"A COMPARATIVE STUDY OF INTRATHECAL 0.5% BUPIVACAINE AND 0.5% BUPIVACAINE WITH FENTANYL IN PATIENTS UNDERGOING LSCS "

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Date: 29 september 2020

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LIST OF ABBREVIATIONS

ASA	American Society of Anaesthesiologist
CC/CNS	Cardiovascular collapse to central nervous system toxicity ratio
CPD	Cephalopelvic disproportion
HB	Hyperbaric bupivacaine
IB	Isobaric bupivacaine
IT	Intrathecal
IV	Intravenous
LA	Local anaesthetics
LSCS	Lower segment caesarean section
PACU	Post anaesthesia care unit
PIH	Pregnancy induced hypertension
PROM	Premature rupture of membrane
RL	Ringers lactate
SAB	Subarachnoid block
SD	Standard deviation

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Introduction

Surgical intervention in obstetric practice is becoming increasingly common. Intrathecal analgesia in labor has become an established technique, and various local anaesthetics and opioids have been used, either alone or in combination.[1]

Spinal anaesthesia consists of the temporary interruption of nerve transmission within the subarachnoid space produced by injection of a local anaesthetic solution into subarachnoid space.

Spinal anaesthesia confers numerous advantages with smaller dose of local anaesthetic. It is simple to perform with rapid onset of action and good muscle relaxation. One main disadvantage is its limited duration of action, hence lack of postoperative analgesia. To address this problem, and to improve the quality of subarachnoid block, intrathecal Opioids are used as adjuvants to Bupivacaine. Among the manufactured narcotics, fentanyl is better due to higher potency, quicker beginning of activity and fast redistribution reducing in the plasma concentration. Thus, improving the early postoperative analgesia.

So this study is being undertaken to examine the effect of adding fentanyl to hyperbaric bupivacaine for spinal anaesthesia in patients undergoing elective LSCS.

OPIOID RECEPTORS

Opioid receptors are classified as mu, delta and kappa receptors.

μ or morphine-preferring receptors are principally responsible for supraspinal and spinal analgesia. Activation of a subpopulation of μ receptors (μ_1) is speculated to produce analgesia, whereas μ_2 receptors are responsible for hypoventilation, bradycardia, and physical dependence.

Exogenous μ receptor agonists include morphine, meperidine, fentanyl, sufentanil, alfentanil and remifentanil. Naloxone is a specific μ receptor antagonist attaching to but not activating the receptor.

Agonists, including the endogenous ligand dymorphin, act at kappa receptors, resulting in inhibition of neurotransmitter release via type N calcium channels.

Opioid agonist-antagonist often act principally on kappa receptors. Delta receptors respond to the endogenous ligands known as enkephalins, and these opioid receptors may serve to modulate the activity of the μ receptor.

In the past, sigma and epsilon receptors were included in the classification of opioid receptors. Sigma receptor mediated effects are not reversed by noloxone, emphasizing that these receptors are not opioid receptors.

Opioid receptors and endorphins is to function as an endogenous pain suppression system. Opioids receptors are located in areas of the brain (periaqueductal gray matter of the brainstem, amygdala, corpus striatum, and hypothalamus) and spinal cord (substantia gelatinosa) that are involved with pain perception,integrationofpainimpulsesandresponsestopain.Itisspeculatedthat

endorphins inhibit the release of excitatory neurotransmitter from terminals of nerves carrying nociceptive impulses.

Mechanism of Analgesia

Stimulation of periaqueductal gray receptor with opioid or endogenous opiate like peptide results in impulses that alter the degree of inhibition of different neuronal pools and contribute to reducing the transmission of nociceptive information from peripheral nerves into the spinal cord and up the neuraxis. Thus, opioids not only produce analgesia by direct action. Whereas opioid application at the spinal cord produces analgesia at the level of administration, and also neurally mediated action at distant CNS sites also enhance analgesia. The systemic administration of opioid activates the analgesic system in the CNS.[14]

In local spinal mechanism, opioids act at nerve synapses either presynaptically (as neuromodulators) or postsynaptically (as neurotransmitters). The substantiagelatinosa of the spinal cord possesses a dense collection of opiate receptors. Direct application of opioids to these receptors creates intense analgesia. Spinal cord presynaptic substance P release in primary sensory neurons is inhibited by μ, κ and δ agonists and is one neuraxial mechanism of opioid analgesia.[15]

Classification of opioid receptors[14]

	μ1	μ2	κ	Δ
Effect	Analgesia (supra spinal and spinal)	Analgesia (spinal)	Analgesia (supra spinal and spinal)	Analgesia (supra spinal and spinal)
	Euphoria	Depression of ventilation	Dysphoria sedation	Depression of ventilation
	Low abuse potential miosis	Physical dependence	Low abuse potential miosis	Physical dependence
		Constipation (marked)		Constipation (minimal)
	Bradycardia Hypothermia Urinary retention		Diuresis	Urinary retention
Agonists	Endorphine Morphine Systemic opioids	Endorphines Morphine Systemic opioids	Dynorphines	Eukephalias
Antagonists	Naloxone Naltrexone Nalmefene	Nalaxone Naltrexone Nalmefene	Nalaxone Naltrexone Nalmefene	Nalaxone Naltrexone Nalmefene

Neuraxial opioids

Opioids act as agonists at stereo-specific opioid receptors at presynaptic and postsynaptic sites in the central nervous system.

Existence of the opioid in the ionised state appears to be necessary for strong binding at the anionic opioid receptor site.

The principal effect of opioid receptor activation is a decrease in neurotransmission at presynaptic site. The intracellular biochemical events initiated by occupation of opioid receptors with an opioid agonist are characterized by increased potassium conductance leading to hyperpolarization, calcium channel activation, or both, which produce an immediate decrease in neurotransmitter release.

Opioid receptors exist on the peripheral ends of primary afferent neurons and their activation may either directly decrease neurotransmission or inhibit the release of excitatory neurotransmitter such as substance P.

Placement of opioids in the epidural or subarachnoid space produces analgesia which is specific for visceral pain rather than somatic pain. Lipophylic opioids have got faster onset of actions and faster elimination compare to hydrophilic opioids.[14]

Classificaiton of neuraxial drugs used to augment regional anaesthesia:[16]

I. Opioids

a. Non-lipophilic: Morphine (commonest)

b. Lipophilic: Fentanyl(commonest)

Sufentanil,

Alfentanil,

PethidineHydromorphine,

Diacetylmorphine

Buprenorphine, Butorphanol

II. Non-opioids

a. α_2 – adrenergic agonists : Clonidine, ST9,tizanidine

b. Anticholinesterases :Neostigmine

c. Benzodiazepine :Midazolam

d. Steroids : Methylprednisolone

e. Ketamine

f. Endogenous neucleosides: Adenosine (experimental inrats)

g. Miscellaneous: Tenoxicam, somatostatin, octreotide,droperidol,Calcitonin

Side effects of neuraxial opioids

- Pruritus
- Nausea and vomiting
- Urinary retention
- Depression of ventilation
- Sedation
- Central nervous system excitation
- Viral reactivation
- Neonatal morbidity
- Sexual dysfunction
- Ocular dysfunction
- Gastrointestinal dysfunction
- Thermo regulatory dysfunction
- Water retention

Factors that increase the risk of depression of ventilation

- High opioid dose
- Low lipid solubility of opioids
- Concomittant administration of parenteral opioids or other sedation.
- Lack of opioid tolerance
- Advanced age
- Patient position
- Increased intrathoracic pressure.

Opioids have the synergistic interaction with local anaesthetics which affect the duration of analgesia. The advantageous of synergism are

- Greater spinal anaesthesia successrate.
- Faster onset of surgical block than LA alone.
- Improved intraoperative analgesia (enhances sensory block without increased motor block).
- Permits lower LA dose with faster recovery from spinal anaesthesia.
- Postoperative analgesia beyond the duration of LA motor block.
- Less nausea and / or vomiting during caesarean delivery.[16]

PHARMACOLOGY

Fentanyl Pharmacology

Fentanyl is a potent lipophilic synthetic opioid, μ receptor agonist with a short onset time and moderate duration of action. Fentanyl citrate is the synthetic parent opioid from which sufentanil and alfentanil are derived.

Chemistry

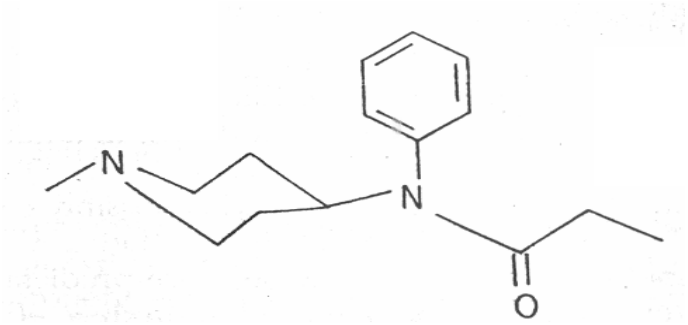
Fentanyl citrate (sublimaze, durageric, duragesic)

$C_{22}H_{28}N_2OC_6H_8O_7$

N-phenyl-N-[1 (2-phenylethyl)-4-piperidinyl] propanamide citrate

The phenylpiperidine (synthetic) opioid fentanyl skeleton structure(Miller).

Molecular weight(freebase) 528.5(336.5)



pKa(amino) 8.43

Solubility
- inalcohol 1 in140
- inwater 1 in40

Octonol / water partition coefficient[17] 955

Fentanyl is a μ agonist. It has a more rapid onset and shorter duration of action than morphine. The greater potency and more rapid onset of action reflect the greater lipid solubility of fentanyl compared with that of morphine.

Fentanyl produces dose related analgesia. Small doses of 0.5-3.0μgkg^{-1} may be used as a supplement in spontaneously breathing anaesthetized patients. Doses of 5.0μgkg^{-1} upward will suppress somatic and autonomic responses to surgical stimulation in ventilated patients.

Doses of 50μgkg^{-1} in conjunction with muscle relaxant and mechanical ventilation, may be used to induce and maintain anaesthesia.

Fentanyl is a potent respiratory depressant and reduces brain stem respiratory responsiveness to CO_2 and peripheral chemoreceptor input during hypoxemia.

Fentanyl exerts minimal effects on the circulation. There is a vagally mediated bradycardia and a slight fall in systemic vascular resistance.

Skeletal muscle rigidity and clonic movements can hinder mechanical ventilation. This effect is reversed by naloxone and overcome by neuromuscular blocking drugs. Rigidity may also occur during emergence from anaesthesia.
High dose fentanyl obtunds the metabolic and hormonal response to surgery.

There is a reduction in metabolic activity following fentanyl and hence in oxygen consumption. Nausea and vomiting are the result of stimulation of the chemoreceptor trigger zone. Cough suppression, pupillary constriction and itching of the nose also occur.

Fentanyl has been found to significantly increase intracranial pressure in patients with severe head injury. Fentanyl also significantly decreases cerebral perfusion pressure.

Fentanyl may cause a rise in biliary intraluminal pressure.

Fentanyl will reduce intraocular pressure independent of changes in arterial blood pressure.

Effect of fentanyl in obstretics patients

Specific concern regarding the use of opioids in obstretics include the questions of opioid induced reproductive or teratogenic actions and the maternal, fetal and newborn consequences of the use of opioids during and after labour and delivery.

Teratogenic action of opioids including fentanyl in animal models appears to be minimal (Miller).[15]

Because of high lipid solubility fentanyl gets transferred across the placenta. Fentanyl (50-100μg) is devoid of action on uterine blood flow and uterine tone in sheep. Fentanyl (50-100μg IV) results in less nausea, vomiting and sedation in the mother and lower nalaxone requirement in newborn.

Although fentanyl concentrates in breast milk, milk to plasma ratio of 2 to 3.1 newborn exposure is reported to be insignificant.

True allergic reactions to opioids are rare. Papaveretum, fentanyl and meperidine shows anaphylactic type reactions very rarely.

Relative contraindications for fentanyl are

1. Hypovolemia
2. Respiratory inadequacy
3. Raised ICP

Pharmacokinetics

A three-compartment model is typically used to describe plasma fentanyl concentration decay. The lungs exert a significant first pass effect and transiently take up approximately 75 percent of an injected dose of fentanyl.[15]

As is typical of the fentanyl both volume of distribution (3-6Lkg^{-1}) and clearance (10-20 mlkg^{-1}min^{-1}) are high.

Approximately 80% of fentanyl is bound to plasma proteins, and significant amount (40%) are taken up by red blood cells. As the pKa of fentanyl is high (8.4) at physiologic pH, it exists mostly in the ionized form (> 90%). Fentanyl's lipid solubility is also high, a finding that explains in part its large volume of distribution. The tissue/blood partition coefficient of fentanyl is found to be 2-30 fold higher than those of alfentanil. Because fentanyl is distributed so widely in the body, it must ultimately be returned to the blood to be metabolized in the liver. Fentanyl is relatively long acting, in large part because of its widespread distribution in body tissues.[15]

Fentanyl is primarily metabolized in the liver by β-dealkylation and hydroxylation. Fentanyl has a high hepatic clearance (approaching hepatic blood flow) and a high hepatic extraction ratio (approaching 1.0). Metabolism begins to appearintheplasmaasearlyas1.5minafterinjection.Norfentanyl,theprimary

metabolite, is detectable in the urine for upto 48 hours after IV fentanyl in humans. The activity of fentanyl's metabolites is unclear, but it is thought to be minimal. Little fentanyl is excreted in the urine unchanged.[15]

Factors that alter pharmacokinetics and pharmacodynamics

- **Age**: The elimination of fentanyl in neonates is prolonged. With advanced age although pharmacokinetics changes may play a minor role, pharmacodynamic differences are primarily responsible for decreased dose requirement in the elderly.
- **Weight**: Fentanyl pharmacokinetics is not grossly different in lean versus obese subjects.
- **Renal failure:** For the fentanyl congeners the clinical importance of kidney failure is less marked.
- **Hepatic failure:** Reduction in liver blood flow that result from either liver disease or some other disorder will delay the decline of fentanyl plasma concentration.
- **Cardiopulmonary bypass:** Fentanyl pharmacokinetics is extensively altered by CPB.
- **Acid-base changes:** Acidosis increase ionized fentanyl in the interstitial space, draws unionized fentanyl out of the intracellular compartment, where a 13-fold accumulation of fentanyl occurs, further augmenting opioid effects, i.e. ventilatory

  depression.

Bupivacaine Pharmacology

Bupivacaine (MARCAINE, SENSORCAINE) introduced in 1963 [2]. It was synthesized by Boat Ekenstam. It is a widely used amide local anaesthetic. Its structure is similar to that of lignocaine, except the amine containing group is a butyl piperidine. Bupivacaine is three to four times as potent as lignocaine, and considerably longer lasting. Its speed of onset is sometimes found to be marginally slower than that of lignocaine.

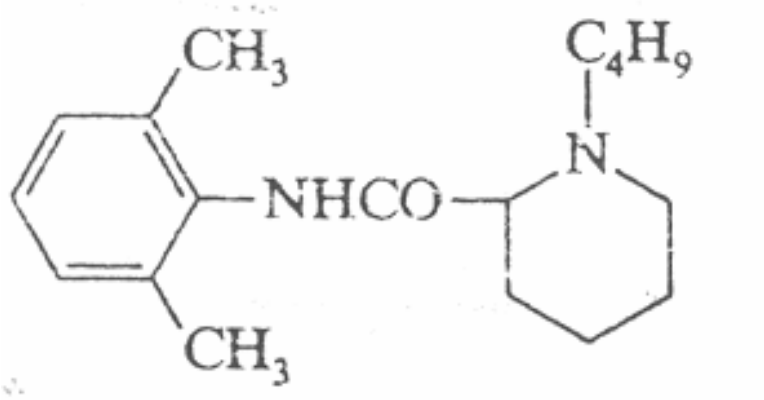
It is a potent agent capable of producing prolonged anaesthesia. Its long duration of action plus its tendency to provide more sensory block than motor block has made it a popular drug for providing prolonged analgesia during labor or postoperative period.

Chemistry

Bupivacaine hydrochloride

$C_{18}H_{28}N_2O$ HCl

(±)-1-Butyl-N-(2-6-dimethyl phenyl-2-piperidine decarboxamide hydrochloride monohydrate).



Molecular weight (free base)	: 342.9 (288.4)
PKa	: 8.1
Solubility	
in alcohol	: 1 in 8
in water	: 1 in 25
Octanol/water partition coefficient	: High
% protein binding	: 95%
Onset of action	: 10-20 min
Duration of action	: 600-700 min[15,18]

Pharmacodynamics

Like other LA, binding of bupivacaine to sites on voltage gated Na^+ channels prevents opening of the channels by inhibiting conformational changes that underlie channel activation.

During onset of and recovery from local anaesthesia, impulse blockade is incomplete, and partially blocked fibers are further inhibited by repetitive stimulation, which produces an additional dose dependent binding to Na^+ channels.

Bupivacaine has got stereo selective effect on the heart. Bupivacaine also interacts with the ion channel of the nicotinic receptor and competes for phencyclidine binding to the channel.

Bupivacaine acts to block conduction in the nerves by decreasing or preventing the permeability of resting nerve membrane to potassium as well as to sodium ions.

Bupivacaine causes a reduction of automaticity in the heart with a negative ionotropic effect.

Intravenous injection of large doses may be more likely to produce cardiac arrhythmia than is the case with other LA.

