% in some cases and there have been a wide variation in the incidence rates [46, 47]. Another

point to be noted is that most patients undergoing TURP are elderly. Shivering can increase the myocardial oxygen demand in a patient with compensated cardiorespiratory status thereby causing tachycardia, hypertension and even arrhythmias [48].Shivering can increase the oxygen consumption and carbon dioxide production which is dangerous in a patient with limited cardiopulmonary reserve [17].This suggests to us as to why one must consider shivering as a relative medical problem which has to be prevented.

The three major factors that can contribute to core hypothermia during anaesthesia include: heat loss to the environment, inhibition of central thermoregulatory control and redistribution of body heat [31]. The body is also exposed to a cold environment in the form of cool ambient temperature. Cold intravenous fluid or blood administered without warming and large amounts of irrigation fluid (volumes in litres) used during TURP and URS can further decrease the body temperature and cause shivering. In infective ureteric stones caused by urease producing bacteria, the bacteria act as a nidus for formation of the stone. The incidence of shivering was thus high due to bacteraemia [49, 50]. Winter reported an incidence of hypothermia as high as 63% during TURP with use of room temperature irrigation fluids [51].

There have been several studies conducted on how to prevent shivering and reduce hypothermia under neuraxial blockade .Several studies have also been done focussing on reducing shivering during urological surgeries in particular

The present study was a prospective randomized single blinded study carried out from June 2012 to August 2012 in the urology theatre on 120 patients in 4 different groups of 30 patients each.

The study conducted by Chun et al at Korea published in Korean journal of Anaesthesia in July 2010 was on elderly patients for TURP alone, comparing the effect of intrathecal Pethidine 0.2mg/kg to Bupivacaine and saline in 50 patients , in reducing intraoperative shivering[31] .Thus this study was done exclusively on male patients up to 80 years. They used the oral thermometer for monitoring sublingual temperature. However their study was done only during the intraoperative period unlike our study which included postoperative monitoring of the patient in the post operative ward for 6 hours. We also used an oral thermometer for monitoring sublingual temperature. Another important point to be noted was that they used IV fluids at room temperature while we warmed fluids to around 37° c.Since our study had four groups of 30 patients each with a total of 120 patients, we included both TURP and URS procedures in the study. So our study was done on both male and female patients. Our study included an age group between 18 and 60 years and patients who had come for both TURP and Ureteroscopic removal of the stone (URS).The incidence of shivering was high in URS group as well. Hence URS was also included in our study. We also used similar dose for Pethidine of Intrathecal 0.2mg/kg with Bupivacaine. In our study we monitored for shivering, temperature and other

hemodynamic parameters both intraoperatively and postoperatively for 6 hours until the effect of bupivacaine and the opioid subsided.

In the study conducted by Chun et al the incidence and intensity of shivering was less in the pethidine group than in the control group. Similar results were obtained in our study where the incidence of shivering in the group P was only 10% as compared to the group C which was around 63.4%. In Chun's study the incidence of shivering in the pethidine group was 4%(1/25) while in the control group was around 32%(8/25).The incidence of pruritus was 16%(4/25) , $P < 0.05$ in the pethidine group while no patients in their control group developed pruritus. In our study the incidence of pruritus was only 3.3% (1/30) in Group P and no other groups developed pruritus during the study. So the incidence of pruritus in our study was 0.8 %(1/120) ($P > 0.05$). Chun et al did not compare other opioids like Tramadol or Fentanyl [(31)].They also monitored the sublingual temperature every ten minutes, and there was no significant difference in the temperature between the two groups in time. The body temperature gradually dropped over time in both the groups in their study. The mean drop in body temperature at 60 minutes was 0.4° c in pethidine group while in the saline group it was 0.6° c in their study. While in our study the mean drop in temperature at 60 minutes was 0.5℃ in group P, 0.9℃ in Group T, 0.28℃ in Group F and in Group C was 0.2 ℃. The secondary parameters like mean

arterial pressure, Spo2, heart rate were not statistically significant in their study similar to our study.

Another study conducted by Davoudi et al. who had compared intrathecal pethidine 15mg with hyperbaric 5% lignocaine 75mg with control group in TURP ,also concluded that pethidine was effective in reducing shivering [(3)].But they measured axillary temperature using a mercury thermometer. Although one limitation in our study was the measurement of sublingual temperature instead of core temperature. We did not prefer to use rectal, nasopharyngeal, oesophageal or tympanic membrane temperature as the patients were conscious. So we preferred the use of sublingual temperature.

Also a study conducted by Crossley and Mahajan proved that the intensity of shivering was unrelated to axillary temperature and that they do not correlate well with with perioperative shivering [(52)]. So we preferred to use sublingual temperature over axillary temperature.

Sessler et al. also mentioned about the liquid crystal strips that are available for monitoring the skin surface temperature were reasonably accurate but there was a difference of 2-4 ℃ between the skin surface and the core temperature [(27)].So we decided to use sublingual temperature for monitoring.

Coming back to the study conducted by Davoudi et al. did not monitor the patients postoperatively. As both URS and TURP are short duration procedures

the patients should be monitored for postoperative shivering until the effect of the drug wears off. So we monitored the patients postoperatively for six hours. Davoudi's study used Lignocaine instead of Bupivacaine; higher sensory block levels due to this difference could have influenced the study. Hence it would be difficult to correlate between our study on body temperature and Davoudi's study. One similarity between our study and that of Davoudi's was that both used only warm IV fluids at around 37℃ for infusion into patients. Chun et al used only IV fluids at room temperature which must have been around 22℃ and did not use warm IV fluid. Okeke et al, in their study have proved that the use of warm IV fluid during TURP and isothermic irrigation fluid could reduce occurrence of perioperative hypothermia [30].

Both Davoudi s and the Korean study did not use other opioids for the control of shivering. They used only pethidine and a control group to study, but did not compare the effects of other opioids for the control of shivering.

Although there are not many studies on Intrathecal Tramadol for the purpose of reducing shivering, Alhashemi et al used Tramadol Intrathecal for post operative pain relief after TURP [35].They used a dose of 25mg Tramadol with 3ml of 0.5% Bupivacaine for the study. Their study showed that Tramadol was ineffective in reducing pain at a dose of 25mg.

Another study by Susmita et al used a dosage of 0.25mg/Kg of Tramadol Intrathecal along with 0.5% Bupivacaine 3ml in Gynaecological surgeries was

effective in reducing post operative pain [40].Since Alhashemi's study was done on TURP we decided to use a similar dose of 0.5mg/kg for preventing shivering.

Aditi et al. conducted one such study which compared the effect of Pethidine and Tramadol in reducing shivering in any case of regional anaesthesia including spinal, epidural, combined spinal- epidural and peripheral nerve blocks [32].Similar to our study both male and female patients were included in the study between the age group of 20 and 60 years, they included ASA PS I, II and III patients in their study unlike ours which included only I and II patients. They also used axillary temperature for monitoring temperature like Davoudi's study [3]. However the major difference between our study and Aditi' s study is that they compared the effect of intravenous and not intrathecal administration of the opioids. Only patients who developed shivering were actually given intravenous Pethidine or Tramadol .So in their study they have actually treated shivering, while in our study we tried to prevent shivering from the beginning and did not allow the patients to experience shivering from the beginning. Their study proved that IV Tramadol was more potent in reducing the recurrence of shivering than pethidine. Around 20% of patients in the pethidine group had nausea and vomiting. But in our study, in the pethidine group only one had nausea and none of the patients vomited. While four patients in the Tramadol group had nausea and one of them had vomiting also. The difference in the

incidence could be due to the different routes of administration in both the studies and the different dose used.

In our study the intensity of shivering were graded using the scale described by Crossley and Mahajan [52] .The same scale was used in the study by Davoudi and Chun et al[3,31] .The scale was also called as the 5 point scale of Wrench [53].

A study conducted by Muralidhara Patel and his collegues used a different scale for measuring the severity of shivering based on how distressing is it to the patient: as Grade I: mild distress, Grade II: moderately distressing and Grade III: severe discomfort and interference with monitoring [33]. Patel et al compared the effect of intrathecal Fentanyl with that of intravenous Fentanyl in reducing shivering in patients posted for LSCS. Unlike our study they used nasopharyngeal probe to monitor core temperature and skin temperature in the right forearm using a skin probe. But their study has not mentioned the use of warm IV fluids for infusion. They have proved that intrathecal Fentanyl can reduce shivering better than IV Fentanyl. The dosage we used for intrathecal Fentanyl was fifty micrograms while in this study by Patel used twenty -five micrograms alone intrathecally. The incidence of shivering in Patel's study was 32% unlike our study which was as high as 80 % with Fentanyl despite giving a higher dose of Fentanyl in our study. The severity of shivering was also greater in our study than Patel's study. Three patients (3/30) in our study developed grade 3 or 4 shivering while none of the patients in their study (0/50) in the

Intrathecal Fentanyl group developed shivering .The difference in this could be due to the different procedures on which both the studies were done .

Techanivate et al. also showed that intrathecal Fentanyl added at a dose of twenty micrograms was effective in reducing shivering in LSCS. Six out of thirty that is 20% patients in the Fentanyl group developed shivering while in our study 80% of patients in the Fentanyl group developed shivering [(42)]. This could be because in Techanivate s study they had used 0.5% Bupivacaine along with 0.2mg of morphine in both the groups and added Fentanyl to one of the groups. Though the control group in their study developed 50% incidence of shivering, in our study 36.6% patients in the control group did not shiver at all. We have not added morphine to spinal anaesthetic because we wanted to compare the effects of shivering reduction only with the three drug groups and adding morphine could have masked the effect of any of these drugs.

In our study the incidence of side effects was not significantly different among the different groups. Although Tramadol has the potential to cause nausea and vomiting, in our study four patients in the Tramadol group and three patients in the control group developed nausea. One patient in the Pethidine group and one in that of Fentanyl group also had nausea. However a study conducted by Gangopadhyay and his colleagues showed that around 20 patients out of the thirty patients given IV Tramadol at 1mg/kg developed vomiting [(36)]. In our study only one patient developed vomiting in the Tramadol group .This could

be due to the different route of administration, the faster delivery of the drug and the use of a drug dose of 1mg/kg. In our case we used only 0.5mg/kg intrathecal. Another study by Wason et al [39] also observed that Tramadol given intravenously did not cause significant cases of vomiting as they used a drug dosage of 0.5mg/kg intravenously unlike Gangopadhyay's study which used IV Tramadol at 1mg/kg for reducing shivering.

One patient in the Pethidine group developed pruritus of the head and neck region, which subsided towards the end of the surgery in our study. No other drug groups developed pruritus. In the study conducted by Chun et al, one patient in the pethidine group also developed pruritus [31]. A study by Shreshta et al [41] have used intrathecal pethidine as a sole anaesthestic for patients undergoing LSCS where six patients of the 30 patients given pethidine as a sole anaesthetic developed pruritus while in our study only one patient of the 30 patients developed pruritus .This could be because of the difference in dose of pethidine used in both the studies. Our study used a dose of 0.2mg/kg while Sreshta's study used a dose of 1m/kg of pethidine [41].

SUMMARY

From this prospective, randomised, single blinded study we have evaluated the effectiveness of intrathecal opioid in reducing shivering in endoscopic urological surgeries. The following points were observed and noted during the study and statistical analysis:

The demographic profile like Age, Sex, and Surgery: TURP and URS, Weight and Height were comparable between the four groups and did not show any statistical significance.

The incidence and intensity of shivering was less in the opioid group than in the control group.

Amongst the opioids, the intensity of shivering was least in Group P at all times and more in Group F.

The incidence of shivering were similar in Group F and in Group C

The incidence of generalised shivering (grade 4) was more in Group F than in Group C

The mean sublingual temperature was lowest in the Group T at the end of T50 and T1H.

At all other time intervals, sublingual temperature was comparable between all four groups. This infers that the addition of opioid did not increase the propensity for hypothermia

The hemodynamic parameters, the occurrence of nausea, vomiting and pruritus, duration of the procedure, level of sensory block, intravenous fluid and irrigation fluid were comparable amongst the four groups

CONCLUSION

- The addition of intrathecal opioid to bupivacaine for spinal anaesthesia reduces the incidence and intensity of shivering in endoscopic urological surgeries
- Intrathecal Pethidine is more efficacious than intrathecal Tramadol and intrathecal Fentanyl in reducing intraoperative and postoperative shivering
- Thus intrathecal Pethidine can be used prophylactically to reduce shivering and it maintains hemodynamic stability particularly in patients who have a diminished cardio respiratory reserve.
- Intrathecal Fentanyl was not as efficacious in controlling shivering

MASTER CHART

no.	name	age	sex	diagnosis		procedure	weight	height	ASA PS	with 2 cc sensorcaine 0.5%	basal HR	basal BP	basal temp° c
1	raja	55	m	BPH		TURP	70 kg	175 cm	II	tramadol	70	140/90	37
2	palani	69	m	BPH		TURP	60 kg	169 cm	II	tramadol	67	140/70	36.8
3	joseph	55	m	BPH		TURP	70kg	160 cm	II	tramadol	80	120/70	37
4	ranadhir	65	m	BPH		TURP	65kg	165 cm	II	tramadol	65	130/80	37
5	kanchana	35	m	R midureteric calculus		URS R	75 kg	164 cm	I	tramadol	100	130/80	37
6	mayilraj	50	m	R VUJ calculus		URS R	72 kg	164 cm	II	tramadol	80	145/86	35
7	kamaladevi	46	f	R LUTS		R URS	80 kg	156cm	II	tramadol	100	140/70	37
8	jayammal	66	f	R LUTS		R URS	74kg	154 cm	II	tramadol	112	140/76	36
9	sankaran	65	m	BPH		TURP	76kg	154cm	II	tramadol	94	140/84	37
10	vishwam	51	m	L URS and R VUJ calculus		B/L URS	65kg	155cm	I	tramadol	90	120/84	37
11	ezhumalai	34	m	L HUN		L URS	60kg	150cm	I	tramadol	80	144/80	36
12	thandavamuthu	60 m		R ureteric calculus		R URS	58kg	152cm	II	tramadol	74	128/80	37
13	rajammal	60	m	R ureteric calculus		R URS	60 kg	155	II	tramadol	72	120/80	36.8
14	satish	27	m	l ureteric calculus		L URS	66kg	155cm	I	tramadol	66	122/65	37
15	thirumalai	60	m	BPH		TURP	61kg	152cm	II	tramadol	77	117/77	37
16	moideen	68	m	BPH		TURP	66kg	158cm	II	tramadol	80	116/80	37
17	saraswathy	65	f	R ureteric calculus		R URS	60kg	150cm	II	tramadol	84	140/90	37
18	thendralarasu	27	m	R LUTS		R URS	58kg	158cm	I	tramadol	78	138/74	37

19	leela	55	f	R ureteric calculus	R URS	56kg	152cm	I	tramadol	86	132/76	37
20	guruvappa	29	m	R ureteric calculus	R URS	60kg	158cm	II	tramadol	90	122/86	37
21	varadan	64	m	BPH	TURP	62kg	156cm	II	tramadol	86	122/78	37
22	karunanithi	54	m	BPH	TURP	60kg	158cm	I	tramadol	86	140/90	37
23	gunasekar	56	m	B/l ureteric calculus	B/L URS	60kg	156cm	I	tramadol	94	122/80	37
24	vediammal	26	f	l ureteric calculus	L URS	62kg	150cm	I	tramadol	92	118/76	37
25	shanmugham	65	m	BPH	TURP	58kg	154cm	II	tramadol	64	140/83	37
26	vinayagam	66	m	BPH	TURP	60kg	156cm	II	tramadol	62	140/90	36.8
27	selvaraj	56	m	BPH	TURP	60kg	154cm	II	tramadol	82	120/92	37
28	lakshmi	54	f	B/l ureteric calculus	B/L URS	62kg	152cm	II	tramadol	65	134/80	36.2
29	ramu	26	m	B/l ureteric calculus	L URS	66kg	158cm	I	tramadol	80	150/80	37
30	malai	44	m	l ureteric calculus	L URS	58kg	160cm	I	tramadol	58	142/78	36.7
31	meganathan	47	m	R ureteric calculus	R URS	70kg	160cm	I	pethidine	86	128/67	37
32	muthu	55	m	l ureteric calculus	L URS	72kg	159cm	II	pethidine	100	119/84	37
33	kamala 55	55	f	B/l ureteric calculus	L URS	57kg	148cm	I	pethidine	68	150/88	37
34	murugan	33	m	R ureteric calculus	R URS	58kg	159cm	I	pethidine	93	132/86	37
35	anjali	40	f	B/l ureteric calculus	B/L URS	50kg	149cm	II	pethidine	112	114/80	36.7
36	gowtham	31	m	R ureteric calculus	R URS	55kg	150cm	I	pethidine	82	120/80	37
37	shankarapandian	65	m	BPH	TURP	80kg	165cm	I	pethidine	87	138/90	37
38	kaali	55	f	R ureteric calculus	R URS	65kg	149cm	I	pethidine	78	132/84	36.4
39	arasan	60	m	BPH	TURP	64kg	157cm	II	pethidine	67	123/69	36.7
40	jaganathan	45	m	BPH	TURP	68kg	161cm	I	pethidine	79	130/90	37
41	solomon	31	m	l ureteric calculus	L URS	78kg	170cm	I	pethidine	88	152/78	36.8
42	devarajan	55	m	BPH	TURP	74kg	166cm	II	pethidine	90	150/10	37

											0	
43	chaithanya	25	m	l ureteric calculus		L URS	65kg	167cm	I	pethidine	98	130/82	37
44	natarajan	69	m	BPH		TURP	65kg	157cm	II	pethidine	72	150/90	36.4
45	azzeze	68	m	BPH		TURP	64kg	157cm	II	pethidine	66	140/90	37
46	venkatesh	67	m	BPH		TURP	65kg	156cm	I	pethidine	90	150/80	37
47	mohan	35	m	R VUJ calculus		R URS	66kg	167cm	I	pethidine	95	140/100	37
48	sumathy	30	f	R ureteric calculus		R URS	68kg	159cm	I	pethidine	88	136/90	36.8
49	muniyammal	44	f	R ureteric calculus		R URS	60kg	150cm	I	pethidine	76	124/84	36.9
50	subramani	56	m	R ureteric calculus		R URS	64kg	165cm	I	pethidine	74	120/80	37
51	arulanandan	68	m	R ureteric calculus		R URS	74kg	168cm	II	pethidine	90	140/80	37
52	krishnan	60	m	BPH		TURP	70kg	162cm	II	pethidine	84	120/80	37
53	kesavraj	26	m	l ureteric calculus		L URS	68kg	160cm	II	pethidine	80	134/76	36.7
54	ganesan	68	m	BPH		TURP	68kg	158cm	II	pethidine	66	126/84	37.1
55	jayanthi	38	f	R ureteric calculus		R URS	66kg	162cm	I	pethidine	90	121/72	37
56	palanisamy	49	m	l ureteric calculus		L URS	70kg	158cm	II	pethidine	76	140/100	37
57	pushparaj	32	m	R LUTS		R URS	66kg	154cm	I	pethidine	100	149/93	37.2
58	Krishnaveni	45	f	l ureteric calculus		L URS	64kg	160cm	II	pethidine	94	132/86	37
59	gunasekar	40	m	l ureteric calculus		L URS	60kg	158cm	I	pethidine	103	146/92	37
60	kishorekumar	22	m	l ureteric calculus		L URS	64kg	159cm	I	pethidine	95	140/90	37
61	govindanpillai	58	m	BPH		TURP	58kg	150cm	I	normal saline	86	100/66	37
62	chamundeshwari,	45	f	R ureteric calculus		R URS	66 kg	156cm	I	normal saline	77	110/77	37
63	vincent	38	m	l ureteric calculus		L URS	60 kg	160cm	I	normal saline	78	123/86	36.8
64	lalitha	44	f	l ureteric calculus		L URS	57kg	158cm	I	normal saline	74	127/80	36.8
65	durairaj	60	m	BPH		TURP	60kg	160cm	I	normal	65	130/70	36.9

										saline			
66	palanivel	52	m	R VUJ calculus		R URS	62kg	162cm	I	normal saline	77	117/80	36.8
67	Thangam	44	f	L VUJ Calculus		L URS	70kg	165cm	I	normal saline	100	150/80	36.9
68	mohan	40	m	R ureteric calculus		R URS	60kg	159cm	I	normal saline	68	122/80	36.8
69	selvaraj	44	m	Rt HUN		R URS	77kg	165cm	I	normal saline	72	120/80	36.8
70	subramani	35	m	R ureteric calculus		R URS	70kg	159cm	II	normal saline	76	122/85	37.1
71	sultan	38	m	L HUN		L URS	68kg	160cm	II	normal saline	88	138/68	36.8
72	rajendran	52	m	l ureteric calculus		L URS	68kg	156cm	I	normal saline	72	116/76	37.2
73	selvi	30	f	l ureteric calculus		L URS	66 kg	160cm	I	normal saline	74	118/72	37
74	appu	19	m	l ureteric calculus		L URS	62kg	159cm	I	normal saline	70	132/80	36.7
75	lalitha	27	f	R HUN		R URS	60kg	160cm	I	normal saline	80	120/70	36.4
76	parthiban	45	m	l ureteric calculus		L URS	66 kg	162cm	II	normal saline	64	134/86	36.8
77	muniyammal	48	f	L HUN		L URS	70 kg	160cm	II	normal saline	98	136/94	36.8
78	sullaiman	46	m	l ureteric calculus		L URS	78kg	162cm	I	normal saline	86	128/85	37
79	kasturi	47	f	R ureteric calculus		R URS	70kg	158cm	I	normal saline	90	130/90	37
80	srinivsan	56	m	BPH		TURP	60kg	156cm	I	normal saline	84	156/80	37
81	kumerasan	22	m	R ureteric calculus		R URS	55kg	158cm	I	normal	88	104/76	37

									saline			
82	venkatesan	21	m	l ureteric calculus	L URS	68kg	166cm	I	normal saline	92	115/70	36.8
83	arul deva	65	m	L HUN	L URS	70kg	170cm	I	normal saline	88	140/93	37
84	velu	65	m	R ureteric calculus	R URS	65kg	168cm	II	normal saline	68	114/70	36.8
85	chinnappan	57	m	BPH	TURP	60kg	168cm	I	normal saline	58	112/80	36.8
86	sushmita	18	f	R PUJ calculus	R URS	58kg	158cm	I	normal saline	96	120/80	36.9
87	kaliyamoorthy	57	m	L VUJ Calculus	L URS	60kg	160cm	I	normal saline	76	100/86	36.5
88	raja	52	m	BPH	TURP	62kg	158cm	I	normal saline	67	110/72	36.8
89	devi	44	f	R ureteric calculus	R URS	70kg	162cm	I	normal saline	72	108/72	36.9
90	kamalam	38	f	R ureteric calculus	R URS	68kg	158cm	I	normal saline	68	110/78	37
91	rajendran	42	m	R ureteric calculus	R URS	70kg	164cm	I	fentanyl	64	104/78	37
92	radhakrishnan 40	nan 40	m	L URS	L URS	62kg	154cm	I	fentanyl	68	110/72	36.8
93	subramani	65	m	BPH	TURP	68kg	168cm	II	fentanyl	70	139/77	36.9
94	jayamani	36	f	R ureteric calculus	R URS	66kg	158cm	II	fentanyl	68	130/80	37.1
95	ramachandran	60	m	BPH	TURP	70kg	160cm	I	fentanyl	63	120/62	36.8
96	shanthi	47	f	L pelvic calculus	L URS	65kg	157cm	I	fentanyl	92	140/86	36.8
97	rampal singh	65	m	BPH	TURP	58kg	150cm	II	fentanyl	102	146/89	36.8
98	radha	55	f	L pelvic calculus	L URS	60kg	156cm	II	fentanyl	78	160/80	36.6
99	rajendran	40	m	R ureteric calculus	R URS	68kg	164cm	I	fentanyl	76	130/90	36.9
100	krishnan	60	m	l ureteric calculus	L URS	70kg	158cm	I	fentanyl	80	148/78	37
101	jamuna	40	f	R ureteric calculus	R URS	66kg	160cm	I	fentanyl	84	120/68	37