It has got less cumulative toxicity. The spread and depth of epidural and spinal anaesthesia are reported to be greater in pregnant than in non-pregnant women. This finding was originally attributed to mechanical factors associated with pregnancy; that is dilated epidural veins decrease the diameter of the epidural and subarachnoid space. Hormonal alterations may also play a role in the apparent increase in local anaesthetic sensitivity during pregnancy because a greater spread of epidural anaesthesia occurs during the first trimester of pregnancy preceding any gross change in vascular dimensions within the epidural or subarachnoid space. A correlation appears to exist between progesterone concentrations in CSF and the milligrams per segment requirement of lignocaine for spinal anaesthesia in pregnant and non-pregnant patients.

Bupivacaine is rapidly absorbed from the site of injection. About 95% of the drug is bound to plasma proteins, mainly α_1-acid glycoproteins.

Concentration in the range 0.25-0.75% are used to produce nerve blocks clinically. Although it is difficult to correlate the appearance of toxic symptoms with plasma concentration, those in excess of 2.5 mgL^{-1} are likely to produce subjective and objective systemiceffects.[15]

Pharmacokinetics

The concentration of local anaesthetics in blood is determined by the amount injected, the rate of absorption from the site of injection, the rate of tissue distribution,

and the rate of biotransformation and excretion of the specific drug. Patient-related factors such as age, cardiovascular status and hepatic function influence the physiologic disposition and the resultant blood concentrations of local anaesthetics.

Though it crosses the placental barrier it has got minimal effect on foetus. New born infants have immature hepatic enzyme systems and prolonged elimination of lignocaine and bupivacaine.[14,15]

A proportion of the drug (4-10%) is excreted unchanged in the urine and the rest appears to be metabolized in the liver by N-dealkylation to produce pipecolylxylidide.

Toxicity

The ratio of the dosage required for irreversible cardiovascular collapse (CC) and the dosage that produces CNS toxicity convulsion, that is the CC/CNS ratio is lower for bupivacaine, i.e. 1.6 to 1.7 compare to lidocaine.[15]

The pregnant patient may be more sensitive to the cardiotoxic effects of bupivacaine than the non-pregnant patient.

Cardiac resuscitation is more difficult following bupivacaine induced cardiovascular collapse.

Acidosis and hypoxia markedly potentiate the cardio toxicity of bupivacaine.

AIM OF THE STUDY :

The aim of this study is to compare the effects of hyperbaric bupivacaine 0.5% alone versus hyperbaric bupivacaine 0.5% + fentanyl 25mcg in spinal anaesthesia in patients undergoing LSCS.

Objectives

Primary Objectives

- To compare the onset and duration of sensory and motor block.
- To compare the quality of intra-operative surgical anaesthesia.

Secondary Objectives

- To compare the analgesic requirements during early postoperative period
- To compare side effects like nausea, vomiting, respiratory depression, shivering, pruritis, etc. if any.

REVIEW OF LITERATURE:

Gary M. Stocks,Stephen P. Hallworth, Roshan Fernando, et al. (2001), conducted a double-blind, randomized, prospective study, aimed to determine the median effective dose (ED50) of intrathecal bupivacaine and then use this to assess the effect of different doses of fentanyl , 124 parturients receiving combined spinal epidural analgesia at 2–6-cm cervical dilatation were allocated to one of four groups to receive bupivacaine 2.5 mg alone or with 5, 15, or 25 mcg fentanyl,. Under the conditions of this study, the addition of intrathecal fentanyl 5 mcg offers a similar significant bupivacaine dose-sparing effect as 15 and 25 mcg. Analgesia in the first stage of labor can be achieved using lower doses of fentanyl, resulting in less pruritus but with a shortening of duration of action. .[1]

Sarvela, P. Johanna,Halonen, Pekka M, Korttila,et, al. (1999) conducted a double-blinded trial on 76 parturients, to receive spinal anesthesia with either hyperbaric or plain bupivacaine 9 mg with fentanyl 20 mcg for elective cesarean delivery. The onset and duration of anesthesia, analgesia, and absence of cold sensation and motor block were measured until recovery from the motor block. No major differences were seen in onset or duration of anesthesia between the groups. The median time for the anesthesia to reach dermatome T5 was 10 min. 9 mg of either plain or hyperbaric bupivacaine with fentanyl intrathecally provided similar onset, depth, and duration of sensory anesthesia for cesarean delivery with good maternal satisfaction. Motor block developed and diminished faster with the hyperbaric solution. ($P < 0.05$) .[2]

Uma srivastav,Aditya Kumar, Gandhi NK, et, al.(2004) conducted a study toanalyzed the impact of hyperbaric and plain bupivacaine with fentanyl with respect to the level of sensory and motar block, nature of intraoperative sedation, symptoms and postoperative absence of pain. 60 ladies going through caesarean section were randomized to receive 10 mg (2 ml) of bupivacaine plain or with 25mcg of additive fentanyl for spinal anaesthesia. No distinction was seen in the beginning time, level and recuperation time of sensory block. Recovery from the motor block was somewhat prolonged in the plain group. The rate of cases requiring ketamine supplement, due to inadequate block and time of the post operative of pain relief was same in both the groups. The symptoms were likewise comparable in both the groups aside from the lower systolic blood pressure in hyperbaric group. The neonatal result was unaffected. Taking everything into account, no difference was observed in the two groups in spite of different densities suggesting that the spread of spinal solution is not dependent on density in patients undergoing caesarean section.[3]

Venkata HG, Pasupuleti S, Pabba UG, et, al. (2015) undertooka double-blinded, randomized, controlled prospective study to compare the effects on hemodynamics and duration of analgesia with a low dose (7.5 mg) bupivacaine fentanyl mixture to a conventional dose (10 mg) of hyperbaric bupivacaine for cesarean sectionon on 50 singleton parturients. It was concluded that the combination of low dose bupivacaine and fentanyl is hemodynamically more stable and prolonged duration of analgesiain comparison to bupivacaine alone. .[4]

Patel D,Mankad PP, Bansal SG, et, al. (2014) conducted a study to evaluate the safe dose of fentanyl added to Bupivacaine 0.125% and its effect on quality and duration of analgesia with side-effects was undertaken. Patients in Group A (n=15) received

Bupivacaine 0.125 percent; Group B (n=15) and C (n=15) received the same agents as Group A but with addition to the initial dose of 2 mcg/ml or 4 mcg/ml of fentanyl respectively. All the patients were evaluated for duration and quality of analgesia, duration of labour, method of delivery and side effects. It was concluded that addition of either 2 mcg/ml or 4mcg/ml of fentanyl resulted in longer duration of analgesia and also decreased number of top up doses significantly. Quality of analgesia was better in Group B and Group C as compared to Group A.[5]

Cowan CM,Kendall JB, Barclay PM, et,al. (2002) conducted a study on75 healthy parturients planned for elective Caesarean section under spinal anaesthesia using hyperbaric 0.5% bupivacaine, were randomly selected to additionally receive intrathecal fentanyl 20 micrograms, diamorphine 300 micrograms or 0.9% saline. Patients were also administered i.v.cyclizine and rectal diclofenac.. This study concluded that intrathecalopiods reduce intraoperative discomfort but only diamorphine reduced need for postoperative analgesic beyond the immediate postoperative period.[6]

ObaraM,Sawamura S, Satoh Yet,al. (2003), In a randomized controlled study, 24 healthy parturients scheduled for elective Cesarean section were given either fentanyl 0.3 ml (15 micrograms) or 0.9% saline 0.3 ml added to 0.5% hyperbaric bupivacaine 2.0 mlintrathecally in the right decubitus position (n = 12 in each group). Level of sensory blockade was evaluated with cold test. Use of intraoperative antiemetics and analgesics was recorded. The study concluded that addition of intrathecal fentanyl with hyperbaric bupivacaine in patients undergoing caesarean section improved quality of anaesthesia without producing any significant side effects.[7]

BograJ,Arora N, Srivastava P (2005) undertook a prospective single-blind study where 120 parturients were divided into six groups B_8, B_{10} and $B_{12.5}$ received 8,10 and 12.5 mg of bupivacaine mg and FB_8, FB_{10} and $FB_{12.5}$ received a combination of 12.5 μgintrathecal fentanyl and bupivacaine respectively. The parameters considered were visceral pain, hemodynamic stability, intraoperative sedation, intraoperative and postoperative shivering, and postoperative pain. The study concluded that fentanyl potentiates the effects of bupivacaine in spinal anaesthesia for caesarean section, and also that fentanyl can reduce the dose of bupivacaine and therefore its harmful effect.[8]

Intrathecal opioids potentiate local anesthetics and intensify the sensory block without increasing sympathetic block. The combination makes allows to achieve spinal anaesthesia with very low doses of local anaesthetics.[13]

Fentanyl is a lipophilic opioid, it has a rapid onset of action after intrathecal administration, and improves the quality of intraoperative analgesia. It also provide postoperative pain relief for longer duration. It does not cause delayed respiratory depression.

Biswas B N. et al.[19] (2002) studied forty healthy women of ASA Grade I posted for elective caesarean section. Twenty women in ‘Group A’ received 2 ml of 0.5% inj bupivacaine (hyperbaric) with 0.25 ml of normalsaline.

Twenty other women in 'Group B' received 0.25 ml (12.5 μg) fentanyl with 2 ml of 0.5% inj bupivacaine (hyperbaric).

Patients were preloaded with 15 ml kg^{-1} Ringers lactate solution before spinal anaesthesia.Pulse rate, blood pressure, respiratory rate and foetal heart rate were recorded.

The onset and duration of sensory block was assessed by pinprick method. Time taken from intrathecal injection to the highest level of sensory block and sensory regression to the L_1 dermatome wasrecorded.

The onset and duration of motor block was noted. Motor block was graded as per Bromagescore .

A standard 10 cm linear visual analog scale (VAS)was used to evaluate pain. The duration of complete analgesia and time of effective analgesia were noted.

Vital parameters and adverse effects such as, pruritus, nausea, vomiting, shivering were recorded. Initially every 2 minutes for 20 minutes, then every 15 minutes till end of operation and thereafter every 30 minutes until patient complained of pain. APGAR scores were noted at 1 and 5 minutes after delivery of baby.

The highest sensory level achieved were T_7 (T_6-T_8) in group A and T_5 (T_4-T_6)in group B. In fentanyl group the time for sensory level to regression to L_1 dermatome was delayed but duration of motor blocks was not delayed.

Complete analgesia lasted longer in group B (fentanyl group) for 183 ± 9 min compared with group A (bupivacaine alone) 129 ± 9.5 min.

There were no differences in the number of patients experiencing episodes of bradycardiahypotensionand respiratory depression. Hence it was concluded that12.5 μg of fentanyl added with hyperbaric 0.5% bupivacaine for spinal anaesthesia would markedly improve the intraoperative anaesthesia and significantly reduced the demandforpostoperativeanalgesiawithgoodmaternalsatisfactionandfoetalwellbeing

.**Catherine O. Hunt et al.**[8](1989) conducted a study on fifty six ASA gradeI patients planned for, repeat caesarean section. They were preloaded with 1.5L of RL. 0, 2.5, 5, 6.25, 12.5, 25, 37.5 or 50 μg of fentanyl was taken and normal saine added to it, to make total volume of injection 1 ml. Which was injected after free CSF was aspirated. The dose of fentanyl was chosen randomly. Immediately, a dose of 0.75% bupivacaine in 8.25% dextrose was administered as per the patient's height. A dose of 1ml for 5 feet tall patient with addition of 0.1 ml for every 1 inch increase in height was given.

After intrathecal injection blood pressure, pulse rate, respiratory rate, sensory level by pinprick, motor block, pain score and occurrence of side effects were recorded every 2 min for first 12 min and then at 15, 30, 45 and 60 min after injection. Thereafter at 30 min intervals until the patient complained of pain. Motor block was assessed with the Bromage score. Pain was evaluated using a 10 cm linear

visual analog scale. The side effects noted were pruritus, somnolence, nausea, shivering, euphoria or dysphoria and chest tightness.

At the time of delivery, maternal vein, umbilical artery and vein blood samples were obtained for blood gas analysis. APGAR score at 1 and 5 min were recorded. Neonatal neurobehaviour assessment was done with the early neonatal neurobehavioural scale between 2 and 4 hours of life and again between 46 and 48 hours of life.

There was no significant difference in the onset time of sensory or motor block between the groups. All patients had a T_4 sensory level and complete motor blockade within 10 min of injection. The number of segment regressed at 60 min was prolonged in the 50 μg fentanyl group compared with bupivacaine alone group.

The duration of complete analgesia was 33.7 ± 30.8 minutes in the bupivacaine group. All patients in the control group reported a pain score greater than 0 during surgery following delivery of the infant. The addition of 2.5 μg or 5 μg of fentanyl caused a slight but insignificant increase in the duration of complete analgesia to 73.2 ± 24.6 and 81.5 ± 57.9 mins, respectively. Whereas with the addition of 6.25 μg of fentanyl, complete analgesia was significantly increased to 130 ± 30 min. Increasing the dose of fentanyl above 6.25 μg did not further increase the duration of complete analgesia.

No significant differences in umbilical vein or arterial blood gases between groups was noted. All blood gases were within normal limits. APGAR scores at 1 min were 7 or better in all but one infants.

It was concluded that the addition of 6.25μg fentanyl to hyperbaric bupivacaine for spinal anaesthesia improves the immediate postoperative analgesia. The optimum dose of fentanyl was 6.25μg as higher doses did not further increase the duration of analgesia.

Belzarena Sergio D et al.[4](1990) studied one hundred twenty patients scheduled for elective caesarean delivery. The patients were randomly divided into four groups of 30 each. In the operating room, they were preloaded with 1000 ml of RL solution before administration of spinal anaesthesia. Once free flow of CSF was established, in the sitting position 3 ml (15 mg) of 0.5% hyperbaric bupivacaine was injected and immediately followed with 2 ml of a solution containing either 0 (group 0), 0.25 mg (group 25), 0.5 mg (group 50) or 0.75 mg (group 75) offentanyl respectively.

The patients were then placed in the supine position with left uterine displacement. All injections were given by the investigator who was blinded to the solution used.

Every 2 mins blood pressure, heart rate, respiratory rate were measured until delivery and at 5 min intervals till end of the surgery. Sensory block level was evaluated at 5, 10, 15, 30 and 60 min after injection by pinprick method. Surgical anaesthesia was graded as excellent if there were no complaints

from the patient at any time during the surgery, good when there was minimal pain and which was relieved by small doses of intravenous opioids (0.1mg of fentanyl) and poor when larger doses of opioids or general anaesthesia had to be administered.

The level of consciousness was noted and it was recorded as “awake and nervous”, “awake and calm”, “sleepy and easily arousable” and “sleepy and difficult to arouse”. Side effects were such as nausea; vomiting, pruritus and dizziness were noted.

APGAR scores of the neonates were recorded at 1 and 5 min after birth.

After surgery patients remained in the recovery room for 24 hrs. There blood pressure, pulse rate and respiratory rate were recorded every 15 min for 2 hrs and then hourly for 24 hrs. Respiratory depression was defined as respiratory rate less than 10 breaths min^{-1} or $PaCO_2$> 50 mm Hg, which was assessed by arterial blood gas analysis once before induction another once at 24 hr after induction.

As the dose of fentanyl increased, regression of anaesthesia to the T_{12} dermatome took longer. All patients recovered by 240 min after injection. With increasing doses of fentanyl administered Effective postoperative analgesia lasted significantly longer. Group 0 (197 ± 77 min), group 25 (305 ± 89 min),

group 50 (640 ± 142 min) and group 75 (787 ± 161 min). Neonatal status in all groups was the same. The main side effects were pruritis and sedation.

They thus concluded that the combination of bupivacaine and a low dose offentanyl(0.25mg)providesgoodsurgicalanaesthesiawithshortduration of

postoperative pain relief and few side effects. As the dose of fentanyl increased to 0.5 or 0.75 mg duration of postoperative pain relief is prolonged, but the incidence of adverse effects also increases and respiratory changes also occur.

Sahar M SiddikSayyidet al.[10](2002) conducted a study on 48 parturients scheduled for elective caesarean delivery. Patients were randomized double blinded. Patients were all classified as ASA physical status of I and II and had no contraindication to spinal anaesthesia.

The 48 subjects were allocated into two groups by using sealed envelope technique. The IT fentanyl group received 12 mg hyperbaric bupivacaine 0.75% and 12.5 μg of IT fentanyl (23 patients). The IV fentanyl group received 12 mg of hyperbaric bupivacaine 0.75% alone (25 patients), mix with CSF to achieve the same volume.

In the OT room patient preloaded with 500 ml of polygeline (hemacel). LP was done in sitting posture. Immediately after intrathecal drug administration, 12.5μg inj fentanyl IV was given in the IV fentanyl group. Immediately after SAB patient was put in a supine position with 15°-20° left lateral tilt and 5L oxygen given via mask.

Blood pressure, pulse rate and $SPO_2$was measured every minute until delivery of the baby and every 3 mins intervals until the end of the surgery. When the systolic BP fell 20% below baseline 5 mg of IV ephedrine was administered. Sensory block was assessed by pinprick method until block reached T_6 dermatome, every minute. Then every 2 min till maximum leve of sensory block was achieved.

The degree of motor block was assessed with Bromage score. 10 cm linear visual analog scale (VAS)was used to evaluate pain.