102	vinod	21	m	l ureteric calculus	L URS	58kg	158cm	I	fentanyl	116	140/80	37.2
103	vinayagam	60	m	BPH	TURP	67kg	160cm	I	fentanyl	62	110/80	36.5
104	guna	42	m	R ureteric calculus	R URS	70kg	158cm	I	fentanyl	94	120/80	36.9
105	parthiban	20	m	bladder stones	vesicolithotripsy	68kg	168cm	II	fentanyl	80	110/84	37
106	kamalakannan	30	m	R ureteric calculus	R URS	70kg	158cm	I	fentanyl	78	102/86	36.8
107	prasanth	32	m	R ureteric calculus	R URS	56kg	160cm	I	fentanyl	65	110/80	36.6
108	kamala	54	f	L pelvic calculus	L URS	60kg	158cm	II	fentanyl	72	146/80	37.1
109	shanmugham	55	m	l ureteric calculus	L URS	68kg	161cm	II	fentanyl	64	110/84	37.1
110	karthikeyan	26	m	R ureteric calculus	R URS	60kg	160cm	I	fentanyl	62	112/58	36.8
111	harish	28	m	l ureteric calculus	L URS	76kg	158cm	I	fentanyl	64	110/70	36.8
112	tamil selvi	35	m	L pelvic calculus	L URS	65kg	158cm	I	fentanyl	70	132/80	36.7
113	venkataraman	27	m	B/l ureteric calculus	B/L URS	70kg	160cm	I	fentanyl	86	110/86	36.8
114	kasi	56	m	BPH	TURP	66kg	158cm	I	fentanyl	62	120/70	36.4
115	gopal	55	m	BPH	TURP	58kg	156cm	II	fentanyl	86	130/90	36.6
116	pooja	19	f	R LUTS	R URS	60kg	158cm	I	fentanyl	89	120/90	36.8
117	C.V.Raman	66	m	BPH	TURP	55kg	158cm	II	fentanyl	86	110/80	36.6
118	kamalakannan	30	m	R ureteric calculus	R URS	60kg	160cm	I	fentanyl	90	138/80	36.4
119	gnanaprakash	54	m	BPH	TURP	66kg	158cm	II	fentanyl	80	120/80	37
120	kanammal	30	f	L VUJ Calculus	L URS	70kg	156cm	I	fentanyl	68	125/86	36.6

name	shiveringT0	T0	T10	T20	T30	T40	T50	T1H	T2H	T3H	T4H	T5H	T6H
raja		0	0	0	0	1	1	0	0	0	0	0	0
palani		0	0	0	0	0	1	0	0	0	0	0	0
joseph		0	0	0	0	0	0	0	0	0	0	0	0
ranadhir		0	0	0	3	3	0	0	0	0	0	0	0
kanchana		0	0	0	1	1	0	0	0	0	0	0	0

mayilraj		0	0	0	1	1	0	0	0	0	0	0	0
kamaladevi		0	0	0	0	0	0	0	0	0	0	0	0
jayammal		0	0	0	0	0	0	0	0	0	0	0	0
sankaran		0	0	1	1	0	0	0	0	0	0	0	0
vishwam		0	0	0	0	0	0	0	0	0	0	0	0
ezhumalai		0	0	0	0	0	0	0	0	0	0	0	0
thandavamuthu		0	0	0	0	0	0	0	0	0	0	0	0
rajammal		0	0	0	0	1	0	0	0	0	0	0	0
satish		0	0	1	1	1	0	0	0	0	0	0	0
thirumalai		0	0	0	0	0	0	0	0	0	0	0	0
moideen		0	0	0	0	0	0	0	0	0	0	0	0
saraswathy		0	0	0	0	0	0	0	0	0	0	0	0
thendralarasu		0	0	0	0	0	0	0	0	0	0	0	0
leela		0	0	0	0	0	0	0	0	0	0	0	0
guruvappa		0	0	0	0	0	0	0	0	0	0	0	0
varadan		0	0	0	0	0	0	0	0	0	0	0	0
karunanithi		0	0	0	2	2	0	0	0	0	0	0	0
gunasekar		0	0	0	0	0	0	0	0	0	0	0	0
vediammal		0	0	0	0	0	0	0	0	0	0	0	0
shanmugham		0	0	1	1	0	0	0	0	0	0	0	0
vinayagam		0	0	0	0	0	0	0	0	0	0	0	0
selvaraj		0	0	0	0	0	0	0	0	0	0	0	0
lakshmi		0	0	0	0	0	0	0	0	0	0	0	0
ramu		1	2	2	0	0	0	0	0	0	0	0	0
malai		0	0	0	0	0	0	0	0	0	0	0	0
meganathan		0	0	0	0	0	0	0	0	0	0	0	0
muthu		0	0	0	0	0	0	0	0	0	0	0	0
kamala	55	0	0	0	0	0	0	0	0	0	0	0	0
murugan		0	0	0	0	0	0	0	0	0	0	0	0

anjali		0	0	0	0	0	0	0	0	0	0	0	0
gowtham		0	0	0	0	0	0	0	0	0	0	0	0
shankarapandian		0	0	0	0	0	0	0	0	0	0	0	0
kaali		0	0	0	0	0	0	0	0	0	0	0	0
arasan		0	0	0	0	0	0	0	0	0	0	0	0
jaganathan		0	0	0	0	0	0	0	0	0	0	0	0
solomon		0	0	0	0	0	0	0	0	0	0	0	0
devarajan		0	0	0	0	0	0	0	0	0	0	0	0
chaithanya		0	0	0	0	0	0	0	0	0	0	0	0
natarajan		0	0	0	0	0	0	0	0	0	0	0	0
azzeze		0	0	0	0	0	0	0	0	0	0	0	0
venkatesh		0	0	0	0	0	0	0	0	0	0	0	0
mohan		0	0	2	3	0	0	0	0	0	0	0	0
sumathy		0	0	0	0	0	0	0	0	0	0	0	0
muniyammal		0	0	0	0	0	0	0	0	0	0	0	0
subramani		0	0	0	0	0	0	0	0	0	0	0	0
arulanandan		0	0	0	0	0	0	0	0	0	0	0	0
krishnan		0	0	0	0	0	0	0	0	0	0	0	0
kesavraj		1	2	1	1	0	0	0	0	0	0	0	0
ganesan		0	0	0	0	0	0	0	0	0	0	0	0
jayanthi		0	0	0	0	0	0	0	0	0	0	0	0
palanisamy		0	0	0	0	0	0	0	0	0	0	0	0
pushparaj		0	0	0	0	0	0	0	0	0	0	0	0
Krishnaveni		0	0	0	0	0	0	0	0	0	0	0	0
gunasekar		0	0	0	0	0	0	0	0	0	0	0	0
kishorekumar		0	0	0	1	0	0	0	0	0	0	0	0
govindanpillai		0	0	0	0	0	0	0	0	0	0	0	0
chamundeshwari		1	2	3	3	1	1	1	1	0	0	0	0
vincent		0	0	0	0	0	0	0	0	0	0	0	0

lalitha		0	2	2	2	2	1	0	0	0	0	0	0
durairaj		0	0	0	0	0	0	0	0	0	0	0	0
palanivel		0	0	0	0	0	0	0	0	0	0	0	0
Thangam		1	1	2	3	3	3	0	0	0	0	0	0
mohan		1	1	1	2	2	1	0	0	0	0	0	0
selvaraj		0	0	1	1	2	1	1	0	0	0	0	0
subramani		0	2	3	3	3	2	1	0	0	0	0	0
sultan		0	0	3	3	3	2	1	0	0	0	0	0
rajendran		0	0	0	1	1	2	0	0	0	0	0	0
selvi		2	2	2	3	3	2	1	0	0	0	0	0
appu		0	0	0	0	0	0	0	0	0	0	0	0
lalitha		0	0	1	1	1	1	0	0	0	0	0	0
parthiban		0	1	1	2	2	1	0	0	0	0	0	0
muniyammal		0	0	0	0	0	0	0	0	0	0	0	0
sullaiman		0	0	1	1	0	0	0	0	0	0	0	0
kasturi		0	0	0	0	0	0	0	0	0	0	0	0
srinivsan		0	1	1	1	2	1	0	0	0	0	0	0
kumerasan		0	0	0	1	1	0	0	0	0	0	0	0
venkatesan		0	0	1	1	2	2	1	1	0	0	0	0
arul deva		0	0	0	0	0	0	0	0	0	0	0	0
velu		0	1	1	2	2	1	1	1	0	0	0	0
chinnappan		0	0	1	1	1	2	1	0	0	0	0	0
sushmita		0	0	0	0	0	0	0	0	0	0	0	0
kaliyamoorthy		0	0	0	0	1	1	2	0	0	0	0	0
raja		0	0	0	0	0	0	0	0	0	0	0	0
devi		0	1	1	2	2	1	1	0	0	0	0	0
kamalam		0	0	0	0	0	0	0	0	0	0	0	0
rajendran		0	1	1	1	1	1	0	0	0	0	0	0
radhakrishnan		1	1	2	4	4	0	0	0	0	0	0	0

subramani	0	0	1	1	1	2	1	1	0	0	0	0
jayamani	0	0	1	1	2	2	1	1	0	0	0	0
ramachandran	0	0	0	0	0	0	0	0	0	0	0	0
shanthi	0	0	0	0	1	0	0	0	0	0	0	0
rampal singh	0	0	0	0	0	0	0	0	0	0	0	0
radha	0	0	0	0	1	1	0	0	0	0	0	0
rajendran	0	0	1	1	1	0	0	0	1	0	0	0
krishnan	0	0	1	1	2	1	0	0	0	0	0	0
jamuna	0	1	1	1	1	2	1	0	0	0	0	0
vinod	0	1	1	2	2	1	0	0	0	0	0	0
vinayagam	0	1	2	1	2	2	1	0	0	0	0	0
guna	0	2	3	3	4	4	2	1	0	0	0	0
parthiban	0	0	1	1	1	0	0	0	0	0	0	0
kamalakannan	0	0	1	1	2	2	0	0	0	0	0	0
prasanth	0	1	1	2	2	1	1	0	0	0	0	0
kamala	0	0	1	1	1	2	1	0	0	0	0	0
shanmugham	0	1	1	2	2	1	1	0	0	0	0	0
karthikeyan	0	0	0	0	0	0	0	0	0	0	0	0
harish	0	0	1	1	2	1	1	0	0	0	0	0
tamil selvi	0	1	1	2	2	1	0	0	0	0	0	0
venkataraman	0	0	0	1	1	2	2	0	0	0	0	0
kasi	0	1	1	2	2	3	1	0	0	0	0	0
gopal	0	0	0	0	0	0	0	0	0	0	0	0
pooja	0	1	1	2	1	1	0	0	0	0	0	0
C.V.Raman	0	0	0	0	0	0	0	0	0	0	0	0
kamalakannan	2	2	3	3	1	1	0	0	0	0	0	0
gnanaprakash	0	3	3	2	1	1	0	0	0	0	0	0
kanammal	0	0	0	0	0	0	0	0	0	0	0	0

name	T0	T10	T20	T30	T40	T50	T1H	T2H	T3H	T4H	T5H	T6H
raja	37	36.9	36.9	36.8	36.7	36.8	37.1	37.2	37	37	36.8	36.8
palani	36.8	36.8	36.8	36.8	36.6	36.8	36.9	37	37	36.5	36.8	36.6
joseph	37	37	36.8	36.9	36.8	36.9	37	37	37	37	37	36.7
ranadhir	37	37	36.7	36.8	36.8	36.8	36.9	36.8	37	37	36.8	36.8
kanchana	37	36.7	36.6	36	35.7	35.6	36	36.3	37	36.8	37	37
mayilraj	37	36.9	36.8	35.8	36	36.2	36.5	36.6	37	36.7	37	37
kamaladevi 46	37	36.8	36.8	36.7	36.5	36.6	36	36.2	37	37	36.9	37.1
jayammal	36	35.8	35.6	35.4	35.8	35.8	36	37	37	37.1	37	36.8
sankaran	37	36.6	36.2	35.5	35.2	36	36	36.6	37	37	37	36.7
vishwam	37	36.7	35.6	35.7	36.6	36	36.6	36.6	37	37	37	36.8
ezhumalai	37	36.7	35.9	35.8	35.8	36	36	37	37	36	37	37
thandavamuthu 60 m	37	36.8	37	37	36.5	36.6	36.8	36.8	37.1	37	37	37
rajammal	36.8	36.6	36.6	36.5	36.3	36.4	36.4	36.6	36.6	36.8	37	37
satish	37	36.9	36.8	36.8	36.8	36.3	35	36.1	36.2	36.5	36.6	37
thirumalai	37	37	36.6	36.1	36	35.3	35.8	36	36	36.7	36.8	37
moideen	37	36.6	36.5	36.4	36	35.6	35.7	36	36.5	37	37	37
saraswathy	37	36.8	36.7	36.5	36.6	36	35.9	36	36.7	36.6	36.6	36.7
thendralarasu	37	36.9	36.7	36.4	36	35	35.7	36	36	37	37	37
leela	37	36.8	36.9	36.8	36.7	36	35	35	36.2	36.7	36.7	36.8
guruvappa	36.8	36.6	36.2	35.8	35	35.9	36	36.1	36.8	37	37	37
varadan	37	37	36.8	36.6	36.4	36.1	36.2	35	36.5	36.8	37	37
karunanithi	37	36.8	36.7	36.2	36	35.7	35.6	35	35	36	36.7	37
gunasekar	37	36.8	36.8	36	35.6	35.4	36	36.7	37	37	37	37
vediammal	37	36.8	36.5	36.4	36	35	35.2	35	36	36.5	36.8	36.9
shanmugham	37	36.5	36.1	36.2	36.1	36	35.8	35	36.2	36.6	36.8	37