Nausea, vomiting, pruritus and shivering were recorded intraoperatively. Maternal sedation was noted by using a graded score (with 0 = no sedation, 1 = mild sedation, 2 = moderate sedation and 3 = severe sedation with difficulty to arouse)., the APGAR scores were assessed at 1 and 5 minutes after delivery.

There were no significant difference between the IT fentanyl group and the IV fentanyl group with respect to age, height, weight and parity. The level of analgesia, the onset of sensory block, the sensory level upon arrival at the PACU and the time of T_{12} regression were similar in both groups. All patients reached motor block of Bromage score 3.

Intraoperative analgesic supplementationwas needed in IV fentanyl group. The mean requirement of fentanyl were 32 ± 35 μg, whereas in the IT fentanyl group ($p = 0.009$)no supplementation was required.

First request for postoperative analgesia was significantly prolonged in the IT fentanyl group compared to IV fentanyl group (159 ± 39 min versus 119 ± 44 min, $p = 0.003$).

The APGAR scores of all neonates were more than 8 at 1 min and more than 9 at 5 min.

It was thus concluded that supplementation of IT fentanyl with bupivacaine during caesarean delivery produces a better quality of spinal anaesthesia thanIVfentanylofsamedose.Thiswasproven byno requirementforadditional

intraoperative analgesia, a lower VAS before delivery and a longer time to first request for analgesia. Additionally, the IT fentanyl group showed lesser incidence of side effects such as severe hypotension, nausea and vomiting.

Uma Srivastavaet al.[1](2004) conducted a study on sixty women of ASA Grade I patients who were undergoing elective/semielective caesarean section. Patients were divided into two groups of 30 each. Patients were premedicated with IVinj ranitidine and inj metaclopromide 30-45 minutes before operation. They were preloaded with 500 ml of Ringers lactate solution. The patients were administered 10 mg (2 ml) of bupivacaine as hyperbaric or plain solution with 25 μg of preservative free fentanyl for spinalanaesthesia.

Sensory block was assessed using pinprick method. Motor block was assessed using modified Bromage score. Sensory and motor assessments were done at 1 and 2 mins initialy, and at 2.5mins there after till the level stabilized. The operation was started when the upper dermatomal level of loss of sensation to pin prick was at or above T_6. The patients who complained of moderate to severe pain were given IV bolus of 10 mg ketamine and repeated if pain was not relieved after 5 min. patients who required two or more doses of ketamine were labelled as failed block.

No significant difference in vital parameters, speed of onset of sensory block and time to highest sensory block was noted. The onset and recovery from motor block was delayed in plain group but the difference was not statistically significant.

Three patients required intraoperative supplementation of ketamine in hyperbaric bupivacaine group and 5 patients in plain bupivacaine group. Nausea, vomiting and pruritus occurred with similar frequency in both the groups except for the lowered systolic BP in hyperbaric group. APGAR score at 1 and 5 min in both the groups was unaffected.

Both plain and hyperbaric solution with fentanyl provided satisfactory surgical anaesthesia and postoperative analgesia. Motor block was slightly prolonged in plain group, but neonatal outcome was good in both groups.

It was concluded that spread of spinal solution containing bupivacaine and fentanyl is not dependent on the baricity in full term pregnant patient.

Chir Duck-Hwan et al.[3] (1999) studied sixty healthy term parturients planned for elective caesarean section. Patients were randomly received 8, 10 or 12 mg of 0.5% hyperbaric bupivacaine intrathecally, which was mixed with 10 μg of fentanyl. Intraoperative analgesia was checked with the visual analog scale. Sensory blockade variable such as time to T_4 block, maximum block height, time to maxima block height, degree of motor block and muscle relaxation were assessed. Side effects and time of regression to T_{10}, complete motor recovery and start of postoperative pain were also checked.

No patients had intraoperative pain. The time to sensory block to T_4 and the level of maximum sensory block were not significantly different between the three groups. Complete motor block was significantly less in the 8mg group (70%) compared to the 10mg and 12mg groups (100%). However excellent muscle

relaxation was obtained in all three groups. There were no significant differences in the side effects but the sensory and motor recovery and the start of postoperative pain appeared faster in the 8 mg group ($p < 0.05$).

Hence they concluded that mixing 10 μg fentanyl, with 8 mg of 0.5%, hyperbaric bupivacaine was sufficient for spinal anaesthesia in caesarean section.

Ben David B Miller et al.[7](2000) studied the effect of combination of low dose of bupivacaine and fentanyl in spinal anaesthesia for caesarean delivery, causing less incidences of hypotension. Patients were divided two groups of 32 women each scheduled for caesarean delivery. One group received intrathecal injection of 10 mg isobaric (plain) bupivacaine 0.5% and the other 5 mg of isobaric bupivacaine with 25μg fentanyl added. Systolic BP recorded less than 95mmHg or a decrease in systolic BP of greater than 25% from baseline was considered as hypotension and treated with a bolus of 5 to 10 mg of IV ephedrine.

Results: Spinal block provided surgical anaesthesia in patients. Peak sensory level was higher (T_3 vs. $T_{4,5}$) and intensity of motor block was greater in the plain bupivacaine group. Patients given bupivacaine alone required treatment for hypotention (94% vs. 3%) and had more persistent hypotension (4.8 vs. 0.6 hypotensive measurement per patient) compared to patients given minidose bupivacaine-fentanyl . Mean ephedrine requirements were 23.8 mg and 2.8 mg for the two groups respectively. Patients given plain bupivacaine also complained of nausea more frequently than patients given minidose bupivacaine-fentanyl group (69% vs. 31%).

Thus, they concluded that bupivacaine 5 mg with fentanyl 25 μg provided better spinal anaesthesia for caesarean delivery and with lesser hypotension, lesser vasopressor requirement and less nausea than spinal anaesthesia with 10 mg bupivacaine alone.

Benhamou et al[20](1998) conducted a study on seventy-eight pregnant women at term belonging to ASA Grade I and II planned for elective caesarean section. Spinal block was performed with hyperbaric bupivacaine alone (Group B) or combined with 75 mg of clonidine (Group BC) or with clonidine 75 mg and fentanyl 12.5 μg (Group BCF). Patients were preloaded with 20 ml kg^{-1} of Ringer lactate solution. In a sitting posture subarchnoid block given. Patients were randomised into three groups. The dose of bupivacaine was same in all groups (0.06 mg cm^{-1} of bodyheight).

The study was conducted in a double blind fashion. Analgesia was evaluated every 5 min by temperature discrimination at each dermatome level. Pain assessed by Visual Analog Scale. Motor block assessed by Bromagescale.

Clonidine increased the spread of the sensory block intraoperativey and decreased pain (pain scores 23 ± 7 mm vs. 17 ± 6 and 2 ± 1 mm in Group B versus Group BC and BCF; $p < 0.05$) and supplemental analgesics.

The clonidine-fentanyl combination provided the best analgesia (Group BC versus Group BCF; $p < 0.05$). Postoperatively analgesia was prolonged only in Group BCF (215 ± 79 min vs. 137 ± 35 and 183 ± 80 min for Group BCF

versus Group B and BC; $p < 0.05$). Hemodynamic changes were not significantly different among groups, whereas sedation and pruritus were significantly more in Group BCF. Nausea and vomiting were less frequent in Group BC and BCF. APGAR scores and umbilical artery blood pH were not different among groups. Hence they concluded that adding small dose of intrathecal clonidine tobupivacaine increases the quality of intraoperative analgesia during caesarean section. Combining clonidine with fentanyl further improved the duration of

analgesia.

Harbhej Singh et al.[21](1995) studied forty-three adult men undergoing elective surgery of lower extremity or genitourinary surgery under spinal anesthesia. Patients were randomly assigned to two groups. One was given 1.8ml (13.5mg) hyperbaric bupivacaine 0.75% + 0.5 ml CSF (Group I) and the other 1.8 ml (13.5mg) hyperbaric bupivacaine 0.75% + 0.5 ml (25μg) fentanyl (Group II). Patients were pre-loaded with 700-800ml of RL. Patients were premedicated with inj. midazolam 1-4mg IV to allay anxiety depending on the preoperative status of the patients.

The onset and duration of sensory block were assessed every two minutes bilaterally, by pinching the skin with forceps in the midclavicular line, for first twenty minutes. Then every five to ten minutes. The onset and duration of motor block were assessed and graded using Bromage score simiarly.

64% of the patients received midazolam 1-4 mg IV in the control group compared with 62% in the fentanyl treated group. The highest level of sensory anesthesia achieved was T_8 (T_{5-10})in group I and T_7 (T_{6-8}) in group II.

The time interval to achieve sensory level L_1 and sensory regression to L_1, dermatome were prolonged in patients receiving fentanyl (26% and 28% respectively; $p < 0.05$). The number of patient experiencing bradycardia, desaturation, shivering, itching or nausea between two groups was comparable. Fewer patients requested pain relief in the fentanyl treated group than in the control group in the early postoperative period (19% vs. 59% $p < 0.05$). Hypotension was more frequent in the fentanyl treated group than in the control group (43% vs. 14%; $p < 0.05$).

Hence they concluded that fentanyl 25 μg intrathecally produced a longer duration of sensory block with bupivacaine by 28% and reduced the early postoperative period analgesic requirement.

Connolly C et al.[22](2001) conducted a study on forty women (aged 18-40 years) who were undergoing elective caesarean section. Patients are of > 37 weeks of gestation, > 150 cms in height and < 110 kg weight (at the time of delivery were recruited). Patients were premedicated with ranitidine 150 mg and 0.3 M sodium citrate 30 ml, preloaded with 500 ml crystalloid solution.

Bupivacaine $5mgml^{-1}$ in glucose, $8mgml^{-1}$ has a density (1.00164 (SD 0.00008) at 37°C), which is relatively greater than that of the CSF of the pregnant patient at term (1.0003 at 21°C) because CSF density decreases during pregnancy. They conducted double blinded, randomized control study to compare intrathecal bupivacaine (glucose $8mgml^{-1}$) with bupivacaine ($80mgml^{-1}$glucose).

Although there was no difference between the groups in onset of sensory block, dose of ephedrine required for hypotension and patient satisfaction. Patient receiving bupivacaine ($5mgml^{-1}$) with glucose ($8mgml^{-1}$) had persistently higher sensory blocks between 60 and 120 min after intrathecal injection suggesting that the spread of spinal solutions in the pregnant patient at term is not depend ondensity.

Martin Cascioet al.[23](1997) conducted a study on 24 women of ASA Gr I and II, at term in active labour. Before starting the procedure baseline vital parameters recorded and venous blood sample collected. Patients were preloaded with 500 ml of RL solution. Patients were randomized into two groups. Group I (n = 12) received 25μg IT fentanyl for labour analgesia and Group II (n = 12) received 10 ml of epidural lidocaine 1.5%.

A combined spinal-epidural technique was used in the IT fentanyl group. After injecting 0.5 ml (25μg) of fentanyl to subarchnoid space spinal needle is removed and an epidural catheter was inserted without injecting any drug through catheter until patient demands for analgesia. Visual analog scores and haemodynamic variables were obtained before and at five minutes intervals for 30 min after the injection of the studydrug.

Blood samples for norepinephrine and epinephrine assay were collected in glutathione containing tubes placed in ice. The plasma was separated and kept frozen at -70°C until analysis.

The concentration of norepinephrine and epinephrine in plasma were determined using high performance liquid chromatography with electrochemical detection. Data were collected and quantified.

Age, height, body weight, parity, cervical dilatation among the patients were not varied between the groups.

Visual analog scores to pain decreased within five minutes of intrathecal fentanyl or epidural lidocaine administration and remained lower than baseline throughout the study. Maternal systolic, diastolic and mean BP decreased in both groups following analgesia. No foetal heart rate abnormality observed in both the groups. All patients in IT fentanyl group experienced pruritus, none in epidural lidocaine group.

Plasma epinephrine concentration decreased following administration of IT fentanyl or epidural lignocaine, but the percentage of decrease in IT fentanyl is 45% and in epidural lidocaine is 24% only.

The pain and anxiety associated with labour pain can cause an increase in maternal plasma catecholamine concentration.

Hence they concluded that IT fentanyl is as effective as epidural analgesia in providing pain relief for labour. Also, intrathecal fentanyl for labour analgesia leads to a decrease in circulating epinephrine concentrations in the labouring parturient which is probably due to pain relief and thus, a reduction in maternalstress.

Joel L Parlowet al.[24](1999) conducted an in vitro study to determine whether the addition of opioids alters the density and spread of intrathecal local anaesthetics.

In part I, the densities of hyperbaric bupivacaine 0.75% (HB), hyperbaric lignocaine 5% (HL) and isobaric bupivacaine 0.5% (IB) with and without morphine (M) and fentanyl (F) were measured at 22°C. In part II a model was constructed utilising a column containing a solution similar composition to cerebrospinal fluid (CSF) at 37°C. The various local anaesthetics opioid solutions, coloured with crystalline methylene blue dye, were injected at 22°C into the column at a controlled rate through a spinal needle. The direction and extent of spread of the injectates were compared.

The relative densities of the five solutions were: HB = HL > IB > M > F. The addition of fentanyl to IB reduced the density of the final solution ($p < 0.05$). In the model, IB alone and IB with morphine showed mainly downward spread, with the addition of fentanyl to IB resulting in upward movement ($p = 0.004$). The hyperbaric local anaesthetics moved downward with or without opioids.

They concluded that the addition of fentanyl reduces the density of IB in vitro and alters its movement in simulated CSF. The addition of fentanyl and morphine to local anaesthetics alters the density of the resulting solution. The addition of opioids to hyperbaric local anaesthetics had no effect on movement in simulated CSF model. The addition of fentanyl altered the direction and extent of spread of isobaric bupivacaine 0.5%, leading to movement in an upward direction. This may have clinical relevance in predicting the spread of intrathecal solutions, and the effect of altering body position on the ultimate level of block.

Buvanendran Asokumar et al.[25](1998) conducted a study on parturients to determine pruritus is a frequent complication (40-100%) of intrathecal (IT), fentanyl 25 μg (F) for labour analgesia. The addition of IT bupivacaine 2.5mg (B) to fentanyl has been reported in a nonrandomized series to have a 17.3% incidence of pruritus.

This study prospectively evaluated the incidence and distribution of pruritus in labouringparturients receiving IT F+B. Sixty-five labouringparturients were randomly assigned to receive IT, F, B or F+B as part of a combined spinal-epidural technique. Visual analog scores, sensory level, motor strength and pruritus were recorded before injection and at intervals thereafter. When present, pruritus distribution was evaluated. The duration of analgesia was determined as the time from IT drug administration until the patient requested supplemental analgesia. The median duration of analgesia in the F, B and F+B groups was 62.5, 55.0 and 94.5 min, respectively.

Compared with F alone, the combination of F+B led to a decreased frequency of pruritus (36.4% vs. 95%). The incidence of facial pruritus (25%) was same in the F+B and F groups. However, the occurrence of pruritus distributed over the rest of the body was significantly more frequent in the F compared with the F+B group. The combination of F+B prolongs the duration of labour analgesia compared with IT F or B alone. F + B also leads to a decreased incidence of pruritus, except in the facial

region.

They concluded that when administered intrathecally with fentanyl 25 μg in Laboring parturients, bupivacaine 2.5 mg attenuates the frequency of pruritus on all

parts of the body except the face and altered the distribution of pruritus in laboring parturients.

Theodore R Manullang et al.[12](2000) compared intrathecal (IT) fentanyl and IV ondansetron for preventing intraoperative nausea and vomiting during caesarean deliveries performed under spinal anaesthesia.

Thirty healthy parturients planned for elective caesarian delivery with bupivacaine spinal anaesthesia, were randomized to be given 20 μg IT fentanyl (Group F) or 4 mg IV ondansetron (Group O) by using double-blinded method. At eight specific intervals during the surgery, a blinded observer examined the patient for nausea (1 = nausea, 0 = no nausea) presence of retching or vomiting (1 = vomiting or retching, 0 = no vomiting or retching) and recorded a verbal pain score (0-10, 0 = no pain, 10 = worst pain imaginable). Cumulative nausea, vomiting and pain scores were calculated as the sum of the eight measurements. Intraoperative nausea was lesser in the IT fentanyl group compared with the IV ondonsetron group. The incidence of vomiting and treatment for vomiting was not different ($p = 0.7$). The intrathecal fentanyl group had a lesser cumulative perioperative pain score than the IV ondansetron group. The median difference in the cumulative pain score was 12 (8.16) ($p = 000078$). The IT fentanyl group required less supplementary intraoperative analgesia. The median difference in the cumulative fentanyl dose was 100 (> 75,100) μg fentanyl. ($p = 0.0002$)

They concluded that for the prevention of perioperative nausea during caesarean delivery performed under bupivacaine spinal anaesthesia, 20 μg IT fentanyl is superior to 4 mg IV ondansetron. Intrathecal fentanyl is also cost effective, has a low incidence of side effects and improved quality of surgical anaesthesia, making it an ideal drug in this setting for routine use.

MATERIALS AND METHODS

SOURCE OF DATA:

This study was carried out in the Department of Anaesthesiology, B.LD.E (DEEMED TO BE UNIVERSITY) Shri B. M. Patil Medical College, Hospital and Research Centre, Vijayapur. Study will be conducted from December 2018 to September 2020.

METHOD OF COLLECTION OF DATA:

Study Design: Prospective randomised comparative study

Study Period: One and half years from December 2018 to September 2020.

Sample Size: Total sample size 32+32=64

With Anticipated Mean Difference of mean duration of analgesia between the study groups as 45.3 min and Anticipated SD as 40.1 min the minimum sample size per group is 32 With 95% power and 1% level of significance.

By using the formula:

$$n = \frac{(z_\alpha + z_\beta)^2 2\ SD^2}{MD^2}$$

Where Z= Z statistic at a level of significance

MD= Anticipated mean difference

SD= Anticipated Standard deviation

Hence 32 cases will be included in each group.

The statistical analysis between the two groups will be compared using student's 't' test and chi-square test.

Randomization:

The study population of 64 patients age and sex matched were randomly divided by computer generated slip in to two groups with 32 patients in each group.

Group A received 0.5% Bupivacaine 2ml.

Group B received 0.5% Bupivacaine 2ml + Fentanyl 25 mcg.

Results were recorded using a preset performa.

Study group:

- After institutional committee approval and written informed consent, 64 patients posted for elective caesarean section were selected. A complete physical examination and routine investigations were done for all patients. The following parameters were monitored and recorded such as heart rate, SPO_2, noninvasive blood pressure and others (if required).

- After taking informed consent. The cases were divided into 2 groups with 32 patients in each group by computer generated slip :

- Group A – Hyperbaric bupivacaine 0.5% 2ml (10mg)
- Group B – Hyperbaric bupivacaine 0.5% 2ml (10mg) + fentanyl citrate (25mcg)

Inclusion criteria:

- Patients undergoing elective LSCS
- Patients belonging to ASA grade I and II.

Exclusion criteria:

- Patients in whom regional anaesthesia is contraindicated.
- Patients with foetal abnormalities.
- Patients with known allergy to study medication.
- Patient with H/O full stomach, Hypertension, Epilepsy.

Investigations Required :

- Hb%, TC, Platelet count.
- RBS
- Blood urea, Serum creatinine
- ECG
- Others (if required) :

Preliminaries :

- Written informed consent.
- Nil per oral status confirmed.
- Intravenous access with a 20 guage I.V cannula under aseptic precautions.

Study materials: Inj Bupivacaine 0.5% hyperbaric solution, Inj Fentanyl.

Procedure:

- 64 patients posted for LSCS were assigned randomly to 2 groups containing 32 patients each.
- All patients were examined the day before surgery and thoroughly investigated according to institute protocol and were counselled with regards to anaesthesia as well as procedure.
- Patient's meeting the above criteria were asked to participate in the study and informed consent was taken. Patients were instructed to fast for 6-8 hours.
- All the resuscitation and monitoring equipments like bag-valve-mask system, laryngoscope, endotracheal tubes and emergency drugs were kept ready in the operation theatre for management of any adverse event.
- On the day of operation, patient were taken to operation theatre. Baseline values of Blood pressure, Heart rate and oxygen saturation were recorded.
- Intravenous line were secured with 20G cannula and premedication i.eInj.Ondensetron 4mg given.

- The patient were placed in the left lateral position on the operating table. The back cleaned with betadine and spirit. The area draped with a sterile towel L3 – L4 space identified and lumbar subarachnoid block was performed, using a 26 guage Quincke-Babcock spinal needle. After confirming free flow of CSF the drug was injected slowly at a rate of 0.25 ml per second.

ANAESTHESIA FEATURES ASSESSED :

- The time of onset of sensory analgesia at T10 segment.

This is the time taken to achieve analgesia at T10 dermatome assessed by pin prick method.

- Maximum level of analgesia

This is the highest level of sensory block as assessed by pinprick method.

- Degree of motor blockade.

  Motar blockade is assessed using modified Bromage score.

Modified Bromage Scale:

0 - Able to perform a full straight leg raise over the bed for 5sec.
1 - Unable to perform a leg raise but can flex the leg on knee.
2 - Unable to flex knee but can flex ankle.
3 - Unable to flex ankle. Unable to move toes.

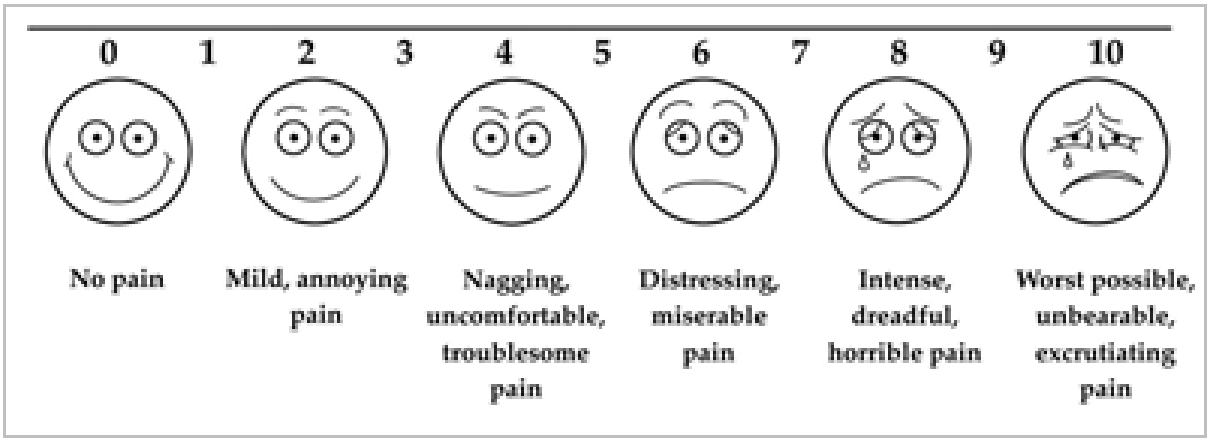
After the block patient will be monitored for pulse rate and blood pressure every 2mins initially for 10 min and then every 15 min up to one hour and every 30 min thereafter, till the sensory block regresses to L1.

- Duration of effective analgesia.

  This is taken as the time interval between injection of spinal drug to first reports of pain.

ASSESSMENT OF PAIN: Pain was assessed using visual analogue scale. VAS consist of a 10 cm line anchored at one end by a label such as “NO PAIN” and at other end by a label “WORST PAIN IMAGINABLE”. The patient simply marks the line to indicate the pain intensity and the

provider then measures the length of line to mark a point scale. All the patients were instructed about VAS and to point out the intensity of pain on the scale.



0-NO PAIN, 10-WORST PAIN.

Rescue analgesia was given with injection Diclofenac 1.5mg/kg IV infusion in 100ml normal saline and time of rescue analgesia was noted.

- Cardiovascular/ hemodynamic status.

Bradycardia: A pulse rate of less than 60 beats per minute is considered bradycardia and it was treated with injection atropine 0.6mg IV bolus.

Hypotension: A systolic blood pressure of less than 90 mmHg or decrease in 20% below the base line systolic blood pressure is considered hypotension. It was treated with rapid infusion of IV fluids. Oxygenation via face mask, foot end elevation and injection ephedrine in incremental doses of 6mg IV bolus.

- Any complications or side effects like nausea, vomiting, respiratory depression, shivering, pruritus, etc. if any, were noted.

RESULTS

The study population consists of 64 female patients posted for lower segment caesarean section delivery. They were divided into two groups of 32each.

Group I received 0.5% hyperbaric bupivacaine 10 mg (2cc) intrathecally.

Group II received 0.5% hyperbaric bupivacaine 10 mg (2cc) + 25μg of fentanyl intrathecally.

The following observations were made during the course of the study.

ABRIVIASIONS

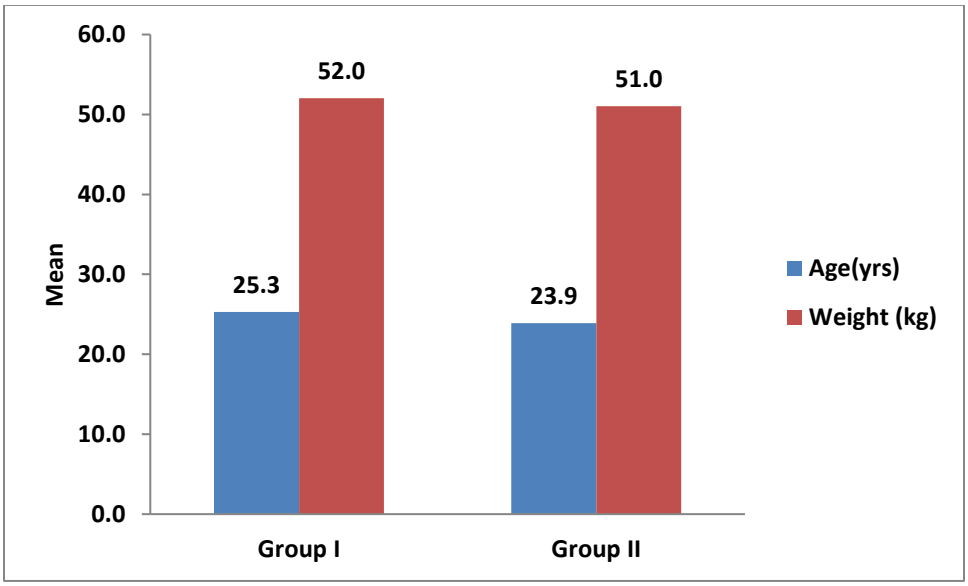
TOSA	Time of onset of sensory analgesia upto T_{10}
HSLA	Highest sensory level of analgesia achieved
TTAHLSA	Time taken to achieve highest level of sensory analgesia
TTSR	Time of two segment regression
TDEA	Total duration of effective analgesia
TSR to L_1	Time of sensory regression to L_1
TWPRA	Time when patient requested for analgesia
TDSA	Total duration of sensory analgesia
TOMB	Time of onset of motor blockade
QMBBS	Quality of motor blockade in Bromage Scale
TCMR	Time of complete motor recovery

Table 1: Age and weight distribution

Parameters	Group I		Group II		p value
	Mean	SD	Mean	SD	
Age(yrs)	25.3	4.6	23.9	4.2	0.216
Weight (kg)	52.0	1.6	51.0	2.1	0.879

p> 0.05 not significant

Figure 1: Age and weight distribution.



All patients posted for caesarean section and were in the age group between 18-35 years.

The mean age in Group I was 25.3 ± 4.6 years and in Group II was 23.9 ± 4.2 years.

The difference in the mean age was not statistically significant (p > 0.05). The two groups were more or less homogeneous.

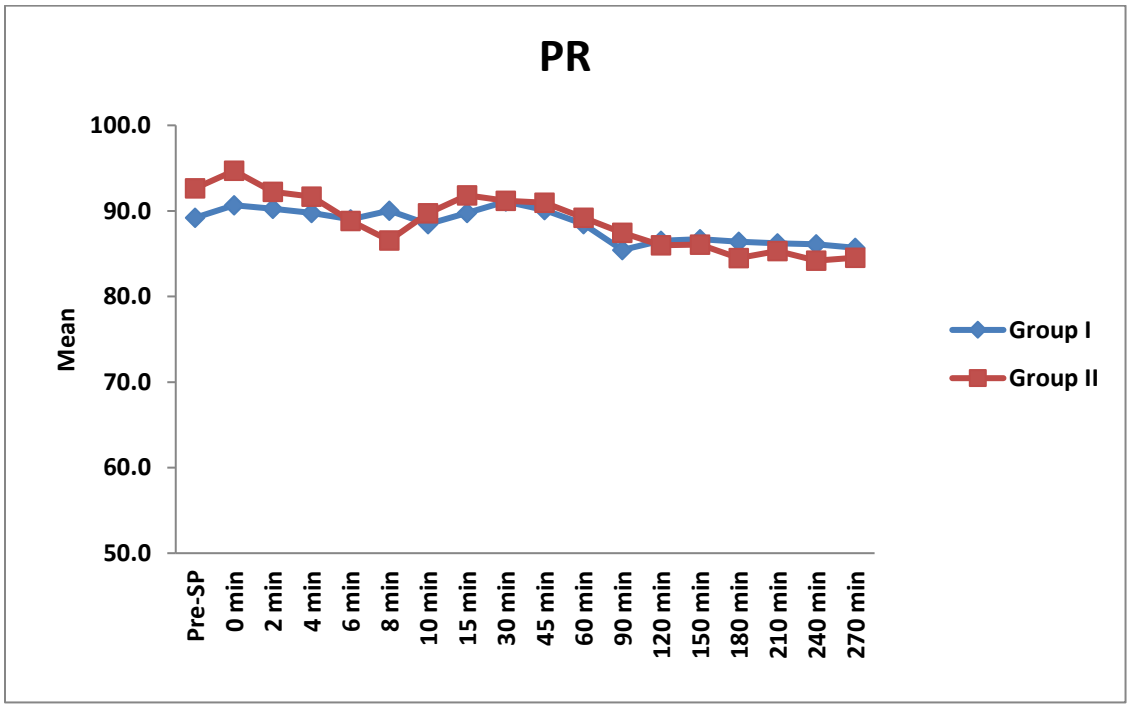
The weight between Group I and Group II was almost same. The difference in the mean weight was not statistically significant ($p > 0.05$)

Hemodynamic parameter

Table 2: Change in mean PR between Study Groups over the time

PR	Group I		Group II		p value
	Mean	SD	Mean	SD	
Pre-SP	89.2	9.9	92.7	10.3	0.178
0 min	90.7	9.6	94.7	9.0	0.088
2 min	90.3	11.0	92.2	10.4	0.466
4 min	89.8	11.8	91.7	10.1	0.490
6 min	89.0	11.6	88.8	11.2	0.957
8 min	90.0	10.5	86.6	11.8	0.218
10 min	88.5	9.9	89.7	10.7	0.629
15 min	89.8	8.3	91.8	10.2	0.378
30 min	91.1	8.1	91.2	8.0	0.963
45 min	90.1	9.3	91.0	7.8	0.685
60 min	88.4	8.6	89.2	6.4	0.681
90 min	85.4	17.9	87.4	6.2	0.553
120 min	86.5	7.5	86.0	6.2	0.772
150 min	86.7	8.1	86.1	4.7	0.355
180 min	86.4	5.8	84.5	5.2	0.172
210 min	86.2	5.6	85.3	4.5	0.478
240 min	86.1	4.6	84.2	4.8	0.109
270 min	85.7	4.8	84.5	4.4	0.319

Figure 2: Change in mean PR between Study Groups over the time



There were no significant haemodynamic alterations in cardiovascular parameters.

The mean value of pulse rate changes per minute recorded in Group I and Group II were almost similar statistically not significant.

Table 3: Change in mean SBP between Study Groups over the time

SBP	Group I		Group II		p value
	Mean	SD	Mean	SD	
Pre-SP	121.1	8.0	122.8	7.9	0.409
0 min	118.5	9.8	117.9	10.2	0.803
2 min	115.4	9.4	113.5	7.6	0.362
4 min	112.4	10.3	109.7	9.9	0.292
6 min	112.3	8.0	112.0	7.4	0.898
8 min	111.9	8.7	112.6	8.2	0.746
10 min	112.5	8.8	114.2	8.8	0.453
15 min	113.9	8.5	112.9	8.1	0.631
30 min	116.3	7.6	112.7	8.0	0.063
45 min	117.3	7.3	114.5	7.4	0.139
60 min	116.8	8.3	116.9	8.2	0.928
90 min	116.4	8.8	116.8	7.5	0.867
120 min	117.9	7.5	117.7	7.7	0.882
150 min	118.5	7.0	117.0	6.9	0.400
180 min	119.1	5.3	118.4	5.9	0.658
210 min	119.9	4.9	119.0	5.1	0.471
240 min	120.1	4.8	119.3	5.6	0.567
270 min	120.2	4.9	120.8	5.4	0.663