vinayagam	37	36.8	36.6	36	35.8	35.6	35	36	37	37	36.9	36.9
selvaraj	36.8	36.4	36	36.2	36	35.8	35.6	36	36.6	36.8	37	37
lakshmi	36.6	36	35	35.2	35.4	36	36	36	36.2	37	37	37
ramu	36.8	36.1	35.9	35	35	34.8	35	35.9	36.3	36.6	37	37
malai	37	37	36.5	36.7	36.1	36	36	36	36.4	36.8	37	37
meganathan	37	37	36.7	36.6	36.7	36	36.1	36.7	37	37	37	37
muthu	37	36.9	36.8	36.4	36.1	35.9	35.8	35.7	37	37	37	36.9
kamala 55	37	36.7	36.3	36.2	36.2	36.2	36.1	36.3	36.8	37	37	37
murugan	37	36.9	36.9	36.6	36.6	36.6	36.4	36.5	36.5	37	37	37
anjali	36.7	36.7	36.5	35.2	35.2	35.1	35.6	36	37	37	37	37
gowtham	37	36.8	36.2	36.2	36.3	36	36.5	36.1	35.8	36.5	37	37
shankarapandian	37	36.6	36.2	36.1	36.2	36.2	36.5	36.7	36.7	36.8	37	36.9
kaali	36.4	36.3	36.3	36	35.8	34.8	36	36	36.8	37	37	37
arasan	36.7	36.7	36.7	36.6	36.6	36.2	36.2	34.3	36	36.3	36.7	36.7
jaganathan	37	36.8	36	36	35.8	35.9	35.5	35.6	35.6	36	36.6	37
solomon	37	37	36.7	36.8	36.8	36.7	36.7	36.6	36.6	36.5	36.6	37
devarajan	37	36.5	36.6	36.6	36.5	36.5	36.5	36.6	36.7	37	36.6	36.7
chaithanya	36.7	36.7	36.8	36.7	36.6	36.5	36.5	36.5	36.6	36.5	36.7	36.7
natarajan	36.4	36.5	36.4	36.6	36.6	36.5	36.3	36.2	36	36.3	36.4	36.6
azzeze	37	36.8	36.8	36.7	36.7	36.4	36.6	36.7	36.8	37	37	37
venkatesh	37	36.9	36.8	36.8	36.9	36.9	36.6	36.6	36.5	37	37	37
mohan	36.4	36.5	36.5	36.5	36.4	36.4	36.1	36.1	35	36	36.2	36.2
sumathy	36.7	36.1	36.6	36.4	35.8	35.5	36.2	36.2	36.6	36.3	36.5	37
muniyammal	36.7	36.6	36.5	36.5	36.5	36.6	36.6	36.6	37	37	37	37
subramani	36.8	36.7	36.7	36.5	36.5	36.2	36.4	36.1	36	37	37	37
arulanandan	37	37	37	36.8	36.8	36.7	36.8	36.8	36.6	36.8	36.8	36.8
krishnan	37	36.8	36.5	36	35.5	35.4	35.4	35.6	35.8	36	36.2	36.5
kesavraj	36.7	36.6	36.6	36.7	36.7	36.6	36.5	37	36.7	36.7	36.8	36.8
ganesan	36.9	36.9	37	37	37.1	37	37	36.8	36.9	37	37	37

jayanthi	37	37.1	37	36.9	36.9	37	37.1	37.2	37.1	37	37	37
palanisamy 49	37	36.8	36.5	36.2	36.1	36.7	36.7	36.8	37	37.1	37.1	37.1
pushparaj	37.2	37.2	37.1	37	37	36.8	36.9	36.9	37	37	37.2	37.1
Krishnaveni	37.1	37.2	37	36.9	36.8	36.7	36.8	36.8	36.9	37	37	37.1
gunasekar	37.2	37.1	37	36.7	36.5	36.7	36.5	36.4	36.7	36.7	37	37
kishorekumar	37	36.8	36.6	36.4	36.5	36.4	36.6	36.7	36.6	36.7	36.7	36.7
govindanpillai	37.1	37	37.1	36.8	36.5	36.4	36.7	36.5	36.5	36.7	36.7	36.9
chamundeshwari, 45	37	36.8	36.8	36.7	36.7	36.8	36.8	36.9	36.9	37	37.1	37.1
vincent	36.8	36.4	36.1	36	35.9	36	36.2	36.2	36.4	36.6	36.8	36.8
lalitha	36.6	36.8	36.3	35.8	36.3	36.6	36.7	36.7	36.7	36.8	36.8	36.9
durairaj	37	37.2	36.8	36.8	36.9	36.7	36.8	36.7	36.8	36.8	36.9	37
palanivel	36.8	36.6	36.7	36.5	36.4	36.6	36.5	36.7	36.8	36.8	36.9	37
Thangam	36.8	36.9	36.7	36.7	36.6	36.5	36.8	36.8	36.9	36.8	37	37
mohan	36.8	36.5	36.4	36.5	36.5	36.6	36.7	36.9	37	37	37	37
selvaraj	36.8	36.7	36.1	36.1	35.9	36	36.1	36.2	36.8	36.9	36.9	37
subramani	37.1	37.1	37	36.9	36.8	36.4	36.7	36.9	36.9	37	37	37.1
sultan	36.8	36.7	36.8	36.6	36.5	36.4	36.7	36.8	36.8	36.9	37	37
rajendran	36.8	36.5	36.6	36.8	36.9	37	37.1	37.1	37	37	37	37
selvi	36.8	36.8	36.5	36.5	36.4	36.8	36.9	37	37.1	37.1	37.2	37.2
appu	36.7	36.8	36.6	36.4	36.4	36.2	36.5	36.5	36.4	36.7	36.8	36.7
lalitha	36.6	36.4	36.2	36.5	36.2	36.5	36.4	36.8	36.9	37	37	37.1
parthiban	36.6	36.8	36.7	36.6	36.5	36.3	36.5	36.7	36.9	37	37	37.2
muniyammal	36.9	36.8	36.6	36.5	36.5	36.6	36.6	36.7	36.9	37	37	37.1
sullaiman	37	36.8	36.6	36.8	36.2	36.1	36.4	36.5	36.8	37	36.9	37.1
kasturi	37	36.8	36.9	36.6	36.5	36.7	36.8	37	37.1	37.1	37	37.1
srinivsan	36.8	36.7	36.8	36.6	36.5	36.4	36.4	36.7	36.7	36.7	36.8	36.8
kumerasan	37	36.8	36.6	36.6	36.5	36.8	36.8	36.9	36.9	37	37.1	37.1
venkatesan	36.8	36.7	36.6	36.6	36.6	36.8	36.8	36.6	36.6	36.6	36.7	36.7

arul deva	37	36.7	36.5	36.4	36.3	36.6	36.7	36.7	36.8	36.8	36.9	36.9
velu	36.7	36.6	36.5	36.6	36.4	36.4	36.5	36.6	36.6	36.7	36.8	36.7
chinnappan	36.7	36.6	36.6	36.5	36.5	36.6	36.5	36.5	36.7	36.6	36.7	36.7
sushmita	36.9	36.8	36.8	36.7	36.9	36.8	36.6	36.5	36.6	36.7	36.7	36.7
kaliyamoorthy	36.6	36.5	36.3	35.9	35.8	35.8	35.8	35.9	36.2	36.6	36.6	36.6
raja	36.8	36.6	36.7	36.5	36.5	36.7	36.7	36.8	36.8	36.9	37	37
devi	36.7	36.6	36.5	36.5	36.5	36.6	36.5	36.5	36.5	36.7	36.8	36.8
kamalam	36.5	36.5	36.4	36.2	36.1	35.8	36.5	36.5	36.7	36.8	36.8	36.8
rajendran	36.6	36.5	36.8	36.7	36.5	36.7	36.6	36.4	36.7	36.8	36.8	36.6
radhakrishnan 40	36.8	36	35	35	36	36	36	37	37	36.8	37	37
subramani	36.9	36.8	36.7	36.7	36.6	36.6	36.8	36.9	36.9	37	37	36.8
jayamani	37	37.1	36.8	36.7	36.7	36.5	36.5	36.5	36.5	36.4	36.8	36.8
ramachandran	36.9	36.6	36.5	36.4	36.7	36.7	36.8	36.8	36.8	36.9	37	37
shanthi	36.9	36.7	36.8	36.8	36.9	36.9	36.5	36.5	36.4	36.8	37	37
rampal singh	36.8	36.9	36.7	36.8	36.7	36.5	36.7	36.8	36.8	36.9	37	37
radha	36.8	36.8	36.5	36.2	36.7	36.7	36.7	36.8	36.8	36.9	37	36.8
rajendran	36.8	36.7	36.8	36.8	36.8	36.8	36.5	36	36.5	36.8	36.8	36.9
krishnan	36.8	36.7	36.8	36.8	36.7	36.5	36.8	36.8	36.9	36.5	36	36.7
jamuna	37.2	37.2	37.1	36.8	36.7	36.5	36.2	36.4	36.6	36.8	36.8	36.9
vinod	37.1	37	36.8	36.7	36.5	35.5	35.4	35.7	36	36.5	36.5	36.8
vinayagam	36.5	36.4	36.6	36.7	36.8	36.8	36.6	36.9	36.9	37	37	37
guna	36.7	36.5	36.5	36.3	36.3	36.2	36.2	35.8	35.5	35.4	35.1	36.7
parthiban	37	36.8	36.5	36.5	36.5	36.4	36.6	36.8	36.8	36.8	37	37.1
kamalakannan	36.7	36.5	36.4	36.3	36.5	36.6	36.7	36.7	36.8	36.8	37	36.7
prasanth	36.6	36.6	36.5	36.5	36.5	36.4	36.4	36.3	36.5	36.6	36.7	36.7
kamala	37.1	37.1	36.8	36.8	36.9	36.6	36.5	36.5	36.5	36.4	36.6	36.7
shanmugham	37.1	37	36.8	36.6	36.5	36.6	36.5	36.6	36.7	36.7	36.8	37.8
karthikeyan	36.8	36.5	36.5	36.5	36.5	36.4	36.5	36.6	36.7	36.7	36.8	36.7
harish	36.8	36.7	36.6	36.6	36.5	36.6	36.6	36.7	36.7	36.8	36.8	36.9

tamil selvi	36.6	36.6	36.5	36.5	36.7	36.5	36.5	36.7	36.8	36.8	36.8	36.9
venkataraman	36.8	36.7	36.8	36.6	36.5	36.5	36.4	36.7	36.7	36.7	36.8	36.9
kasi	36.4	36.6	36.5	36.6	36.7	36.7	36.7	36.8	36.8	36.7	36.8	36.8
gopal	36.7	36.5	36.5	36.7	36.6	36.7	36.8	36.9	36.9	37	37	37
pooja	36.7	36.5	36.5	36.6	36.4	36.4	36.2	36.4	36.6	36.6	36.7	36.8
C.V.Raman	36.6	36.7	36.5	36.4	36.5	36.7	36.7	36.8	36.8	36.9	36.8	36.8
kamalakannan	36.4	36.5	36.5	36.7	36.5	36.5	36.6	36.7	36.8	36.8	36.9	36.7
gnanaprakash	37	36.8	36.7	36.4	36.4	36.3	36.5	36.6	36.6	36.7	36.7	36.7
kanammal	36.6	36.5	36.6	36.7	36.7	36.8	36.9	37	37	36.8	36.8	36.7

name	basal HR	T0	T10	T20	T30	T40	T50	T1H	T2H	T3H	T4H	T5H	T6H
raja	70	70	74	72	73	68	63	64	67	65	66	62	60
palani	67	68	62	68	65	60	55	54	57	56	65	64	62
joseph	80	90	92	88	84	84	82	82	82	80	85	86	88
ranadhir	65	86	78	82	82	84	86	84	88	90	92	94	94
kanchana	100	100	98	94	92	86	88	86	90	89	90	98	90
mayilraj	80	70	72	72	76	70	68	64	66	68	66	62	60
kamaladevi	100	108	107	94	89	88	89	84	86	88	82	80	89
jayammal	112	112	108	104	104	102	102	98	96	95	96	89	100
sankaran	94	94	92	96	90	89	86	84	86	85	83	88	88
vishwam	90	90	92	86	88	86	90	92	90	92	94	90	89
ezhumalai	80	80	82	84	88	76	74	72	77	74	80	82	80
thandavamuthu	74	74	70	72	70	74	78	70	70	76	74	72	78
rajammal	72	74	70	72	74	70	72	70	77	74	80	77	76
satish	66	64	62	60	65	67	66	60	62	66	60	64	66
thirumalai	77	81	81	81	77	79	77	74	77	72	77	70	70
moideen	80	84	82	80	88	84	82	80	88	84	82	88	80
saraswathy	84	84	80	82	80	80	79	74	72	77	79	76	78
thendralarasu	78	72	68	69	70	72	70	68	69	64	68	66	69
leela	86	82	88	84	83	82	88	84	82	86	88	90	92
guruvappa	90	92	84	88	88	89	90	92	94	90	88	89	92
varadan	86	78	78	79	75	72	68	62	69	74	78	80	82
karunanithi	86	82	80	82	84	86	85	86	84	85	80	85	82
gunasekar	94	90	92	90	90	88	94	96	92	90	90	91	90
vediammal	92	90	90	89	82	88	89	85	88	87	85	87	87
shanmugham	64	66	66	62	64	68	62	62	63	64	62	62	60
vinayagam	62	62	64	69	76	74	72	76	73	72	77	70	74
selvaraj	82	86	88	90	92	98	89	84	80	88	82	80	84