Figure 3: Change in mean SBP between Study Groups over the time

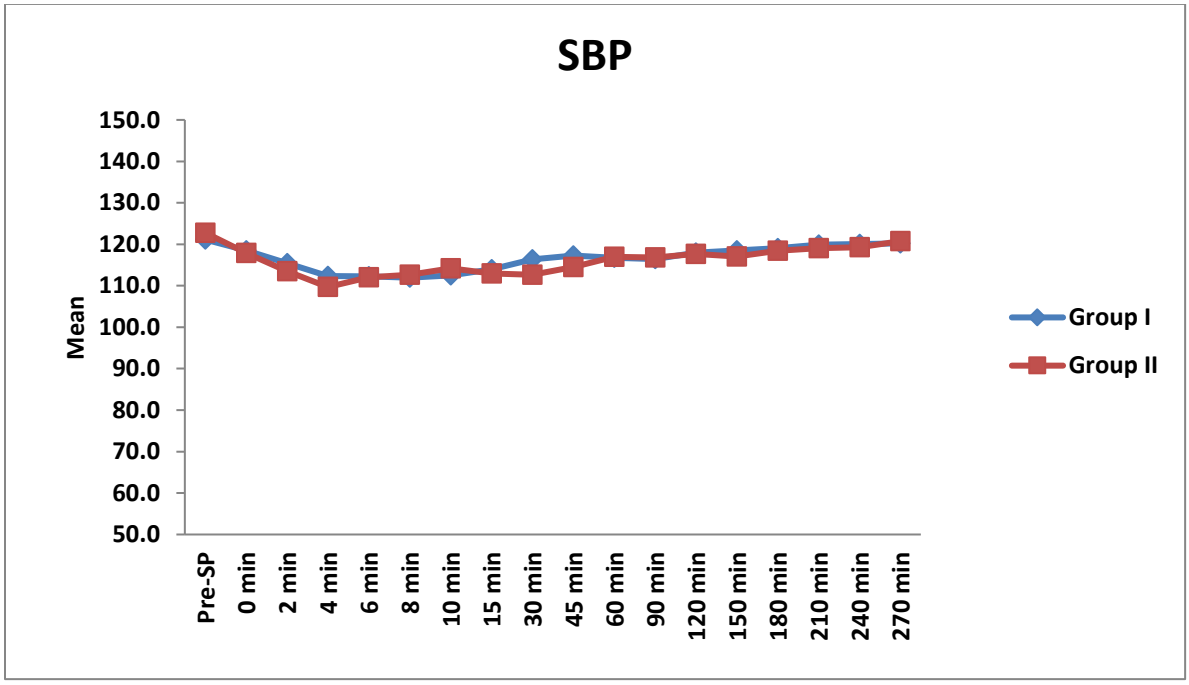


Table 4: Change in mean DBP between Study Groups over the time

DBP	Group I		Group II		p value
	Mean	SD	Mean	SD	
Pre-SP	79.6	6.6	79.1	7.2	0.759
0 min	75.1	9.9	74.5	9.0	0.803
2 min	72.7	10.4	70.3	11.3	0.396
4 min	68.6	12.1	70.0	10.2	0.616
6 min	71.6	7.7	69.2	8.2	0.229
8 min	70.7	9.1	69.5	8.8	0.598
10 min	71.6	7.9	70.0	9.5	0.853
15 min	71.0	7.4	68.5	6.7	0.412
30 min	71.6	7.9	67.4	8.5	0.043
45 min	72.1	7.0	71.0	8.1	0.565
60 min	74.0	7.4	73.6	8.6	0.840
90 min	76.4	7.6	74.8	8.6	0.416
120 min	75.9	6.7	74.2	7.6	0.351
150 min	77.8	7.5	75.3	7.4	0.194
180 min	77.7	7.0	75.8	6.8	0.264
210 min	77.6	6.2	76.1	6.8	0.342
240 min	78.5	6.2	76.9	7.2	0.356
270 min	78.9	5.7	77.4	6.8	0.341

Figure 4: Change in mean DBP between Study Groups over the time

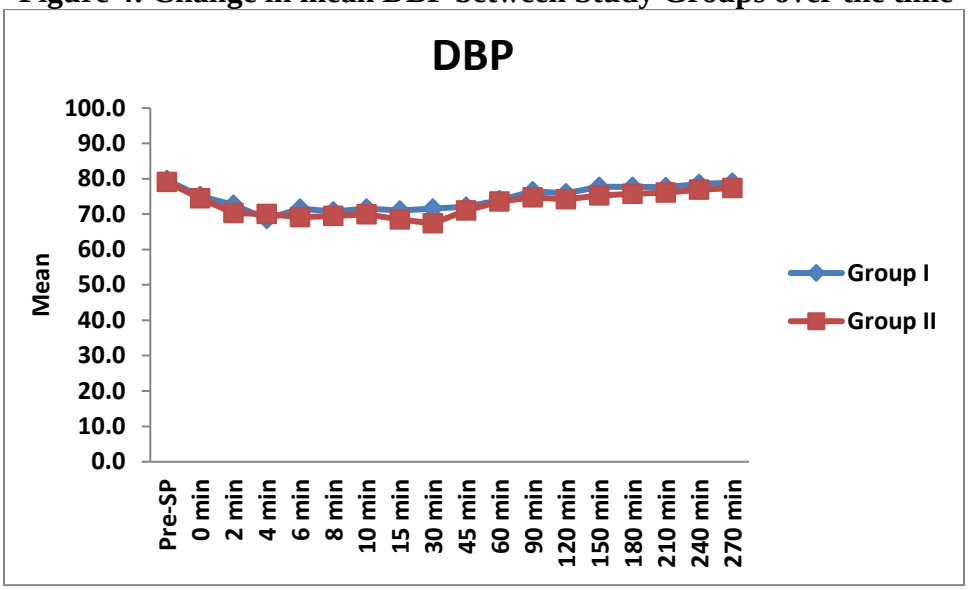
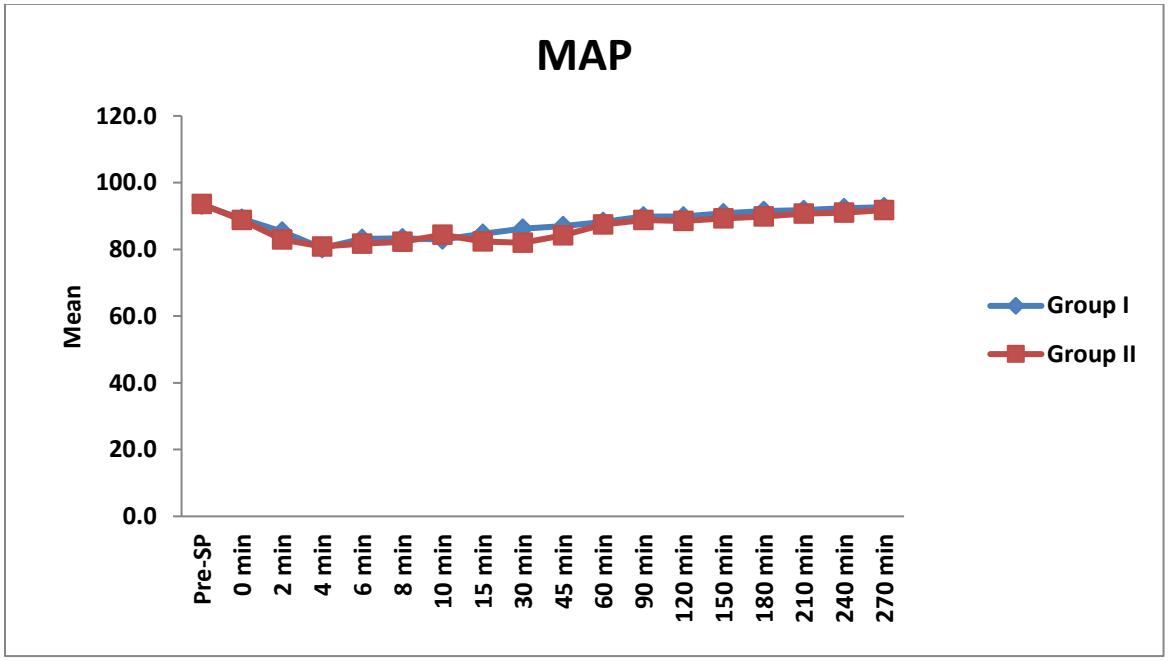


Table 5: Change in mean MAP between Study Groups over the time

MAP	Group I		Group II		p value
	Mean	SD	Mean	SD	
Pre-SP	93.4	5.9	93.6	6.4	0.888
0 min	89.2	10.1	88.8	8.6	0.874
2 min	85.3	10.0	83.0	11.1	0.379
4 min	80.4	17.4	80.9	11.8	0.900
6 min	83.2	9.9	81.8	8.7	0.549
8 min	83.3	9.3	82.3	9.6	0.664
10 min	83.0	11.2	84.4	9.9	0.588
15 min	84.7	10.0	82.3	7.5	0.301
30 min	86.2	6.7	82.0	8.1	0.025
45 min	87.0	6.5	84.2	9.4	0.174
60 min	88.2	6.5	87.5	8.7	0.710
90 min	89.8	6.6	88.8	8.0	0.588
120 min	89.9	5.6	88.5	6.8	0.360
150 min	90.8	5.3	89.3	6.2	0.285
180 min	91.5	5.5	89.9	5.7	0.259
210 min	91.8	5.0	90.7	5.4	0.431
240 min	92.4	5.1	91.0	5.5	0.318
270 min	92.6	4.7	91.8	5.2	0.515

Figure 5: Change in mean MAP between Study Groups over the time



There were no significant haemodynamic alterations in cardiovascular parameters.

The mean value of systolic bood pressure, diastolic bood pressure and mean arterial pressure changes in mmHg between Group 1 and Group II were almost similar, statistically not significant.

Table 6: Change in mean RR between Study Groups over the time

RR	Group I		Group II		p value
	Mean	SD	Mean	SD	
Pre-SP	22.3	2.8	20.9	2.9	0.050
0 min	22.4	2.8	21.6	3.0	0.253
2 min	21.9	2.4	21.1	2.7	0.193
4 min	22.1	2.5	21.0	2.7	0.118
6 min	21.7	2.4	20.8	2.5	0.160
8 min	21.4	2.4	20.6	2.7	0.222
10 min	21.1	2.2	20.5	2.5	0.266
15 min	20.8	2.1	20.7	2.5	0.829
30 min	20.8	2.0	20.8	2.6	1.000
45 min	20.8	2.0	20.5	2.6	0.668
60 min	20.7	1.8	20.6	2.6	0.868
90 min	20.6	1.9	20.3	2.5	0.572
120 min	20.5	1.8	20.6	2.2	0.903
150 min	20.4	1.9	20.5	2.2	0.904
180 min	20.6	1.9	20.6	2.2	1.000
210 min	20.5	1.9	20.5	2.3	1.000
240 min	20.5	1.9	20.4	2.4	0.816
270 min	20.6	1.8	20.3	2.3	0.550

Figure 6: Change in mean RR between Study Groups over the time

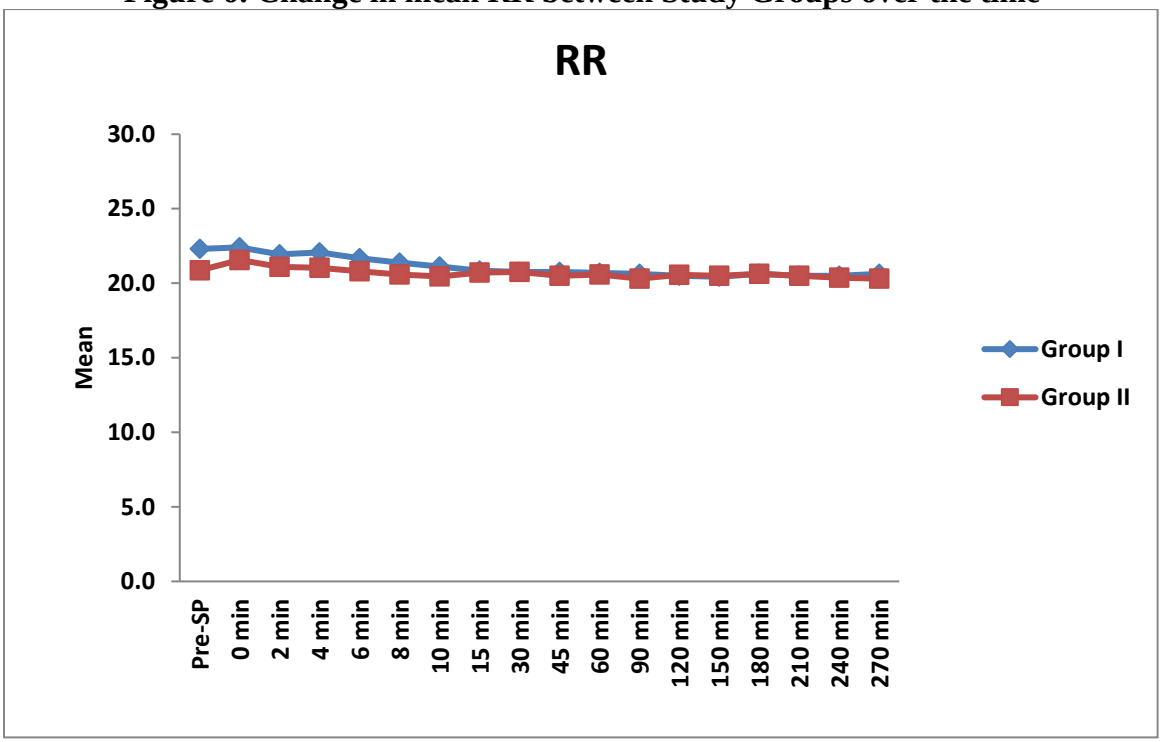
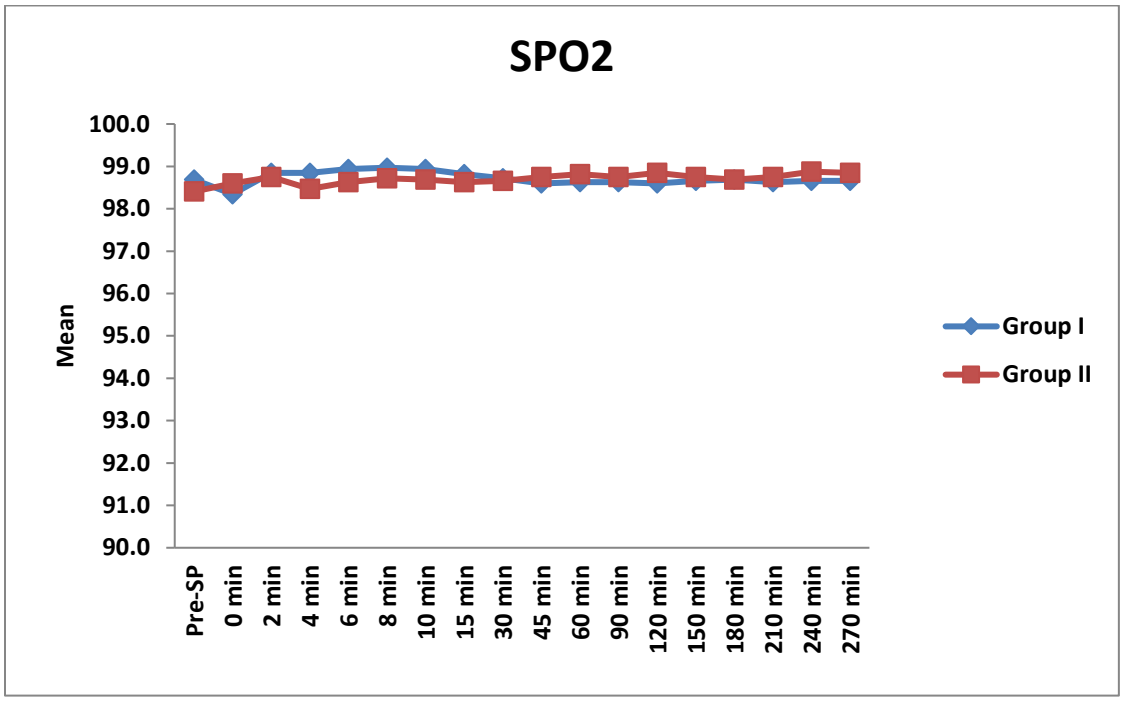


Table 7: Change in mean SPO2 between Study Groups over the time

SPO2	Group I		Group II		p value
	Mean	SD	Mean	SD	
Pre-SP	98.7	0.5	98.4	0.8	0.091
0 min	98.3	0.9	98.6	0.8	0.265
2 min	98.8	0.4	98.8	0.7	0.514
4 min	98.8	0.4	98.5	0.8	0.015
6 min	98.9	0.2	98.6	0.7	0.021
8 min	99.0	0.2	98.7	0.7	0.049
10 min	98.9	0.2	98.7	0.6	0.031
15 min	98.8	0.4	98.6	0.7	0.196
30 min	98.7	0.5	98.7	0.6	0.641
45 min	98.6	0.6	98.8	0.5	0.247
60 min	98.6	0.6	98.8	0.4	0.124
90 min	98.6	0.6	98.8	0.5	0.376
120 min	98.6	0.7	98.8	0.4	0.083
150 min	98.7	0.5	98.8	0.4	0.420
180 min	98.7	0.6	98.7	0.5	1.000
210 min	98.6	0.6	98.8	0.4	0.350
240 min	98.7	0.5	98.9	0.3	0.058
270 min	98.7	0.5	98.8	0.4	0.112

Figure 7: Change in mean SPO2 between Study Groups over the time



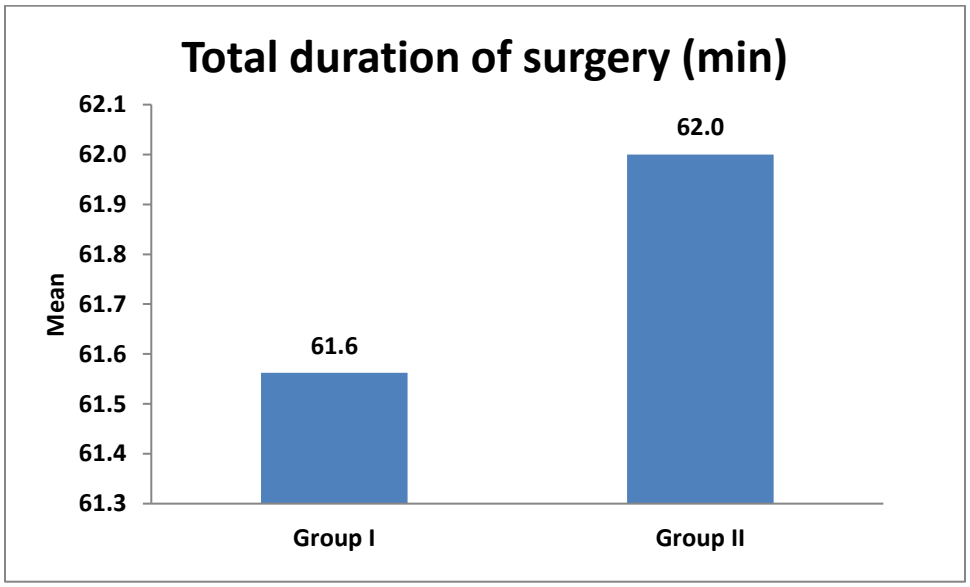
There were no significant alteration in respiratory parameters.