lakshmi	65	65	61	60	56	58	54	60	56	58	62	60	58
ramu	80	84	89	84	90	93	86	92	90	85	80	84	86
malai	58	56	67	69	70	72	77	68	69	66	65	62	66
meganathan	86	70	66	64	62	63	62	60	59	62	66	62	66
muthu	100	102	95	91	90	89	88	89	86	90	89	90	90
kamala	68	62	66	64	64	67	68	68	66	68	69	70	70
murugan	93	94	94	92	95	89	86	90	92	90	90	92	90
anjali	112	112	115	116	120	122	110	100	99	98	94	92	91
gowtham	82	83	80	80	86	87	89	99	98	93	90	89	88
shankarapandian	87	86	82	84	82	86	87	82	80	86	80	86	90
kaali	78	75	70	65	68	69	70	74	70	66	67	69	73
arasan	67	66	66	68	69	73	74	78	70	72	73	70	78
jaganathan	79	74	72	78	79	80	88	84	86	82	82	81	80
solomon	88	84	87	86	80	86	82	83	80	85	80	86	90
devarajan	90	95	96	92	94	94	92	90	92	95	90	88	87
chaithanya	98	89	84	83	84	88	84	82	80	82	80	80	83
natarajan	72	63	60	60	65	63	66	58	56	58	56	58	60
azzeze	66	64	62	64	66	68	66	62	62	62	66	63	62
venkatesh	90	95	96	92	94	94	94	94	92	90	92	91	90
mohan	95	92	92	90	89	89	88	80	82	80	82	86	80
sumathy	88	89	90	86	86	85	84	82	80	78	78	76	78
muniyammal	76	76	72	70	74	78	76	72	79	79	80	82	82
subramani	74	72	70	72	70	68	66	62	66	67	68	66	68
arulanandan	90	94	92	94	92	90	89	80	87	90	94	92	90
krishnan	84	82	84	82	80	78	76	76	75	70	70	68	66
kesavraj	80	78	74	76	72	70	68	66	68	69	66	68	69
ganesan	66	66	59	56	58	60	58	59	60	62	66	64	62
jayanthi	90	90	86	85	92	90	86	80	76	75	72	70	73
palanisamy	76	76	74	72	70	74	70	68	69	66	64	62	60

pushparaj	100	108	98	96	89	88	92	94	94	92	90	90	91
Krishnaveni	94	92	95	92	90	86	89	84	85	82	88	89	90
gunasekar	103	100	98	96	97	98	96	95	90	94	93	92	90
kishorekumar	95	90	92	90	86	87	88	85	82	80	86	83	86
govindanpillai	86	74	72	70	76	73	74	77	79	76	70	72	73
chamundeshwari	77	70	78	79	72	68	66	68	70	74	76	72	76
vincent	78	74	76	83	84	84	83	82	84	83	89	86	83
lalitha	74	74	75	72	70	76	74	76	72	76	78	77	78
durairaj	65	76	75	72	70	68	66	69	68	66	66	63	74
palanivel	77	82	80	86	84	86	82	88	80	90	92	92	94
Thangam	100	102	105	98	99	97	96	100	102	101	97	98	94
mohan	68	66	69	72	70	76	74	68	69	76	77	72	70
selvaraj	72	77	74	76	74	70	78	74	78	80	88	90	88
subramani	76	74	74	72	78	80	74	72	70	76	80	87	80
sultan	84	86	80	82	78	76	78	79	80	82	86	84	80
rajendran	72	70	76	75	70	68	65	66	68	60	62	60	66
selvi	72	78	70	74	76	70	74	70	68	66	65	66	60
appu	90	86	82	80	85	86	82	86	80	82	80	82	88
lalitha	86	82	80	75	76	72	78	78	74	70	73	72	70
parthiban	64	62	78	74	76	68	66	62	66	64	62	60	58
muniyammal	98	100	94	96	92	90	92	90	92	90	94	92	90
sullaiman	86	88	89	80	78	72	70	76	78	77	79	80	82
kasturi	86	80	76	72	70	74	72	74	70	76	70	74	77
srinivsan	84	90	93	92	90	96	94	90	96	92	90	90	89
kumerasan	88	86	82	86	89	88	90	92	90	93	91	90	96
venkatesan	92	90	91	90	93	90	89	88	89	92	91	90	97
arul deva	86	84	80	82	80	82	88	82	84	79	78	76	78
velu	68	64	62	65	62	60	58	56	58	60	57	62	62
chinnappan	58	56	58	59	59	60	61	62	60	64	66	62	60

sushmita	94	90	92	90	89	87	86	88	82	80	84	80	82
kaliyamoorthy	76	72	70	76	75	70	72	70	68	69	70	68	66
raja	66	62	64	60	58	61	60	62	66	62	70	72	70
devi	74	72	68	69	72	70	68	67	62	60	62	58	69
kamalam	72	74	68	78	88	90	92	89	86	83	80	78	72
rajendran	64	62	60	70	68	64	62	60	62	64	60	62	62
radhakrishnan	68	64	66	76	74	76	78	80	66	66	68	68	64
subramani	70	66	68	69	72	72	68	68	66	68	66	67	68
jayamani	68	66	62	68	68	65	68	62	68	62	60	55	60
ramachandran	63	62	60	68	65	64	67	62	66	68	64	60	64
shanthi	92	94	98	92	90	89	87	86	89	98	88	82	86
rampal singh	102	105	94	92	93	92	90	89	84	84	81	83	81
radha	78	76	74	68	70	76	72	68	70	74	60	78	72
rajendran	76	72	74	70	72	75	70	76	78	75	68	66	68
krishnan	100	102	104	100	102	98	96	94	96	98	104	92	96
jamuna	90	92	94	98	94	92	90	86	88	84	80	85	78
vinod	116	112	114	114	114	109	110	108	106	112	108	100	104
vinayagam	62	68	69	70	72	69	66	65	68	69	70	72	70
guna	94	90	96	90	98	98	90	92	90	90	89	88	87
parthiban	84	80	84	82	80	78	78	76	76	70	78	70	72
kamalakannan	80	82	84	82	85	80	82	84	86	89	90	92	95
prasanth	64	62	60	66	62	60	68	65	64	67	68	66	62
kamala	72	78	74	70	72	78	76	78	70	72	70	77	73
shanmugham	64	62	60	67	68	67	65	66	70	72	76	70	77
karthikeyan	62	66	62	60	58	58	56	58	57	60	62	66	64
harish	72	74	70	76	78	80	82	80	86	80	82	80	88
tamil selvi	72	74	70	68	68	62	65	66	68	65	67	67	68
venkataraman	86	82	80	82	80	88	86	79	78	81	80	84	80
kasi	62	60	58	59	60	61	61	60	58	52	58	58	60

gopal	86	84	82	80	80	82	80	78	76	78	76	72	74
pooja	89	88	83	80	82	78	72	70	70	68	66	64	68
C.V.Raman	84	82	80	78	76	72	78	80	82	80	83	84	80
kamalakannan	82	83	80	90	94	92	96	100	98	94	88	89	82
gnanaprakash	82	80	86	84	79	76	78	80	82	87	80	90	92
kanammal	68	66	69	68	62	60	61	67	66	68	65	60	72

name	basal BP	T0	T10	T20	T30	T40	T50	T1H	T2H	T3H	T4H	T5H	T6H
raja	140/90	140	130	105	100	106	110	120	110	110	114	120	110
palani	140/70	140	130	136	136	120	120	110	120	120	124	122	124
joseph	120/70	120	110	100	110	110	110	100	120	110	110	120	130
ranadhir	130/80	130	110	110	110	120	114	120	110	122	110	128	134
kanchana	130/80	130	132	125	124	110	122	124	122	120	126	126	120
mayilraj	145/86	122	124	110	100	110	106	105	110	110	124	122	110
kamaladevi	140/70	145	120	110	112	110	102	114	110	114	128	120	114
jayammal	140/76	140	140	136	120	118	120	122	120	120	110	130	116
sankaran	140/84	124	122	125	120	110	105	105	106	120	120	140	122
vishwam	120/84	140	136	132	124	120	122	120	122	120	124	120	120
ezhumalai	144/80	132	120	124	120	114	112	120	118	124	100	110	112
thandavamuthu	128/80	124	122	110	100	90	100	104	108	105	110	100	116
rajammal	120/80	120	110	114	104	110	105	102	100	110	112	110	120
satish	122/65	133	130	120	124	120	118	115	110	112	114	110	108
thirumalai	117/77	112	107	109	104	101	110	115	112	110	114	106	110
moideen	116/80	110	110	100	97	99	100	110	112	100	110	110	112
saraswathy	140/90	142	130	128	126	128	126	120	124	120	124	110	112
thendralarasu	138/74	130	132	134	126	130	126	120	126	124	120	122	120
leela	132/76	124	118	112	110	116	110	114	116	122	120	124	120
guruvappa	122/86	118	117	115	120	122	114	118	122	124	120	110	110

varadan	122/78	108	108	106	96	98	100	106	108	110	112	108	110
karunanithi	140/90	110	113	116	112	110	120	124	120	120	110	122	120
gunasekar	122/80	140	134	132	130	124	120	114	110	108	110	110	114
vediammal	118/76	116	114	122	116	116	118	112	114	116	114	112	110
shanmugham	140/83	106	110	93	95	105	108	98	92	100	110	106	110
vinayagam	140/90	130	108	106	105	102	110	112	114	114	116	110	120
selvaraj	120/92	128	136	140	120	140	142	144	136	132	122	128	124
lakshmi	134/80	130	130	128	122	110	122	100	125	122	120	110	108
ramu	150/80	152	156	148	146	140	138	136	130	135	132	136	144
malai	142/78	145	135	120	100	96	100	103	103	100	120	122	110
meganathan	128/67	113	107	107	110	108	104	102	110	102	105	116	110
muthu	119/84	122	123	120	109	108	110	120	122	100	98	101	103
kamala	150/88	154	150	137	140	138	137	130	145	140	141	143	140
murugan	132/86	133	130	130	127	126	124	120	110	112	123	122	120
anjali	114/80	110	100	97	114	116	120	122	128	133	130	130	123
gowtham	120/80	130	132	120	122	127	123	124	125	123	122	124	124
shankarapandian	138/90	132	124	113	112	113	114	112	110	113	123	120	123
kaali	132/84	130	132	127	120	110	100	98	97	101	100	106	110
arasan	123/69	120	125	126	120	112	114	126	117	113	110	113	104
jaganathan	130/90	114	110	98	99	90	100	110	110	102	105	108	110
solomon	152/78	148	146	140	136	132	140	136	128	128	138	134	134
devarajan	150/100	140	123	122	110	122	130	125	124	125	126	126	120
chaithanya	130/82	126	125	124	120	110	108	106	110	114	112	114	110
natarajan	150/90	132	134	124	122	127	120	127	125	122	120	110	118
azzeze	140/90	130	132	133	124	122	110	112	114	110	114	112	110
venkatesh	150/80	144	124	122	110	122	124	118	100	112	100	120	114
mohan	140/100	132	134	136	123	124	122	120	128	125	122	124	120
sumathy	136/90	124	128	124	122	120	110	108	104	110	112	110	108
muniyammal	124/84	120	136	144	140	142	132	124	120	122	110	112	110

subramani	120/80	122	124	120	110	108	102	110	114	112	102	112	110
arulanandan	140/80	142	138	128	122	120	110	118	115	132	134	142	150
krishnan	120/80	126	130	132	133	132	120	110	100	110	100	104	122
kesavraj	134/76	124	120	110	118	112	116	112	104	120	125	124	120
ganesan	126/84	110	93	92	103	98	99	104	106	110	122	120	110
jayanthi	121/72	116	119	120	114	110	110	112	114	116	120	122	132
palanisamy	140/100	136	134	132	130	128	130	132	130	126	120	134	132
pushparaj	149/93	144	142	138	130	129	130	128	138	135	134	135	136
Krishnaveni	132/86	140	138	134	132	128	129	132	130	125	120	124	120
gunasekar	146/92	124	122	120	110	90	90	94	92	94	96	100	110
kishorekumar	140/90	136	132	120	116	110	102	100	104	102	104	100	110
govindanpillai	100/66	112	114	105	107	108	112	110	114	110	104	102	110
chamundeshwari	110/77	130	122	126	126	122	110	106	112	114	112	104	102
vincent	123/86	124	122	125	122	123	120	122	120	122	126	125	127
lalitha	127/80	122	123	128	127	127	124	120	113	112	110	118	116
durairaj	130/70	119	109	101	100	99	106	106	105	110	112	114	112
palanivel	117/80	117	109	101	106	110	112	120	122	124	122	120	110
Thangam	150/80	150	144	142	130	136	132	122	120	122	110	108	110
mohan	122/80	122	110	105	102	98	99	92	90	110	106	110	112
selvaraj	120/80	120	118	115	124	122	116	110	112	114	110	98	94
subramani	120/88	122	110	109	110	122	108	116	108	105	112	115	116
sultan	140/88	140	138	142	155	146	142	140	138	144	142	140	148
rajendran	116/76	116	112	112	110	108	106	104	110	112	112	110	102
selvi	118/72	118	108	107	112	104	110	105	114	102	112	110	102
appu	130/80	130	130	120	125	120	122	124	120	116	114	117	112
lalitha	120/70	120	115	110	112	110	110	112	108	104	104	112	114
parthiban	130/86	130	134	136	130	124	124	128	124	122	120	120	118
muniyammal	136/90	134	136	138	132	130	134	130	122	124	128	128	124
sullaiman	128/85	128	125	122	125	122	121	120	122	124	128	120	118

kasturi	130/90	140	124	117	126	122	114	120	114	120	124	120	116
srinivsan	156/80	154	152	150	148	144	146	146	142	140	138	138	132
kumerasan	104/76	104	108	108	107	105	110	112	104	98	96	102	100
venkatesan	128/66	128	115	114	112	110	108	110	104	112	102	100	104
arul deva	140/83	140	138	133	132	130	112	110	114	110	108	112	112
velu	114/70	114	112	104	104	108	102	124	122	120	114	108	110
chinnappan	112/68	112	112	110	108	108	106	106	114	104	102	102	110
sushmita	120/80	120	122	124	120	110	108	106	104	112	110	102	110
kaliyamoorthy	100/86	110	108	107	106	104	102	98	112	110	104	106	106
raja	112/74	112	114	108	106	116	112	112	104	110	107	106	108
devi	110/66	110	108	112	108	106	108	110	108	104	98	94	98
kamalam	120/86	120	118	114	112	114	112	108	108	104	112	108	102
rajendran	104/80	102	112	108	106	112	110	104	112	104	112	104	108
radhakrishnan	110/72	140	124	120	110	124	126	100	110	124	122	120	116
subramani	139/77	139	130	111	98	92	97	116	116	117	117	118	118
jayamani	130/80	130	132	114	112	110	112	118	110	108	112	112	110
ramachandran	120/62	122	120	110	108	104	106	108	110	107	107	108	112
shanthi	140/86	140	138	132	133	150	154	148	146	138	136	140	142
rampal singh	146/89	146	142	138	130	132	129	128	127	128	136	140	142
radha	160/80	160	152	142	148	142	140	136	138	138	132	130	148
rajendran	130/90	132	128	124	122	125	126	124	120	122	110	114	116
krishnan	105/80	108	107	106	106	110	108	115	101	108	109	110	111
jamuna	110/78	110	112	108	106	112	107	116	122	120	118	116	112
vinod	122/70	120	116	114	107	108	116	120	110	98	96	100	101
vinayagam	110/72	110	132	108	106	106	108	110	122	130	132	132	122
guna	120/67	120	120	148	150	140	138	134	132	138	128	128	129
parthiban	110/60	110	112	108	108	106	110	112	110	112	108	108	110
kamalakannan	112/90	112	114	108	116	110	106	105	108	108	110	106	110
prasanth	110/80	110	112	114	112	110	115	112	110	114	110	106	104

kamala	122/80	140	136	132	114	124	120	122	130	132	118	114	112
shanmugham	110/80	112	114	108	104	98	92	100	102	104	110	112	114
karthikeyan	104/60	104	105	106	110	104	106	110	106	106	108	110	110
harish	114/80	114	112	108	106	112	110	115	108	106	108	108	110
tamil selvi	132/80	132	123	124	120	116	114	112	110	120	116	112	112
venkataraman	110/80	110	112	112	114	108	106	104	114	112	110	108	104
kasi	120/70	120	110	108	106	102	112	114	104	112	110	110	106
gopal	130/80	130	126	120	110	112	114	112	110	112	110	116	112
pooja	120/79	120	122	115	112	114	112	110	112	112	114	115	120
C.V.Raman	110/77	110	112	108	106	112	105	104	112	110	116	120	122
kamalakannan	109/68	109	110	112	114	118	122	120	124	120	113	112	114
gnanaprakash	150/100	150	148	144	150	152	152	150	148	144	142	138	132
kanammal	125/86	125	111	108	105	104	104	103	100	112	112	114	116

name	baseline	T0	T10	T20	T30	T40	T50	T1H	T2H	T3H	T4H	T5H	T6H
raja	90	90	80	72	75	76	80	80	82	80	82	74	70
palani	80	80	84	84	81	80	80	84	80	84	84	86	80
joseph	80	80	78	76	74	72	74	79	75	74	74	72	76
ranadhir	80	80	80	74	76	74	78	76	76	70	78	80	82
kanchana	92	92	85	70	76	70	68	70	70	72	70	74	72
mayilraj	94	94	86	68	66	60	76	72	72	70	70	74	76
kamaladevi	86	86	88	90	76	70	78	74	74	72	76	72	77
jayammal	67	67	60	70	64	70	68	66	64	60	66	70	72
sankaran	88	88	80	82	80	84	80	84	86	80	82	84	84
vishwam	86	86	66	78	70	70	78	70	70	70	74	72	70
ezhumalai	92	92	80	84	76	85	82	88	82	82	80	88	80

thandavamuthu	72	72	70	68	66	60	62	70	72	70	77	70	76
rajammal	77	77	76	74	72	70	74	70	77	70	73	68	66
satish	82	82	80	88	80	82	80	80	77	78	77	76	78
thirumalai	77	77	74	75	77	74	77	72	70	77	68	66	68
moideen	82	82	77	76	78	70	66	60	62	68	60	68	65
saraswathy	86	86	84	82	82	80	82	79	76	80	80	82	86
thendralarasu	80	80	80	82	80	84	82	78	76	72	74	80	82
leela	80	80	76	76	74	74	72	70	74	78	72	74	72
guruvappa	84	84	82	84	79	80	86	84	82	86	88	84	82
varadan	74	74	70	66	58	58	60	58	68	70	72	74	70
karunanithi	76	76	72	72	78	78	74	69	70	76	70	72	74
gunasekar	92	92	84	74	69	70	74	70	72	69	68	70	76
vediammal	80	80	82	84	78	76	75	78	78	74	70	66	70
shanmugham	80	80	80	76	70	68	64	60	64	66	60	66	62
vinayagam	76	76	77	78	68	62	66	60	62	64	68	66	62
selvaraj	84	84	86	80	82	88	80	84	88	76	79	78	70
lakshmi	78	78	74	70	72	70	68	69	70	72	77	79	70
ramu	76	76	70	60	65	66	60	64	60	67	56	64	66
malai	80	80	92	90	98	90	97	80	75	90	80	77	80
meganathan	68	68	65	60	66	68	63	63	61	64	68	65	66
muthu	84	84	80	78	74	70	82	72	66	64	64	68	68
kamala	88	88	80	80	86	81	75	78	74	72	79	70	78
murugan	86	86	80	85	78	75	79	78	70	68	66	68	69
anjali	78	78	76	74	70	69	68	69	72	74	80	80	82
gowtham	83	83	84	89	90	88	82	80	78	78	74	72	79
shankarapandian	98	98	80	84	80	79	80	80	86	86	78	79	67
kaali	82	82	80	72	70	66	68	64	62	60	58	68	66
arasan	82	82	85	84	88	80	82	70	72	74	76	73	70
jaganathan	82	82	80	80	78	75	72	73	68	66	69	66	68

solomon	66	66	68	65	64	62	60	68	62	60	67	66	68
devarajan	90	90	88	87	90	86	80	85	84	82	80	80	78
chaithanya	82	82	70	72	74	70	74	74	70	72	78	74	79
natarajan	80	80	57	58	58	55	57	67	66	64	65	62	60
azzeze	82	82	80	84	86	90	92	90	88	78	76	75	76
venkatesh	90	90	80	83	82	80	84	80	82	60	66	78	76
mohan	92	92	96	88	89	80	96	90	92	90	92	90	88
sumathy	92	92	86	90	72	74	72	74	70	72	70	69	68
muniyammal	84	84	78	76	76	72	70	72	76	78	76	70	66
subramani	84	84	82	80	78	76	76	74	74	72	72	72	76
arulanandan	82	82	78	74	75	79	76	74	75	78	74	70	72
krishnan	86	86	76	72	74	70	80	84	80	78	76	72	70
kesavraj	78	78	74	72	74	68	68	66	62	68	67	65	68
ganesan	72	72	69	64	66	64	67	68	66	62	62	61	60
jayanthi	74	74	69	72	66	58	60	59	60	62	61	60	60
palanisamy 49	94	94	98	92	94	96	100	92	90	88	84	84	88
pushparaj	94	94	82	80	84	84	80	77	79	80	86	98	94
Krishnaveni	92	92	94	92	95	90	90	88	84	82	80	78	74
gunasekar	86	86	76	74	70	78	68	66	62	64	66	58	60
kishorekumar	66	66	65	69	62	60	68	65	68	69	63	67	66
govindanpillai	66	66	62	56	60	67	68	66	68	69	64	65	68
chamundeshwari, 45	62	62	60	64	66	60	60	61	65	60	68	70	78
vincent	86	86	85	80	80	79	79	78	76	75	72	74	77
lalitha	82	82	82	80	78	74	72	70	78	72	72	74	70
durairaj	73	73	65	66	67	66	68	66	69	70	72	74	74
palanivel	87	87	76	79	78	78	80	84	87	82	80	78	77
Thangam	82	82	80	74	77	76	78	78	79	80	88	89	80

mohan	82	82	78	70	66	65	60	68	68	67	62	60	66
selvaraj	88	88	78	76	72	70	66	68	67	66	65	60	68
subramani	86	86	82	80	78	76	77	67	68	68	70	72	77
sultan	86	86	82	80	96	92	90	92	94	95	96	100	90
rajendran	67	67	72	73	70	66	62	60	58	52	54	60	62
selvi	70	70	68	66	62	66	65	60	65	68	66	64	68
appu	80	80	78	70	72	70	68	64	62	66	68	66	67
lalitha	72	72	70	70	78	76	66	68	64	68	62	66	65
parthiban	82	82	80	84	82	80	78	74	76	84	88	80	82
muniyammal	92	92	90	94	96	90	98	94	90	96	94	92	86
sullaiman	82	82	85	80	78	80	72	76	78	70	74	70	72
kasturi	66	66	59	61	62	68	60	65	64	60	62	60	68
srinivsan	72	72	70	67	68	66	62	60	63	64	62	60	68
kumerasan	70	70	72	70	66	70	72	70	66	58	59	60	66
venkatesan	92	92	94	88	82	80	78	74	74	78	74	70	68
arul deva	84	84	88	86	82	80	78	76	64	66	68	78	76
velu	72	72	72	72	70	68	67	64	62	60	68	68	65
chinnappan	60	60	65	68	65	60	65	60	68	67	67	67	66
sushmita	76	76	74	73	72	72	70	74	68	68	66	64	68
kaliyamoorthy	84	84	82	80	78	72	70	67	68	70	72	70	76
raja	88	88	84	80	82	76	87	74	77	68	64	62	60
devi	64	64	64	68	60	58	60	62	66	65	64	62	60
kamalam	66	66	62	60	65	70	72	68	66	73	66	64	62
rajendran	62	62	68	64	58	67	62	60	62	58	70	72	64
radhakrishnan 40	82	82	84	88	59	82	86	82	80	86	82	88	84
subramani	69	69	66	57	60	60	60	65	68	68	68	70	72
jayamani	87	87	86	86	64	70	72	70	72	72	70	66	68
ramachandran	66	66	65	67	68	62	65	68	58	56	58	55	59
shanthi	88	88	80	78	82	78	80	78	75	72	78	78	76