The mean value of respiratory rate and SPO2 between Group 1 and Group II were almost similar and statistically not significant.

Table 8: Total duration of surgery between Study Groups

Parameters	Group I		Group II		p value
	Mean	SD	Mean	SD	
Total duration of surgery (min)	61.6	9.8	62.0	7.7	0.844

Figure 8: Total duration of surgery between Study Groups

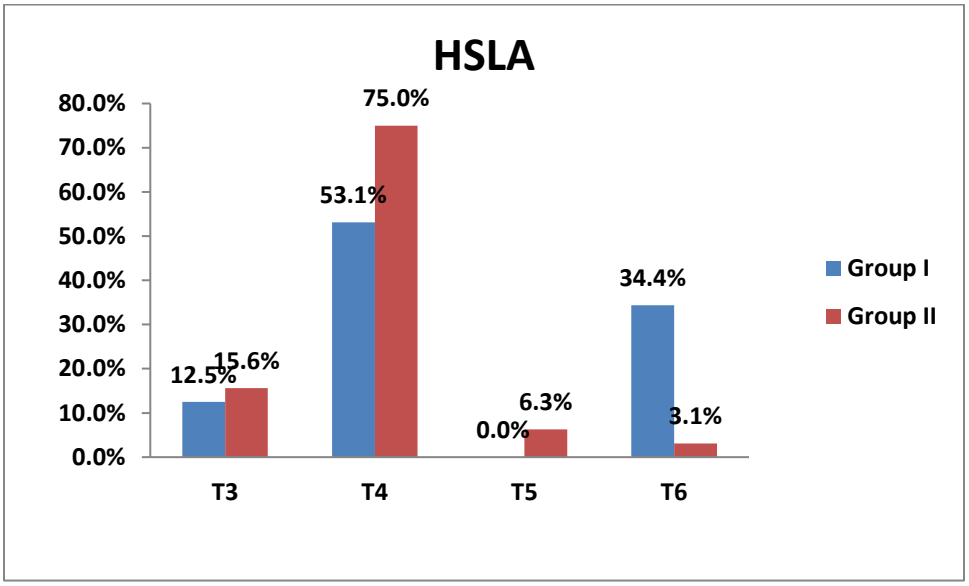


The duration of surgery between Group I and II statistically not significant (p >0.05).

Table 9: Distribution of HSLA between Study Groups

HSLA	Group I		Group II		p value
	N	%	N	%	
T3	4	12.5%	5	15.6%	0.009*
T4	17	53.1%	24	75.0%	
T5	0	0.0%	2	6.3%	
T6	11	34.4%	1	3.1%	
Total	32	100.0%	32	100.0%	

Figure 9: Distribution of HSLA between Study Groups



In Group I, maximum level of sensory analgesia achieved was T_3 (12.5%) and minimum height achieved was T_6 (34.4%). 53.1% of the patients achieved up to the level of T_4. The median range of highest level of sensory analgesia was T_4 (T_3-T_6).

In Group II, maximum level of sensory analgesia achieved was T_3 (15.6%) and minimum height achieved was T_6 (3.1%). 75% of the patients achieved T_4 and 6.3% of the patients achieved up to T_5 level. The median range of height (sensory analgesia) was T_4 (T_3-T_6).

Table 10: Time parameters between Study Groups

Parameters	Group I		Group II		p value
	Mean	SD	Mean	SD	
TOSA upto T10 (min)	2.2	0.7	1.7	0.5	0.002*
TTAHLSA (min)	5.3	2.0	4.1	1.7	0.012*
TTSR (min)	93.8	15.7	129.5	33.1	<0.001*
TDEA (min)	172.0	42.9	273.9	33.7	<0.001*
TSR to L1 (min)	170.8	30.9	263.8	29.6	<0.001*
TWPRA (min)	176.6	31.7	276.7	31.4	<0.001*
TDSA (min)	183.0	31.9	274.5	30.0	<0.001*
TOMB (min)	3.0	0.9	2.6	0.8	0.075
TCMR (min)	112.0	21.3	133.3	39.0	0.009*

Note: * significant at 5% level of significance (p<0.05)

Figure 10: Time parameters between Study Groups

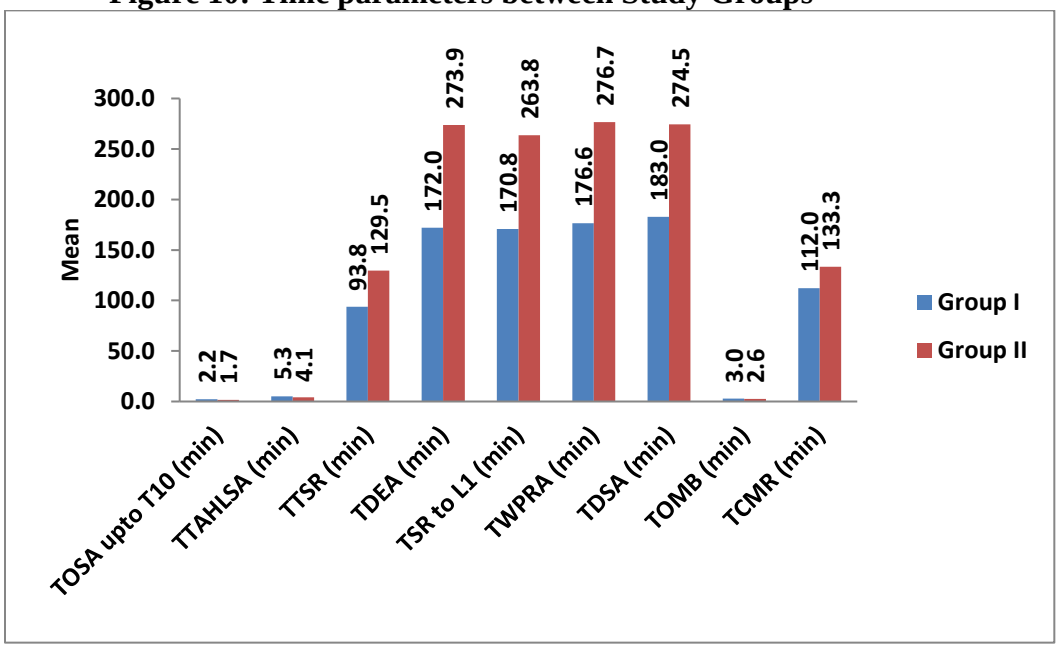


Table 11: Distribution of Side effects between Study Groups

Side effects	Group I		Group II	
	N	%	N	%
Low BP	14	43.8%	11	34.4%
Low PR	5	15.6%	0	0.0%
Low HR	0	0.0%	4	12.5%
Shivering	3	9.4%	2	6.3%
Vomiting	5	15.6%	4	12.5%
Pruritus	0	0.0%	2	6.3%

In the present study hypotension was seen in 43.8% of patients in Group I i.e. bupivacaine alone and 34.4% in Group II, i.e. bupivacaine with fentanyl group.

Bradycardia was seen in 15.6% in Group I, i.e. bupivacaine alone and none in Group II, i.e. bupivacaine with fentanyl group.

Nausea vomiting was seen in 15.6% in Group I, i.e. bupivacaine alone and 12.5% in Group II patients, i.e. bupivacaine with fentanyl which was statistically significant in Group I ($p < 0.05$).

Shivering was noted in 9.4% of the patients in Group I i.e. bupivacaine alone and 6.3% in Group II, i.e. bupivacaine with fentanyl group, which was statistically significant in Group I ($p < 0.05$).

Pruritus was observed in 6.3% of patients in Group II and not observed in any patients in Group I, i.e. bupivacaine alone.

DISCUSSION

Till today spinal anaesthesia is the most versatile block available and being used for various surgeries on the lower half of the body. The advantages of spinal anaesthesia includes simplicity, easier to perform and has a definitive end point. It is ideal in situations when rapid onset of action and profound motor blockade is required (Hans Nolte et al., 1977). In addition short duration spinal anaesthesia may help to prevent complications due to polypharmacy, nausea, vomiting, deep vein thrombosis, associated with delayed immobilization following general anaesthesia.

The use of neuraxial opioids has gained popularity over the last few years. They may augment the analgesia produced by local anaesthetics through direct binding with the specific spinal receptors.

Opioid added to local anaesthetic for spialanaesthesia was first introduced into clinical practice in 1979 with intrathecal morphine as a forerunner. Neuraxial administration of opioids along with local anaesthetic improves the quality of intraoperative analgesia and also provide postoperative pain relief for longer duration.[8,9]

Administration of fentanyl intrathecally is an established method for intraoperative anaesthesia and to supplement postoperative analgesia (Mcqually HJ et al., 1989). The spread of fentanyl after administration into cerebrospinal fluid include, movement from the cerebrospinal fluid into the opioid receptors or other non-specific binding sites in the spinal cord (Gourlay GK et al., 1989) androstral

migration via the cerebrospinal fluid to supraspinal sites. Because of the high affinity of fentanyl with non-specific binding sites on the lipid surface only a small proportion of the administered dose migrate to the cervical region (Gourlay GK et al., 1989).

Use of morphine, via subarachnoid route in the routine postoperative pain management has been limited for the fear of greater incidence of side effects, particularly respiratory depression.

Fentanyl is more lipid soluble than morphine. Thus it is more readily eliminated from the CSF than morphine making late respiratory depression less likely.

Intrathecal use of fentanyl is advantageous due to its extremely rapid onset of action, getting desired level of analgesia and anaesthesia with minimum dosage of fentanylas well asbupivacaine.

This study showed that fentanyl 25μg prolongs the duration of bupivacaine induced sensory blockade (sensory regression to L_1 dermatome). This suggests a potential synergism between fentanyl and bupivacaine.

Hence when large doses of local anaesthetics are used the sensory and motor blocks develop rapidly as a result of overdose in relation to the minimum concentration required to block the various nerve fibers. But this higher concentration is accompanied by side effects like bradycardia, hypotension. In our study we used 25μg fentanyl and 10mg(2cc)bupivacaine

to study its effect on anaesthesia quality, sensory block, motor block and duration of analgesia.

Sensory Characteristics

The duration of onset of sensory block, i.e. time taken from administration of the drug intrathecally to the loss of pinprick sensation at T_{10} dermatome level bilaterally.

In the present study the onset of sensory analgesia was achieved between 2-3 minutes in Group I i.e. bupivacaine only and between 1-2 minutes in Group II, i.e. bupivacaine and fentanyl group. The mean time of onset of analgesia at T_{10} in Group I is 2.2 ± 0.7 and in Group II is 1.7 ± 0.5. The difference in the mean time between two groups is statistically significant ($p < 0.05$). This showed addition of fentanyl to bupivacaine hastens the onset of sensory block. B N Biswaset al. (2002) in their study used the same drugs but the author have not commented on the time of onset of sensoryanalgesia.

Catherine O' Hunt et al.[8] (1989) studied the duration of analgesia for various IT fentanyl dosage with bupivacaine for patients undergoing caesarean delivery. But the author did not comment on the time of onset of sensory analgesia at T_{10}.

In the present study, majority of the patients in both the groups achieved the highest sensory level of T_4. The highest sensory level range was T_4 (T_3-T_6) in both Group I and Group II.

The time taken to achieve highest sensory level in Group I (i.e. bupivacaine alone), was between 3-8 minutes whereas in Group II (i.e. with fentanyl) was achieved between 1-6 minutes.

The mean time in Group I was 5.3 ± 2.0minutes and in Group II was 4.1 ± 1.7 minutes ($p < 0.05$) which was statistically significant.

In B N Biswaset al.[19] study highest sensory level (range) in Group A, i.e. bupivacaine alone was T_7 (T_6-T_8) and in Group B, i.e. with fentanyl it was T_5 (T_4-T_6). Mean time taken to achieve this level in Group A was 8 ± 2.1minutes and 7 ± 2.4minutes in Group B.

According to Catherine O' Hunt et al.[8] (1989) the onset time to T_4 in Group O i.e. bupivacaine alone is 4.571 ± 2.76minutes and in Group with fentanyl the mean time of onset was 4.222 ± 2.108minutes.

The results of the present study concurs with the findings of the above authors. However, it was found that patients receiving a combination of fentanyl and bupivacaine had a statistically significant faster onset of action (Hunt et al., 1998).

Time for two segment regression, i.e. time taken for regression of two dermatome segments below the highest sensory level.

In the present study mean time was 93.8 ± 15.7 minutes in Group I, i.e. bupivacaine only. In Group II, i.e. with fentanyl the mean time was 129.5 ± 33.1minutes.

The difference in the mean time between Group I and Group II is statistically significant ($p < 0.05$). Time for two segment regression was prolonged with the addition of fentanyl to bupivacaine.

According to Catherine O'Hunt et al.[8] (1989) the time for two segment regression was prolonged in fentany with bupivacaine group. They observed the number of segment regressed in 60 minutes in Group O, i.e. bupivacaine alone was 2.5 ± 2.588 segments and in group 12.5 μg fentanyl is 0.75 ± 1.389segments.

According to Harbhej Singh et al.[21] (1995) the time taken for two segment regression was prolonged in fentanyl with bupivacaine group. In Group I, i.e. bupivacaine alone time for two segment regression from the highest sensory level was 74 ± 18 minutes and in Group II, i.e. with fentanyl it was 93 ± 22 minutes, it was statistically significant. Our results concurs with findings of the above authors. Similar results were noticed with Uma Srivastavaet al.[1] (2004) and Belzarena Sergio et al.[4] (1991) and Benhamou Dan et al.[20] (1998)studies.

In the present study time for sensory regression to L_1 in Group I, i.e. bupivacaine alone, the mean time was 170.8 ± 30.9 minutes. In Group II with fentanyl combination the the mean time was 263.8 ± 29.6 minutes. The difference in the mean time value between Group I and Group II was statistically significant ($p < 0.05$). Similar results were noticed with B N Biswaset al.[19] (2002), Harbhej Singh et al.[21] (1995)and Catherine O'Hunt et al.[8] (1989). They observed sensory regression to L_1 in GroupI,

i.e. bupivacaine alone was 116 ± 14.39 minutes and in Group II, i.e. with fentanyl combination it was 151 ± 7.33 minutes and it was statistically significant in their studies. However it was found that time for sensory regression to L_1 was prolonged with fentanyl. Our results concurs with the results of the above authors.

In the present study, the maximum time for complete sensory recovery in Group I, i.e. bupivacaine alone the mean time was 183.0 ± 31.9 minutes. In Group II with the addition of fentanyl the maximum time for complete sensory recovery, the mean time was 274.5 ± 30.0 minutes. The difference in mean time between Group I and Group II was statistically significant ($p< 0.05$). The time for complete sensory recovery was prolonged in Group II when compared to Group I.

According to B N Biswas et al.[19] (2002) in their studies the mean time taken for complete sensory recovery was 129 ± 9.5 minutes in bupivacaine alone groupand 183 ± 9 minutes in the fentanyl with bupivacaine group which was statistically significant. Complete analgesia lasted longer in fentanyl group compared to bupivacaine alone group. Our results in the present study concurs with the study B N Biswas et al.[19] (2002). Similar results were obtained with Belzarenaet al.[4] (1991) and Harbhej Singh et al.[21](1995).

Motor blockade characteristics

In the present study by adding 25μg of fentanyl to 10mg (2cc) of bupivacaine the time of onset of grade III motor block was not statistically significant

(p> 0.05) in both groups. The mean time of onset of grade III motor block in GroupI i.e. bupivacaine alone was 3.0 ± 0.9 minutes and in Group II, i.e. with fentanyl it was 2.6 ± 0.8 minutes. The addition of fentanyl to bupivacaine did not affect the onset of motor block. Similar results were noticed in the studies conducted by the authors B N Biswas et al. (2002),[19]Harbhej Singh et al. (1995)[21] and Catherine O'Hunt (1989).[18]

In the present study, onset of grade III motor block was not significant our results concurs with the results of studies done by above authors.

In the present study, the mean time for complete motor recovery was 112.0 ± 21.3 minutes in Group I, i.e. bupivacaine alone and 133.3 ± 39.0 minutes in Group II, i.e. fentanyl group. B N Biswas et al.[19] (2002) observed complete motor recovery of 125 ± 6.7 minutes in Group I, i.e. bupivacaine alone and 127 ± 7.1 minutes in fentanyl with bupivacaine group. Similar results were noticed with Harbhej Singh et al.[21] (1995) study i.e. 151 ± 46 minutes in Group I and 169 ± 37 minutes in Group II, but results of above studies were statistically not significant. The results of our study were more or less similar to abovestudies.

Total Duration of Analgesia

The total duration of effective analgesia was taken as the time interval between the injection of the spinal drug to first dose of rescue analgesics. In the present study mean time of total duration of analgesia was 172 ± 42.9 minutes in Group I, i.e. bupivacaine only and 273.9 ± 33.7 minutes in Group II i.e. bupivacaine with fentanyl combination. This difference in the mean time between Group I and Group II was

statistically significant ($p < 0.05$). The total duration of analgesia was prolonged with the addition of fentanyl in our present study. Results of our study concur with the results of studies done by B N Biswas et al.[19] (2002). In their study the duration of effective analgesia was prolonged in Group B (Fentanyl 12.5μg) i.e. 248 ± 11.76 minutes. In Group A (Bupivacaine 10 mg) the duration of effective analgesia was 150 ± 10.48 minutes. Catherine O'Hunt et al. (1989),[8] in their study the duration of effective analgesia was 192 ± 74.9 minutes in fentanyl 6.25 μg Group whereas in control group (bupivacaine alone) 71.8 ± 43.2 minutes. Similarly, results of our study also concur with studies done by Herbhej Singh et al. (1995), Belzarena Sergio et al. (1991) and Uma Srivastava et al.(2004).