rampal singh	84	84	83	81	82	80	82	82	80	83	80	82	84
radha	88	88	78	72	74	72	60	65	64	65	65	67	78
rajendran	80	80	86	85	80	78	75	72	76	78	88	82	80
krishnan	66	66	64	65	70	76	68	66	62	66	65	68	66
jamuna	62	62	65	70	76	72	75	72	70	75	76	68	69
vinod	72	72	76	74	68	64	66	67	68	63	68	66	62
vinayagam	68	68	79	100	79	68	68	100	75	88	87	80	90
guna	78	78	72	67	68	62	68	66	68	67	78	70	72
parthiban	64	64	68	66	68	65	68	56	60	62	60	65	67
kamalakannan	60	60	62	66	62	60	64	67	66	65	66	68	67
prasanth	62	62	66	66	62	60	66	58	58	60	62	66	64
kamala	65	65	66	67	68	65	68	70	75	73	72	70	74
shanmugham	62	62	63	60	70	72	68	60	66	65	60	62	60
karthikeyan	65	65	65	60	62	58	52	50	56	60	62	60	62
harish	56	56	58	60	62	64	64	60	62	58	54	58	58
tamil selvi	65	65	62	68	66	64	65	62	66	68	67	68	66
venkataraman	82	82	80	76	72	78	76	78	76	79	72	70	78
kasi	72	72	64	64	60	60	60	70	60	68	62	60	62
gopal	92	92	86	88	82	80	78	72	70	76	78	76	78
pooja	62	62	70	76	78	66	68	78	70	72	66	78	77
C.V.Raman	66	66	68	64	62	68	67	66	65	66	68	68	70
kamalakannan	88	88	87	80	82	86	84	89	90	92	98	99	90
gnanaprakash	98	98	96	90	92	96	96	90	94	90	90	98	96
kanammal	83	83	84	89	84	88	82	80	83	84	70	79	76

name	MAP	T0	T10	T20	T30	T40	T50	T1H	T2H	T3H	T4H	T5H	T6H
raja		107	97	83	83	86	90	93	91	90	93	89	83
palani		100	99	101	99	93	93	93	93	96	97	98	95

joseph		93	89	84	86	85	86	86	90	86	86	88	94
ranadhir		97	90	86	87	89	90	91	87	87	89	96	99
kanchana		105	101	88	92	83	86	88	87	88	89	91	88
mayilraj		103	99	82	77	77	86	83	85	83	88	90	87
kamaladevi		106	99	97	88	83	86	87	86	86	93	88	89
jayammal		91	87	92	83	86	85	85	83	80	81	90	87
sankaran		100	94	96	93	93	88	91	93	93	95	103	97
vishwam		104	89	96	88	87	93	87	87	87	91	88	87
ezhumalai		105	93	97	91	95	92	99	94	96	87	95	91
thandavamuthu		89	87	82	77	70	75	81	84	82	88	80	89
rajammal		91	87	87	83	83	84	81	85	83	86	82	84
satish		99	97	99	95	95	93	92	88	89	89	87	88
thirumalai		89	85	86	86	83	88	86	84	88	83	79	82
moideen		91	88	84	84	80	77	77	79	79	77	82	81
saraswathy		105	99	97	97	96	97	93	92	93	95	91	95
thendralarasu		97	97	99	95	99	97	92	93	89	89	94	95
leela		95	90	88	86	88	85	85	88	93	88	91	88
guruvappa		95	94	94	93	94	95	95	95	99	99	93	91
varadan		85	83	79	71	71	73	74	81	83	85	85	83
karunanithi		87	86	87	89	89	89	87	87	91	83	89	89
gunasekar		108	101	93	89	88	89	85	85	82	82	83	89
vediammal		92	93	97	91	89	89	89	90	88	85	81	83
shanmugham		89	90	82	78	80	79	73	73	77	77	79	78
vinayagam		94	87	87	80	75	81	77	79	81	84	81	81
selvaraj		99	103	100	95	105	101	104	104	95	93	95	88
lakshmi		95	93	89	89	83	86	79	88	89	91	89	83
ramu		101	99	89	92	91	86	88	83	90	81	88	92
malai		102	106	100	99	92	98	88	84	93	93	92	90
meganathan		83	79	76	81	81	77	76	77	77	80	82	81

muthu		97	94	92	86	83	91	88	85	76	75	79	80
kamala	55	110	103	99	104	100	96	95	98	95	100	94	99
murugan		102	97	100	94	92	94	92	83	83	85	86	86
anjali		89	84	82	85	85	85	87	91	94	97	97	96
gowtham		99	100	99	101	101	96	95	94	93	90	89	94
shankarapandian		109	95	94	91	90	91	91	94	95	93	93	86
kaali		98	97	90	87	81	79	75	74	74	72	81	81
arasan		95	98	98	99	91	93	89	87	87	87	86	81
jaganathan		93	90	86	85	80	81	85	82	78	81	80	82
solomon		93	94	90	88	85	87	91	84	83	91	89	90
devarajan		107	100	99	97	98	97	98	97	96	95	95	92
chaithanya		97	88	89	89	83	85	85	83	86	89	87	89
natarajan		97	83	80	79	79	78	87	86	83	83	78	79
azzeze		98	97	100	99	101	98	97	97	89	89	87	87
venkatesh		108	95	96	91	94	97	93	88	77	77	92	89
mohan		105	109	104	100	95	105	100	104	102	102	101	99
sumathy		103	100	101	89	89	85	85	81	85	84	83	81
muniyammal		96	97	99	97	95	91	89	91	93	87	84	81
subramani		97	96	93	89	87	85	86	87	85	82	85	87
arulanandan		102	98	92	91	93	87	89	88	96	94	94	98
krishnan		99	94	92	94	91	93	93	87	89	84	83	87
kesavraj		93	89	85	89	83	84	81	76	85	86	85	85
ganesan		85	77	73	78	75	78	80	79	78	82	81	77
jayanthi		88	86	88	82	75	77	77	78	80	81	81	84
palanisamy		108	110	105	106	107	110	105	103	101	96	101	103
pushparaj		111	102	99	99	99	97	94	99	98	102	110	108
Krishnaveni		108	109	106	107	103	103	103	99	96	93	93	89
gunasekar		99	91	89	83	82	75	75	72	74	76	72	77
kishorekumar		89	87	86	80	77	79	77	80	80	77	78	81

govindanpillai		81	79	72	76	81	83	81	83	83	77	77	82
chamundeshwari		85	81	85	86	81	77	76	81	78	83	81	86
vincent		99	97	95	94	94	93	93	91	91	90	91	94
lalitha		95	96	96	94	92	89	87	90	85	85	89	85
durairaj		88	80	78	78	77	81	79	81	83	85	87	87
palanivel		97	87	86	87	89	91	96	99	96	94	92	88
Thangam		105	101	97	95	96	96	93	93	94	95	95	90
mohan		95	89	82	78	76	73	76	75	81	77	77	81
selvaraj		99	91	89	89	87	83	82	82	82	80	73	77
subramani		98	91	90	89	91	87	83	81	80	84	86	90
sultan		104	101	101	116	110	107	108	109	111	111	113	109
rajendran		83	85	86	83	80	77	75	75	72	73	77	75
selvi		86	81	80	79	79	80	75	81	79	81	79	79
appu		97	95	87	90	87	86	84	81	83	83	83	82
lalitha		88	85	83	89	87	81	83	79	80	76	81	81
parthiban		98	98	101	98	95	93	92	92	97	99	93	94
muniyammal		106	105	109	108	103	110	106	101	105	105	104	99
sullaiman		97	98	94	94	94	88	91	93	88	92	87	87
kasturi		91	81	80	83	86	78	83	81	80	83	80	84
srinivsan		99	97	95	95	92	90	89	89	89	87	86	89
kumerasan		81	84	83	80	82	85	84	79	71	71	74	77
venkatesan		104	101	97	92	90	88	86	84	89	83	80	80
arul deva		103	105	102	99	97	89	87	81	81	81	89	88
velu		86	85	83	81	81	79	84	82	80	83	81	80
chinnappan		77	81	82	79	76	79	75	83	79	79	79	81
sushmita		91	90	90	88	85	83	85	80	83	81	77	82
kaliyamoorthy		93	91	89	87	83	81	77	83	83	83	82	86
raja		96	94	89	90	89	95	87	86	82	78	77	76
devi		79	79	83	76	74	76	78	80	78	75	73	73

kamalam	84	81	78	81	85	85	81	80	83	81	79	75
rajendran	75	83	79	74	82	78	75	79	73	84	83	79
radhakrishnan	101	97	99	76	96	99	88	90	99	95	99	95
subramani	92	87	75	73	71	72	82	84	84	84	86	87
jayamani	101	101	95	80	83	85	86	85	84	84	81	82
ramachandran	85	83	81	81	76	79	81	75	73	74	73	77
shanthi	105	99	96	99	102	105	101	99	94	97	99	98
rampal singh	105	103	100	98	97	98	97	96	98	99	101	103
radha	112	103	95	99	95	87	89	89	89	87	88	101
rajendran	97	100	98	94	94	92	89	91	93	95	93	92
krishnan	80	78	79	82	87	81	82	75	80	80	82	81
jamuna	78	81	83	86	85	86	87	87	90	90	84	83
vinod	88	89	87	81	79	83	85	82	75	77	77	75
vinayagam	82	97	103	88	81	81	103	91	102	102	97	101
guna	92	88	94	95	88	91	89	89	91	95	89	91
parthiban	79	83	80	81	79	82	75	77	79	76	79	81
kamalakannan	77	79	80	80	77	78	80	80	79	81	81	81
prasanth	78	81	82	79	77	82	76	75	78	78	79	77
kamala	90	89	89	83	85	85	87	93	93	87	85	87
shanmugham	79	80	76	81	81	76	73	78	78	77	79	78
karthikeyan	78	78	75	78	73	70	70	73	75	77	77	78
harish	75	76	76	77	80	79	78	77	74	72	75	75
tamil selvi	87	82	87	84	81	81	79	81	85	83	83	81
venkataraman	91	91	88	86	88	86	87	89	90	85	83	87
kasi	88	79	79	75	74	77	85	75	83	78	77	77
gopal	105	99	99	91	91	90	85	83	88	89	89	89
pooja	81	87	89	89	82	83	89	84	85	82	90	91
C.V.Raman	81	83	79	77	83	80	79	81	81	84	85	87
kamalakannan	95	95	91	93	97	97	99	101	101	103	103	98

gnanaprakash	115	113	108	111	115	115	110	112	108	107	111	108
kanammal	97	93	95	91	93	89	88	89	93	84	91	89

name	SPO_2T0 %	T10%	T20	T30	T40	T50	T1H	T2H	T3H	T4H	T5H	T6H
raja	99	99	99%	98%	99%	98%	99%	99%	99%	99%	98%	99%
palani	99	99	99%	98%	99%	99%	99%	99%	99%	99%	99%	99%
joseph	99	99	99%	98%	98%	98%	99%	98%	99%	99%	100%	100%
ranadhir	99	99	98%	99%	98%	99%	99%	98%	98%	99%	99%	98%
kanchana	99	99	99%	99%	97%	99%	98%	98%	99%	99%	97%	99%
mayilraj	99	99	99%	99%	99%	99%	99%	99%	99%	99%	98%	99%
kamaladevi	99	99	98%	99%	98%	99%	98%	99%	99%	99%	99%	99%
jayammal	99	99	97%	96%	99%	98%	99%	99%	98%	99%	100%	99%
sankaran	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
vishwam	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
ezhumalai	99	99	99%	99%	100%	100%	99%	99%	99%	98%	99%	99%
thandavamuthu	99	99	98%	99%	100%	99%	99%	98%	99%	99%	99%	99%
rajammal	99	99	99%	99%	98%	99%	99%	99%	99%	99%	99%	99%
satish	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
thirumalai	99	99	99%	98%	99%	99%	99%	99%	99%	99%	99%	99%
moideen	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
saraswathy	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
thendralarasu	99	99	99%	99%	99%	99%	100%	99%	100%	100%	98%	100%
leela	99	99	99%	99%	98%	99%	100%	100%	100%	99%	100%	99%
guruvappa	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
varadan	99	99	99%	98%	99%	99%	99%	99%	99%	99%	99%	99%
karunanithi	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
gunasekar	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
vediammal	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%

shanmugham	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
vinayagam	99	99	99%	99%	99%	98%	100%	99%	98%	98%	99%	99%
selvaraj	99	99	99%	99%	99%	99%	99%	99%	99%	99%	100%	100%
lakshmi	99	99	99%	99%	99%	99%	99%	99%	98%	99%	99%	99%
ramu	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
malai	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
meganathan	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
muthu	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
kamala 55	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
murugan	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
anjali	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
gowtham	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
shankarapandian	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
kaali	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
arasan	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
jaganathan	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
solomon	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
devarajan	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	98%
chaithanya	99	99	99%	98%	99%	99%	97%	99%	99%	99%	99%	99%
natarajan	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
azzeze	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
venkatesh	99	99	99%	99%	99%	98%	97%	99%	99%	98%	99%	98%
mohan	99	99	99%	99%	99%	98%	99%	98%	99%	99%	99%	99%
sumathy	99	99	99%	98%	99%	99%	99%	98%	100%	98%	98%	99%
muniyammal	99	99	100%	99%	98%	100%	100%	98%	99%	99%	99%	99%
subramani	99	99	98%	99%	99%	98%	99%	98%	98%	99%	99%	99%
arulanandan	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
krishnan	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
kesavraj	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%

ganesan	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
jayanthi	99	99	99%	99%	99%	98%	99%	98%	98%	98%	100%	100%
palanisamy	99	99	99%	98%	99%	99%	100%	99%	99%	99%	99%	99%
pushparaj	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
Krishnaveni	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
gunasekar	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
kishorekumar	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
govindanpillai	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
chamundeshwari, 45	99	99	97%	99%	99%	99%	99%	99%	99%	99%	99%	99%
vincent	99	99	99%	99%	99%	99%	99%	100%	98%	99%	99%	99%
lalitha	99	99	99%	99%	100%	98%	99%	99%	99%	99%	99%	99%
durairaj	99	99	99%	99%	99%	99%	100%	99%	99%	99%	99%	99%
palanivel	99	99	98%	99%	98%	99%	99%	100%	98%	99%	99%	98%
Thangam	99	99	99%	99%	99%	98%	99%	99%	99%	100%	100%	99%
mohan	99	99	99%	98%	97%	99%	99%	98%	99%	99%	99%	99%
selvaraj	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
subramani	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
sultan	99	99	99%	99%	99%	99%	99%	98%	99%	99%	99%	99%
rajendran	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
selvi	99	99	99%	99%	98%	99%	99%	98%	99%	98%	99%	99%
appu	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
lalitha	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
parthiban	99	99	97%	99%	98%	99%	99%	99%	99%	99%	99%	99%
muniyammal	99	99	99%	98%	99%	99%	99%	99%	99%	99%	99%	99%
sullaiman	99	99	98%	97%	99%	99%	98%	99%	99%	99%	99%	99%
kasturi	99	99	98%	99%	99%	99%	98%	99%	99%	97%	99%	99%
srinivsan	99	99	99%	99%	99%	98%	99%	99%	99%	99%	99%	99%
kumerasan	99	99	99%	98%	99%	98%	99%	99%	99%	99%	98%	99%

venkatesan	99	99	98%	98%	99%	98%	98%	99%	100%	100%	100%	100%
arul deva	99	99	98%	99%	98%	100%	98%	99%	99%	100%	98%	99%
velu	99	99	99%	98%	99%	98%	99%	100%	98%	98%	99%	99%
chinnappan	99	99	99%	98%	97%	97%	97%	98%	98%	98%	97%	99%
sushmita	99	99	99%	99%	98%	99%	98%	99%	98%	98%	99%	99%
kaliyamoorthy	99	99	98%	99%	98%	99%	98%	100%	98%	99%	99%	99%
raja	99	99	98%	99%	99%	99%	98%	100%	98%	99%	99%	99%
devi	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
kamalam	99	99	99%	99%	99%	98%	99%	99%	99%	99%	98%	99%
rajendran	99	99	99%	99%	99%	98%	99%	99%	99%	99%	99%	98%
radhakrishnan 40	99	99	99%	98%	99%	100%	100%	99%	98%	99%	99%	98%
subramani	99	99	99%	98%	99%	100%	99%	98%	98%	100%	99%	99%
jayamani	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
ramachandran	99	99	99%	99%	100%	99%	99%	99%	99%	99%	99%	99%
shanthi	99	99	99%	99%	98%	99%	99%	99%	99%	99%	99%	99%
rampal singh	99	99	99%	99%	98%	99%	99%	99%	99%	99%	99%	99%
radha	99	99	99%	99%	98%	99%	99%	99%	99%	98%	99%	99%
rajendran	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
krishnan	99	99	99%	99%	98%	99%	99%	99%	99%	99%	99%	99%
jamuna	99	99	99%	99%	98%	97%	99%	99%	99%	99%	98%	99%
vinod	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
vinayagam	99	99	99%	99%	99%	99%	98%	99%	99%	99%	99%	99%
guna	99	99	99%	99%	99%	98%	99%	99%	99%	99%	99%	98%
parthiban	99	99	99%	99%	98%	99%	99%	98%	99%	99%	99%	98%
kamalakannan	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	9%
prasanth	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
kamala	99	99	99%	99%	99%	98%	99%	99%	99%	98%	99%	99%
shanmugham	99	99	99%	99%	98%	99%	99%	99%	98%	99%	99%	99%
karthikeyan	99	99	99%	99%	99%	98%	99%	99%	98%	99%	99%	99%

harish	99	99	99%	99%	99%	99%	98%	99%	99%	99%	98%	99%
tamil selvi	99	99	98%	99%	99%	98%	99%	99%	99%	98%	99%	98%
venkataraman	99	99	99%	99%	98%	99%	99%	99%	99%	99%	99%	99%
kasi	99	99	98%	98%	99%	99%	99%	99%	99%	99%	100%	99%
gopal	99	99	99%	99%	99%	99%	99%	99%	98%	98%	98%	99%
pooja	99	99	99%	98%	99%	99%	99%	99%	99%	98%	99%	99%
C.V.Raman	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
kamalakannan	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
gnanaprakash	99	99	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
kanammal	99	99	99%	99%	99%	99%	98%	99%	99%	99%	99%	99%

name	pruritus	Nausea/	vomiting	duration of procedure	irrigating solution used	Litres)	IV fluids(ml)	highest level of sensory block
raja	0	0	0	40 minutes	5		750	T 8
palani	0	0	0	40 minutes	5		750	T9
joseph	0	0	0	60 minutes	6		700	T8
ranadhir	0	0	0	45 minutes	5		650	T10
kanchana	0	0	0	60 minutes	4		700	T8
mayilraj	0	0	0	40 minutes	5		750	T10
kamaladevi	0	0	0	50 minutes	3		800	T8
jayammal	0	0	0	35minutes	6		750	T9
sankaran	0	0	0	40minutes	5		750	T10
vishwam	0	0	0	40 minutes	6		650	T8
ezhumalai	0	0	0	60minutes	6		800	T10
thandavamuthu	0	0	0	40minutes	5		1000	T9

rajammal	0	0	0	40 minutes		6			750		T11
satish	0	0	0	45minutes		6.5			750		T10
thirumalai	0	0	0	45minutes		6			750		T8
moideen	0	0	0	45minutes		7			750		T9
saraswathy	0	0	0	45minutes		7			750		T10
thendralarasu	0	1	0	40minutes		5.5			750		T10
leela	0	1	1	45minutes		7			1000		T8
guruvappa	0	0	0	45minutes		6			650		T10
varadan	0	1	0	50minutes		5			800		T10
karunanithi	0	0	0	45minutes		6			750		T8
gunasekar	0	0	0	45minutes		5			700		T7
vediammal	0	0	0	50minutes		6			800		T8
shanmugham	0	0	0	60 minutes		6			750		T9
vinayagam	0	0	0	50minutes		6			700		T10
selvaraj	0	0	0	50minutes		6			700		T8
lakshmi	0	1	0	35 minutes		7			750		T10
ramu	0	0	0	40minutes		5			700		T8
malai	0	0	0	42minutes		6			850		T9
meganathan	0	0	0	45minutes		5			850		T10
muthu	0	0	0	40 minutes		6			850		T8
kamala	0	1	0	42minutes		5			900		T9
murugan	0	0	0	45minutes		7			940		T10
anjali	0	0	0	42minutes		5			950		T7
gowtham	0	0	0	40minutes		5			650		T6
shankarapandian	0	0	0	46minutes		6			750		T10
kaali	0	0	0	45minutes		7			850		T10
arasan	0	0	0	40minutes		6			800		T8
jaganathan	0	0	0	47minutes		7			750		T8
solomon	0	0	0	45 minutes		6			750		T6

devarajan	0	0	0	50 minutes		7			800		T7
chaithanya	0	0	0	50minutes		6			850		T7
natarajan	0	0	0	50 minutes		7			750		T6
azzeze	1	0	0	45 minutes		6			750		T7
venkatesh	0	0	0	45 minutes		6			700		T10
mohan	0	0	0	50 minutes		7			850		T9
sumathy	0	0	0	45 minutes		6			800		T6
muniyammal	0	0	0	50 minutes		7			700		T8
subramani	0	0	0	50 minutes		6			750		T8
arulanandan	0	0	0	50 minutes		7			700		T9
krishnan	0	0	0	60minutes		7			750		T9
kesavraj	0	0	0	56minutes		6			800		T10
ganesan	0	0	0	50 minutes		7			850		T10
jayanthi	0	0	0	49 minutes		7			800		T8
palanisamy 49	0	0	0	56minutes		7			1000		T7
pushparaj	0	0	0	48minutes		7			1000		T8
Krishnaveni	0	0	0	50minutes		7			800		T10
gunasekar	0	0	0	54minutes		7			700		T8
kishorekumar	0	0	0	55 minutes		7			800		T7
govindanpillai	0	0	0	45minutes		7			700		T8
chamundeshwari	0	0	0	40 minutes		6			900		T8
vincent	0	0	0	40 minutes		6			800		T7
lalitha	0	0	0	35 minutes		7			850		T8
durairaj	0	0	0	40 minutes		6			700		T7
palanivel	0	0	0	44 minutes		6			800		T10
Thangam	0	0	0	40 minutes		6			1000		T8
mohan	0	0	0	48minutes		7			650		T8
selvaraj	0	0	0	40 minutes		6			900		T9
subramani	0	0	0	44 minutes		7			850		T10

sultan	0	0	0	40 minutes		7			900		T10
rajendran	0	0	0	45minutes		7			800		T7
selvi	0	0	0	36minutes		6			850		T8
appu	0	0	0	40 minutes		6			800		T8
lalitha	0	0	0	35 minutes		6			750		T8
parthiban	0	0	0	40minutes		6			700		T8
muniyammal	0	0	0	35minutes		6			850		T9
sullaiman	0	0	0	40minutes		7			850		T10
kasturi	0	1	0	45minutes		6			800		T10
srinivsan	0	0	1	60minutes		6			600		T8
kumerasan	0	0	0	40minutes		6			800		T9
venkatesan	0	1	0	60minutes		7			900		T10
arul deva	0	0	0	45minutes		6			850		T10
velu	0	0	0	60minutes		7			800		T7
chinnappan	0	0	0	60minutes		6			650		T9
sushmita	0	1	0	58minutes		6			700		T8
kaliyamoorthy	0	0	0	45minutes		6			600		T10
raja	0	0	0	40minutes		7			650		T10
devi	0	0	0	40minutes		6			650		T10
kamalam	0	0	0	42minutes		6			700		T8
rajendran	0	0	0	38minutes		6			800		T9
radhakrishnan 40	0	0	0	45 minutes		6			750		T10
subramani	0	0	0	55minutes		6			500		T8
jayamani	0	0	0	46minutes		6			800		T10
ramachandran	0	0	0	35minutes		6			600		T8
shanthi	0	0	0	46minutes		6			650		T10
rampal singh	0	0	0	50minutes		8			600		T10
radha	0	0	0	50minutes		6			600		T8
rajendran	0	0	0	40minutes		7			900		T9

krishnan	0	0	1	48minutes		6			850		T9
jamuna	0	0	0	46minutes		6			850		T10
vinod	0	0	0	50minutes		5			800		T10
vinayagam	0	0	0	60minutes		6			600		T8
guna	0	0	0	45minutes		5			900		T9
parthiban	0	0	0	38minutes		5			950		T10
kamalakannan	0	0	0	40minutes		6			950		T10
prasanth	0	0	0	45minutes		6			850		T9
kamala	0	0	0	40minutes		5			800		T10
shanmugham	0	0	0	44minutes		6			1000		T10
karthikeyan	0	0	0	40minutes		5			950		T8
harish	0	1	1	45minutes		4			900		T9
tamil selvi	0	0	0	50minutes		4			850		T10
venkataraman	0	0	0	55minutes		3			800		T8
kasi	0	0	0	50minutes		5			700		T8
gopal	0	0	0	50minutes		6			700		T9
pooja	0	0	0	45minutes		6			800		T10
C.V.Raman	0	0	0	50minutes		5			650		T7
kamalakannan	0	0	0	54minutes		5			700		T6
gnanaprakash	0	0	0	50minutes		4			650		T10
kanammal	0	0	0	46minutes		3			650		T8

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GRADES OF SHIVERING

Grades of shivering were given by Crossley and Mahajan[52,31]

- Grade 0: No shivering
- Grade 1 : Piloerection
- Grade 2: Muscular activity in only one muscle group
- Grade 3: Muscular activity in more than one muscle group but not generalized shivering
- Grade 4: Generalised shivering