Cardiovascular Changes

Hypotension is considered as fall in systolic blood pressure of more than 20% of the baseline systolic pressure or systolic pressure<90mmHg . Heart rate less than 60 bpm is considered as bradycardia. Bradycardia was observed in patients 15.6% in Group I and 12.5% in Group II and these patients responded to treatment with injection atropine 0.6 mg IV.

Hypotension was observed in 43.8% of the patients in Group I and 34.44% of the patients in Group II and these patients were treated with 6 mg of injection ephiderine IV and rapid infusion of IV fluids.

The mean values of pulse rate changes per minute recorded in Group I and Group II were almost similar. This was statistically not significant.

The mean value of mean arterial blood pressure changes in mmHg between Group I and Group II were almost similar. This was statistically not significant. Similar results were obtained in the studies done by B N Biswas et al. (2002), in their studies hypotension in Group I, i.e. bupivacaine alone was in 20% of the patients and it was in 30% of the patients in Group II, i.e. fentanyl 12.5 μg and bradycardia 15% in Group I and 20% in Group II. Similar results noticed in Harbhej Singh et al. (1995) studies.

Complications

In the present study hypotension was seen in 43.8% of patients in Group I i.e. bupivacaine alone and 34.4% in Group II, i.e. bupivacaine with fentanyl group. All patients responded to rapid infusion of intravenous fluid and 6 mg incremental dosage of ephiderine injection IV.

Bradycardia was seen in 15.6% in Group I, i.e. bupivacaine alone and none in Group II, i.e. bupivacaine with fentanyl group. These patients responded to injection atropine 0.6 mg IV which was not significant statistically.

Nausea vomiting was seen in 15.6% in Group I, i.e. bupivacaine alone and 12.5% in Group II patients, i.e. bupivacaine with fentanyl which was statistically significant in Group I ($p < 0.05$) our results showed addition of fentanyl to local anaesthetics reduces the perioperative nausea-vomiting. Our results concurs with the study done by Theodore et al.[12] (2000) who got similar results. In our patients this was treated by inj ondonsetrone 4 mg IV.

Shivering was noted in 9.4% of the patients in Group I i.e. bupivacaine alone and 6.3% in Group II, i.e. bupivacaine with fentanyl group, which was statistically significant in Group I ($p < 0.05$). These patients were treated with oxygenation with face mask and inj tramadol 25mg slow IV.

Pruritus was observed in 6.3% of patients in Group II and not observed in any patients in Group I, i.e. bupivacaine alone. But it was well tolerated and did not require any treatment. Sahar M SiddikSajjidet al.[10] (2002) also observed pruritus in 26% of patients in IT fentanyl group and 8% in IV fentanyl group. BuvanendranAsokumar et al.[25] (1998) in their study noticed pruritus in 95% of patients in fentanyl (25 μg) alone group and 36.4% of patients in fentanyl with bupivacaine group 0% in bupivacaine alone group. One patient in the fentanyl alone group received IV naloxone 0.2 mg at 45 min for severe pruritus. The occurrence of pruritus in patients who received fentanyl was dose dependent. Thus our results concurs with the results of Sahara M SiddikSayyid et al.[10] (2002) study and Catherine O'Hunt et al.[8] (1989) also noticed similar results. Pruritus subsided without any treatment.

In the present study we did not notice any incidence of respiratory depression upto 24 hours postoperatively. Similar results of, no incidence of respiratory depression was noticed in the studies conducted by B N Biswas et al. (2002),[19] Catherine O'Hunt et al. (1989)[8] and Herbej Singh et al. (1995).[21]Belzarena et al. (1992) however noticed a significant low respiratory rate in the initial 40 minutes when dose of fentanyl was more than $0.5\mu gmkg^{-1}$. But there was no respiratory depression.

None of the patients in this study experienced any neurological complication during postoperative follow-up.

In the present study follow-up to 24 hours postoperatively did not reveal symptoms suggestive of post dural puncture headache or radicular irritation. None of the patients required supplementation with general anaesthesia in our present study.

CONCLUSIONS

From the present study, it can be concluded that

1. Onset of sensory analgesia was achieved in 2-3 min in majority of patients in Group I and 1-2 min in majority of patients in Group II which was significant ($p < 0.05$). The mean height of sensory analgesia range was T_4 (T_3-T_6) in both the groups. The time taken to achieve the highest sensory level was 5.3± 2.0 minutes in Group I and 4.1± 1.7 minutes in Group II which was significant ($p<0.05$).
2. Time for two segment regression, time for sensory regression to L_1 and time for complete sensory recovery was significantly prolonged in bupivacaine with fentanyl combination when compared to bupivacaine alone.
3. Time of onset to Grade III motor block was not significant (3.0 ± 0.9 minutes in Group I and 2.6± 0.8 minutes in GroupII).
4. The total duration of analgesia was significantly more in bupivacaine with fentanyl combination, i.e. 273.9 ± 33.7 minutes when compared to bupivacaine alone group, i.e. 172 ± 42.9minutes.
5. The addition of fentanyl 25 μg to bupivacaine 2 ml (10 mg) was not associated with any significant haemodynamic changes.
6. Hypotension, bradycardia, nausea-vomiting, shivering, pruritus were the only few side effects observed. The incidence of hypotension (43.8%) was more in Group I compared to 34.4% in group ll (bupivacaine and fentanyl) but it was not significant $p > 0.05$

When compared to the same with Group I (i.e., bupivacaine alone). Nausea, vomiting and shivering were significantly more in bupivacaine alone group. No cases of respiratory depression, post dural puncture headache or neurological complication were observed during 24 hours post operative period.

The addition of 25μg of fentanyl to 2ml (10mg) of hyperbaric bupivacaine definitely intensified and prolonged the duration of bupivacaine induced sensory spinal block without affecting the onset and intensity of motor blockade. Combination of fentanyl to bupivacaine can be safely employed for patients who undergo caesarean section without significant haemodynamic changes and adverse effects. Hence it is recommended to add 25μg of fentanyl to hyperbaric 0.5% bupivacaine for spinal anaesthesia in caesarean section deliveries. It would markedly improve intraoperative anaesthesia, and significantly reduce the demand for postoperative analgesic with good maternal satisfaction.

SUMMARY

"A comparitive study of intrathecal 0.5% bupivacaine and 0.5% bupivacaine with fentanyl in patients undergoing LSCS "was conducted at Department of Anaesthesiology, B.LD.E (DEEMED TO BE UNIVERSITY) Shri B. M. Patil Medical College, Hospital and Research Centre, Vijayapur. Study was conducted from December 2018 to September 2020.

The study population consisted of 64 patients divided into two groups of 32 each.

Group I received: 0.5% hyperbaric bupivacaine 2 ml (10mg) intrathecally.

Group II received: 0.5% hyperbaric bupivacaine 2 ml (10mg) + fentanyl 25µg intrathecally.

The following parameters were studied in all patients.

1. Time of onset of sensory analgesia at T_{10}
2. Highest level of sensory analgesia
3. Time taken to achieve the highest level of analgesia
4. Time for sensory regression to L_1 from the highest sensory level
5. Time for complete sensory recovery
6. Time of onset of motor blockade
7. Duration of Grade III motor block according to modified Bromage scale1978.
8. Time for complete motor recovery

9. Duration of effective analgesia

10. Cardiovascular changes

11. Any complication or side effects like respiratory depression, shivering, itching, nausea, etc. if any.

The following table shows the results obtained in the present study.

	Group I	**Group II**
Mean age (years)	25.3±4.6	23.9 ± 4.20
Mean weight (kgs)	52.0 ± 1.6	51.0 ± 2.1
Mean duration of surgery (min)	61.6 ± 9.8	62.0±7.7
Mean time of onset of sensory analgesia (min) at T_{10}	2.2 ± 0.7	1.7 ± 0.5
Mean height of analgesia (range)	T_4 (T_3 – T_6)	T_4 (T_3 – T_6)
Mean time for highest sensory level (min)	5.3 ± 2	4.1 ± 1.7
Mean time for two segment regression from the highest sensory level (min)	93.8±15.7	129.5±33.1
Mean time for sensory regression to L_1 from the highest sensory level	170.8±30.9	263.8± 29.6
Mean time for complete sensory recovery (min)	183.0 ± 31.9	274.5 ± 30.0
Mean time of total duration analgesia (min)	176.6 ± 31.7	276.7 ± 31.4
Mean time of onset to Grade III motor block (min)	3.0 ± 0.9	2.6 ± 0.8
Mean time of duration of Grade III motor block (min)	112 ± 21.3	133.3 ± 39.0
Complication Hypotension (%)	43.8%	34.4%
Bradycardia (%)	15.6%	12.5%
Nausea and vomiting (%)	15.6%	12.5%
Shivering (%)	9.4%	6.3%
Itching (%)	0	6.3%
Respiratory depression (%)	0	0
Post dural puncture headache and neurological complication	0	0

The addition of 25μg of fentanyl to 2ml (10mg) of hyperbaric bupivacaine definitely intensified and prolonged the duration of bupivacaine induced sensory spinal block without affecting the onset and intensity of motor blockade. Combination of fentanyl to bupivacaine can be safely employed for patients who undergo caesarean section without significant haemodynamic changes and adverse effects. Hence it is recommended to add 25μg of fentanyl to hyperbaric 0.5% bupivacaine for spinal anaesthesia in caesarean section deliveries. It would markedly improve intraoperative anaesthesia, and significantly reduce the demand for postoperative analgesic with good maternal satisfaction.

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IEC/NO:286
17-11-2018

INSTITUTIONAL ETHICAL COMMITTEE

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this college met on 13-11-2018 at 03-15 PM scrutinize the Synopsis of Postgraduate Students of this college from Ethical Clearance point of view. After scrutiny the following original/corrected and revised version synopsis of the Thesis has accorded Ethical Clearance.

Title : A comparative study of intrathecal 0.5% bupivacaine and 0.5% bupivacaine with fentanyl in patients undergoing effective LSCS.

Name of P.G. Student : Dr Nafasat Tanseem Abroo.
Department of General Anaesthesiology

Name of Guide/Co-investigator: Dr. Vijaykumar.T, Professor of Anaesthesiology.

DR RAGHAVENDRA KULKARNI
CHAIRMAN
Institutional Ethical Committee
BLDEU's Shri B.M. Patil
Medical College,BIJAPUR-586103.

Following documents were placed before E.C. for Scrutinization:

1) Copy of Synopsis/Research Project
2) Copy of informed consent form.
3) Any other relevant documents.

ANNEXURE – VII

INFORMED CONSENT FORM

TITLE OF THE PROJECT	:	**"A COMPARATIVE STUDY OF INTRATHECAL 0.5% BUPIVACAINE AND 0.5% BUPIVACAINE WITH FENTANYL IN PATIENTS UNDERGOING ELECTIVE LSCS "**
PRINCIPAL INVESTIGATOR	:	**Dr. Nafasat Tasneem Abroo** Department of Anaesthesiology, Email: me.naffu@gmail.com
PG GUIDE	:	**Dr.VIJAYKUMAR T.K**, Professor, Department of Anaesthesiology, B.L.D.E. (Deemed to be University) Shri B.M. Patil Medica lCollege,Hospital & Research Centre, Vijayapur, Karnataka.

I have been informed that this study is "A COMPARATIVE STUDY OF INTRATHECAL 0.5% BUPIVACAINE AND 0.5% BUPIVACAINE WITH FENTANYL IN PATIENTS UNDERGOING ELECTIVE LSCS". I have been explained about this study in the language which I understand. I have been explained about the reason for doing this study and selecting me/my ward as a subject for this study. I have been told that my participation in the above study is voluntary and I am aware that I can opt out of the study at any time without having to give any reasons for doing so. I am also informed that my refusal to participate in this study will not affect my treatment by any means.

I agree to participate in the above study and cooperate fully. I agree to follow the Doctor's instructions about my treatment to the best of my ability.

CONFIDENTIALITY:

I understand that medical information produced by this study will become a part of this Hospital records and will be subjected to the confidentiality and privacy regulation of this hospital. Information of a sensitive, personal nature will not be a part of the medical records, but will be stored in the investigator's research file and identified only by a code number. The code key connecting name to numbers will be kept in a separate secure location.

If the data are used for publication in the medical literature or for teaching purpose, no names will be used and other identifiers such as photographs and audio or video tapes will be used only with my special written permission. I understand that I may see the photograph and videotapes and hear audiotapes before giving this permission.

REQUEST FOR MORE INFORMATION:

I understand that I may ask more questions about the study at any time and Dr.NafasatTasneemAbroo available to answer my questions or concerns. I understand that I will be informed of any significant new findings discovered during the course of this study, which might influence my continued participation.

If during this study, or later, I wish to discuss my participation or concerns regarding this study with a person not directly involved, I am aware that the social worker of the hospital is available to talk with me and that a copy of this consent form will be given to me for my careful reading.

REFUSAL OR WITHDRAWL OF PARTICIPATION:

I understand that my participation is voluntary and I may refuse to participate or may withdraw consent and discontinue participation in the study at any time without prejudice to my present or future care at this hospital.

I also understand that Dr. Nafasat Tasneem Abroo will terminate my participation in this study at any time after she has explained the reasons for doing so and has helped arrange for my continued care by my own physician or therapist.

INJURY STATEMENT:

I understand that in the unlikely event of injury to me/my ward, resulting directly to my participation in this study, if such injury were reported promptly, then medical treatment would be available to me, but no further compensation will be provided.

I understand that by my agreement to participate in this study, I am not waiving any of my legal rights.

I have been explained about the purpose of this research, the procedures required and the possible risks and benefits, in my own language.

I have been explained all the above in detail and I understand the same. Therefore I agree to give my consent to participate as a subject in this research project.

Patient's Signature: Witness Signature

Name : Name :

Date : Date :

Dr. VIJAYKUMAR.T.K. **DR NAFASAT TASNEEM ABROO.**

(Guide) (Investigator)

ANNEXURE – VIII

10. SCHEME OF CASE TAKING :

PROFORMA

STUDY"A COMPARATIVE STUDY OF INTRATHECAL 0.5% BUPIVACAINE AND 0.5% BUPIVACAINE WITH FENTANYL IN PATIENTS UNDERGOING LSCS "

Name of the patient :

I.P. No. :

Age :

Weight:

Date :

Address :

Consent taken for study: Y/N

Group allocated : A/B

Chief complaints :

Past History :

a) Presence of any co morbid condition - Diabetes/ Hypertension/ Ischemic heart disease/ Cerebrovascular accident / Asthma/ Epilepsy/ Bleeding disorder/ Drug allergy/ any other
b) Drug Therapy
c) H/o previous anaesthetic exposure :

Family History :
Obstetric history:
General Physical Examination:

- General condition :
- Pallor / Icterus / Cyanosis / Clubbing / Lympadenopathy / Pedal edema.
- Temperature:
- Pulse rate:
- Respiratory rate:
- Blood Pressure :

Mallampatigrade :

Systemic Examination :

- Cardiovascular system
- Respiratory system
- Central nervous system
- Others

Investigations :

- Complete blood picture
- Total Leucocyte count :
- Blood group and type:
- Platelet count :
- Random Blood sugar :
- Urine routine:
- ECG:
- Any other :

ASA Grade :

Diagnosis:

PARAMETERS OBSERVED INTRA-OP:

Onset time of sensory blockade:	(Min)
Onset time of motor blockade:	(Min)
Duration of sensory blockade:	(Min)
Duration of motor blockade:	(Min)
Duration of Analgesia :	(Min)
Quality of blockade:	
Side effects:	Nausea[ ] / vomiting[ ]
	Bradycardia[ ]/hypotension[ ] / Shivering [ ]

OBSERVATIONS

SENSORY BLOCKADE-Tested by pin prick using hypodermic needle

Time of onset-

Highest level of sensory blocked-

Time for 2 segment regression-

Duration of sensory block (return of pinprick sensation to S1-heel area).

MOTOR BLOCK-

Tested by modified Bromage scale time of onset (time to Bromage 2)-

Duration of motor block (time to Bromage 4)-

ANALGESIA

Duration of complete analgesia(VAS<0)

Duration of effective analgesia (VAS<4)

Quality of intra operative analgesia assessed by Visual analogue scale

MONITORING OF VITALS

MONITORING

Time in mins	Heartrate/ min	BP (mmHg)	Res. Rate/ min	SpO2 %
Basal				
2				
4				
6				
8				
10				
25				
45				
60				
90				
120				

Time of first rescue analgesia :

Study ends when patient demands for analgesic in postoperative period.

Rescue analgesia is provided with injection Diclofenac 1.5mg/kg IV infusion in 100ml normal saline.

DATE: STAFF SIGNATURE

BIO-DATA

GUIDE

NAME	:	DR. VIJAYKUMAR T.K.
DATE OF BIRTH	:	08/09/1964
EDUCATION	:	M.B.B.S. – 1989 MAHADEVAPPA RAMPURE MEDICAL COLLEGE, GULBARGA UNIVERSITY, GULBARGA, KARNATAKA. M.D. ANAESTHESIOLOGY-2000 B.L.D.E.(Deemed to be University) SHRI B.M PATIL MEDICAL COLLEGE, HOSPITAL & RESEARCH CENTRE, VIJAYAPUR, KARNATAKA. D.ANAESTHESIOLOGY-1992 JAWAHARLAL NEHRU MEDICAL COLLEGE BELGAUM, KARNATAKA UNIVERSITY, DHARWAD, KARNATAKA.
DESIGNATION	:	PROFESSOR OF ANAESTHESIOLOGY.
TEACHING	:	UG TEACHING - 23YEARS PG TEACHING - 15 YEARS
ADDRESS	:	PROFESSOR, DEPARTMENT OF ANESTHESIOLOGY, B.L.D.E.(Deemed to be University) SHRI B.M PATIL MEDICAL COLLEGE HOSPITAL & RESEARCH CENTRE, VIJAYAPUR – 586103 KARNATAKA.
PHONE	:	(08352)262770 EXT 2052, 9844095250
EMAIL	:	drvijay8@gmail.com

INVESTIGATOR

NAME	:	DR. NAFASAT TASNEEM ABROO
QUALIFICATION	:	M.B.B.S.(JUNE 2013)
K.M.C. REGISTRATION NO.	:	111771
ADDRESS	:	DEPARTMENT OF ANESTHESIOLOGY, B.L.D.E.(Deemed to be University) SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE, VIJAYAPUR – 586103 KARNATAKA.

				Group I: 0.5% hyperbaric bupivacaine 10 mg (2 cc)																	
				Pulse rate per minute																	
Sl.No.	Age (years)	Weight (kg)	Diagnosis	Pre-SP	0	2	4	6	8	10	15	30	45	60	90	120	150	180	210	240	270
1	30	52	EP primi ê PROM	100	98	107	105	103	104	103	98	89	100	98	96	90	88	88	89	88	88
2	24	50	G2P1L0 ê FTP ê FP	109	102	102	100	106	107	104	105	105	102	102	104	102	108	100	98	92	90
3	22	54	Primi ê PD	84	89	68	63	55	85	89	101	102	92	94	90	76	68	76	78	89	88
4	32	49	G3P1L1A1 ê Pr LSCS	86	84	84	76	76	80	80	86	82	78	80	76	76	76	78	82	80	78
5	27	51	G3P2L1 ê BP	96	90	92	88	86	88	88	84	82	82	84	84	86	88	88	90	86	84
6	25	48	G2P1L0 ê FTP ê Pr LSCS	92	94	95	96	90	92	90	90	90	88	92	94	90	88	86	90	92	90
7	19	50	G2P1L1 ê Pr LSCS	86	86	88	90	90	93	90	86	96	96	92	90	88	86	86	86	86	86
8	32	51	EP ê PROM	68	64	58	62	68	72	72	76	74	70	64	64	68	68	70	72	76	76
9	20	53	Primi ê OL	78	68	86	88	90	92	90	88	90	92	92	90	86	90	86	86	82	84
10	25	52	G5P3L2A1 ê Pr LSCS	94	90	94	96	96	90	92	87	90	80	80	82	84	86	84	82	82	82
11	22	53	Primi ê CPD	96	96	84	93	98	99	98	97	97	92	94	95	84	88	86	87	88	86
12	26	50	G2P1L1 ê Pr LSCS	93	98	93	92	93	96	100	96	100	100	95	94	94	92	93	93	92	92
13	30	52	G3P2L0 ê FTP	87	86	88	89	89	83	84	85	89	80	82	83	84	82	84	84	86	86
14	24	51	G2P1L1 ê Pr LSCS	90	94	92	94	90	88	94	93	98	99	89	90	86	84	84	86	90	88
15	34	52	Primi ê LF	96	92	90	76	75	68	65	80	86	86	84	86	85	82	84	84	82	80
16	25	50	G2P1L1 ê Pr LSCS	93	90	90	92	92	90	92	90	90	90	88	84	86	86	86	84	86	86
17	20	49	G3P2L1 ê Pr LSCS	86	82	84	88	90	88	86	86	86	90	86	84	82	86	84	82	82	82
18	19	51	G2P1L0 ê Pr LSCS	86	78	76	72	84	82	88	86	87	81	80	82	80	82	84	82	80	80
19	21	48	G2P1L1 ê Pr LSCS	90	95	95	92	96	95	86	82	82	90	94	80	82	86	88	82	84	88
20	23	50	G2P1L1 ê Pr LSCS	96	100	105	106	102	106	102	106	102	108	100	96	92	90	92	94	90	96
21	20	51	Primi ê PROM	86	96	100	100	90	104	93	95	100	96	92	90	88	88	86	88	88	88
22	19	52	Primi ê FTP ê CPD	86	89	97	95	83	86	82	84	90	84	84	86	82	86	88	84	82	80
23	30	54	G2P1L1 ê Pr LSCS	94	96	94	95	90	85	84	84	88	86	88	86	94	90	90	92	90	90
24	28	52	G2P1L1 ê Pr LSCS	86	90	88	86	86	84	90	92	96	90	88	86	90	100	90	96	88	88
25	21	53	G2P1L1 ê CPD ê Pr LSCS	72	80	90	73	71	77	73	83	76	89	70	74	75	76	78	76	74	74
26	30	49	G3P1L1 ê FTP 2 Pr LSCS	86	90	92	100	102	90	88	86	90	94	90	92	86	88	90	92	90	86
27	25	52	G2P1L1 ê FTP Pr LSCS	74	90	92	94	92	88	76	90	92	82	90	88	86	84	86	84	88	86
28	26	52	G3P2L2 ê FTP ê 2 Pr LSCS	110	110	110	106	108	110	106	108	107	110	102	108	100	98	96	90	90	92
29	29	50	G2P1L1 ê CPD ê Pr LSCS	89	100	90	103	92	78	76	78	86	86	88	86	88	90	84	86	86	86
30	21	49	Primi ê PROM	73	86	73	79	78	87	84	82	83	78	80	84`	86	84	88	84	88	84
31	25	50	G2P1L1 ê FTP ê Pr LSCS	86	92	84	80	82	84	84	86	88	86	86	88	88	86	86	86	86	88
32	35	53	G4P2L1A1 ê Pr LSCS	107	106	107	103	105	110	102	102	102	106	102	106	104	100	96	90	92	90

			Group II: 0.5% hyperbaric bupivacaine 10 mg (2 cc) + 25 micro gram fentanyl																		
Sl.No.	Age (years)	Weight (kg)	Diagnosis	Pulse rate per minute																	
				Pre-SP	0	2	4	6	8	10	15	30	45	60	90	120	150	180	210	240	270
1	28	52	G3P2L2 ê FTP ê Pr LSCS	88	100	90	100	102	100	92	96	94	92	90	94	90	92	92	88	90	92
2	28	50	G2P1L1 ê FTP ê Post dated	99	100	99	100	94	96	94	96	90	100	100	94	90	88	86	88	86	86
3	23	48	G5P1A3L0 ê Pr LSCS	110	108	98	104	100	103	110	108	110	108	106	100	98	96	90	88	90	88
4	22	54	G2P1L1 ê Pr LSCS	82	100	76	76	78	86	86	84	88	90	86	86	86	84	86	84	82	82
5	20	50	G3P2 v Pr LSCS ê CPD	80	94	83	77	74	82	80	80	84	84	80	86	86	88	86	84	86	88
6	25	55	G2P1L1 ê Pr LSCS ê CPD	93	93	90	92	92	90	92	92	90	90	90	88	90	86	88	86	88	88
7	20	52	Primi ê breech presentation	114	114	102	102	110	110	108	106	100	100	96	96	90	90	90	88	90	90
8	25	54	Primi ê polyhydrominia	94	92	72	70	58	82	80	76	80	76	86	88	82	80	80	88	86	86
9	22	48	G4P2L1 ê Pr LSCS	120	121	122	105	86	79	81	109	100	98	92	90	88	80	82	84	80	80
10	28	52	Primi ê low fecundity	83	95	94	88	75	70	74	75	84	84	86	80	76	76	76	80	82	80
11	20	50	G3P1L0A1 ê breech presentation	80	86	86	84	82	84	72	84	86	88	80	72	66	68	70	72	70	72
12	35	54	G2P1L1 ê Pr LSCS	82	98	98	100	90	94	90	88	85	72	78	80	84	80	80	80	72	76
13	30	52	G4P3L3 ê FTP	86	82	82	82	82	82	82	74	77	87	86	76	80	88	82	80	84	84
14	22	49	Primi ê CPD	100	79	73	73	84	80	77	88	90	80	78	78	72	68	70	72	76	78
15	20	51	Primi ê CPD	97	101	100	101	94	94	110	107	106	103	101	90	88	90	90	88	90	90
16	25	53	Primi ê PROM	99	101	103	99	93	64	108	106	103	102	90	86	88	86	84	88	84	84
17	25	54	G2P1L1 ê PROM	95	96	94	87	89	87	85	95	91	95	92	90	90	86	84	86	84	84
18	27	50	G5P2L1A2 ê 2Pr LSCS	80	86	88	84	73	60	84	90	90	86	84	86	84	86	86	86	84	86
19	28	51	G2P1L1 ê Pr LSCS	98	95	109	109	106	103	105	98	96	94	90	92	90	90	86	86	84	84
20	20	49	G2A1 ê PROM	88	86	82	82	70	82	74	88	90	92	86	84	88	86	90	92	80	86
21	20	52	G2P1L1 ê Pr LSCS	86	96	98	96	98	89	92	98	96	90	92	88	88	86	86	88	86	90
22	19	48	Primi ê transverse lie	86	94	93	96	93	90	96	92	90	90	92	92	94	90	90	92	90	90
23	28	49	Primi ê PROM	80	84	86	84	93	70	96	98	90	92	90	86	84	86	84	82	86	84
24	18	48	G2P0L0 ê FTP	106	104	108	108	100	102	94	102	99	100	96	90	90	88	88	88	86	86
25	24	50	G2P1L1 ê Pr LSCS ê breech	88	90	92	90	88	90	90	86	88	90	92	90	90	86	88	86	86	86
26	19	51	Primi ê Post dated	105	91	87	84	93	100	93	96	90	95	93	88	86	88	84	86	84	84
27	22	54	Primi ê CPD	95	96	94	97	92	79	85	76	88	87	84	80	78	80	80	86	88	80
28	20	49	G2P1L1 ê Pr LSCS	93	93	94	91	97	93	94	95	96	94	91	86	88	886	86	86	80	81
29	29	53	G2P1L1 ê Pr LSCS	95	93	90	94	84	73	76	75	72	84	86	84	86	84	84	86	84	84
30	22	50	G3P2L1 ê Pr LSCS	92	90	93	94	97	90	94	94	97	91	88	96	86	86	86	88	86	88
31	21	50	Primi ê CPD ê Polyhydromnia	88	90	88	91	80	76	82	89	85	84	84	86	86	84	84	86	84	84
32	30	51	G3P2L1 ê CPD ê Pr LSCS	83	82	87	93	96	90	95	97	93	93	90	96	90	90	86	88	86	84

Sl.No.	Haemodynamic parameters																																					
	BP in mm Hg																			Mean arterial pressure																			
	Pre SP	0	2	4	6	8	10	15	30	45	60	90	120	150	180	210	240	270		Pre SP	0	2	4	6	8	10	15	30	45	60	90	120	15					
1	130/87	110/63	113/64	117/63	116/66	95/64	73/30	120/71	119/77	116/74	115/79	110/90	110/80	110/80	116/90	120/80	120/86	122/80		101	79	80	81	83	74	44	77	91	88	91	97	90	9					
2	127/68	105/61	104/66	102/66	111/64	106/62	105/65	93/37	97/63	98/68	117/72	116/80	116/82	118/84	120/84	120/82	120/80	120/80		88	76	79	78	80	77	78	56	74	78	87	92	93	9					
3	130/80	130/80	126/80	120/78	104/76	100/70	110/80	120/70	120/72	124/72	106/80	110/80	114/80	120/80	120/80	124/80	124/80	124/80		97	97	95	92	85	80	90	87	88	89	89	92	91	9					
4	130/90	130/90	130/90	130/86	130/80	130/90	134/70	130/70	130/80	124/80	136/84	130/90	120/80	136/90	130/80	130/86	130/86	130/84		103	103	103	101	97	103	91	90	97	95	101	103	93	9					
5	107/78	109/60	109/60	104/64	99/41	102/64	106/69	113/67	124/67	117/69	112/64	100/60	114/70	110/90	120/80	122/80	124/84	124/90		88	76	76	77	60	77	81	82	86	85	80	73	85	9					
6	110/70	110/70	100/70	120/80	120/80	120/80	110/80	100/80	110/80	130/80	120/80	110/80	110/80	112/80	110/70	118/70	116/70	116/80		83	88	80	93	93	93	90	87	90	97	93	90	90	9					
7	130/80	110/70	110/70	108/70	100/60	102/60	70/60	100/70	120/60	120/70	122/70	124/80	122/80	126/80	130/80	130/80	128/80	128/82		97	83	83	83	73	74	63	80	80	87	87	95	94	9					
8	120/80	120/80	110/70	120/80	120/90	124/80	122/88	120/80	120/80	110/80	110/70	120/80	120/80	120/82	120/80	120/80	120/80	120/80		93	93	83	93	100	95	99	93	93	90	83	93	93	9					
9	120/90	70/60	80/70	90/80	120/82	120/80	126/80	128/80	110/70	120/90	120/90	120/90	122/90	124/90	120/90	120/90	120/90	120/90		100	63	73	83	95	93	95	96	83	100	100	100	101	10					
10	124/82	120/86	124/84	120/90	120//82	120/80	122/80	110/80	114/80	120/70	100/80	104/86	104/82	110/80	114/82	116/82	118/80	118/80		96	97	97	100	95	93	95	90	89	87	87	92	89	9					
11	124/78	105/60	86/42	88/52	97/59	102/61	104/64	124/84	105/62	100/63	108/62	106/78	122/80	120/80	118/80	120/80	118/80	120/80		93	75	57	64	72	75	77	97	76	78	77	87	94	9					
12	113/84	123/74	119/78	116/76	121/73	118/71	120/73	119/71	116/73	122/70	124/70	118/72	124/80	114/80	116/80	120/80	116/78	118/78		94	90	92	89	89	87	89	87	87	87	88	87	95	9					
13	126/81	136/92	111/71	110/61	102/61	98/69	105/66	85/47	101/60	110/61	116/63	120/70	124/68	124/70	122/80	120/80	120/82	120/82		96	107	84	77	75	79	79	60	74	77	81	87	87	8					
14	116/80	116/80	114/60	110/60	110/64	110/66	100/60	120/80	110/60	110/70	120/70	130/80	130/80	120/90	120/90	120/82	120/90	120/90		92	92	78	77	79	81	73	93	77	83	87	97	97	10					
15	122/86	122/86	114/76	110/68	117/76	117/74	114/73	112/74	123/84	126/80	126/82	128/80	128/80	126/80	126/84	124/82	126/84	126/82		98	98	89	82	90	88	87	87	97	95	97	96	96	9					
16	124/76	132/68	130/64	129/63	124/60	117/66	124/61	119/69	119/67	120/65	128/77	128/75	126/70	124/70	124/72	120/70	124/70	124/74		92	89	86	85	81	83	82	86	84	83	94	93	89	8					
17	120/80	120/80	116/80	110/70	100/70	90/60	100/70	110/70	120/80	120/80	110/70	110/70	106/70	110/70	114/70	114/70	112/70	112/70		93	93	92	83	80	70	80	83	93	93	83	83	82	8					
18	113/67	113/64	96/93	86/36	111/84	127/79	128/84	120/82	112/83	113/78	115/78	110/78	114/70	110/70	112/70	114/76	116/76	114/78		82	80	67	53	93	95	99	95	93	90	90	89	85	8					
19	120/90	130/90	120/90	120/90	110/80	110/80	120/80	130/90	130/70	120/70	120/80	120/80	122/80	118/80	120/82	120/82	120/84	120/84		100	103	100	100	90	90	93	103	90	87	93	93	94	9					
20	128/82	115/74	119/74	130/68	120/80	96/60	85/60	100/64	124/68	118/68	124/68	124/76	120/80	124/80	124/76	124/80	124/82	124/80		97	88	89	89	93	72	68	76	87	85	87	92	93	9					
21	104/67	106/66	112/66	111/63	94/54	94/67	106/66	106/65	126/64	128/80	126/80	128/80	128/82	124/86	124/86	128/86	128/84	128/80		79	79	81	79	67	76	79	79	85	96	96	96	97	9					
22	126/87	126/89	124/86	102/66	93/56	110/61	109/60	90/58	94/69	96/60	100/60	102/64	102/64	108/70	110/70	116/70	116/70	120/70		100	101	99	78	68	77	76	69	77	72	73	77	77	8					
23	127/84	130/82	132/78	130/84	117/70	127/84	120/70	112/61	123/62	127/67	123/64	130/60	128/60	130/60	126/60	128/60	126/70	124/72		98	98	96	99	86	98	87	78	82	87	84	83	83	8					
24	110/70	110/70	100/70	92/70	102/70	80/70	90/70	106/70	108/70	108/70	110/70	112/70	110/70	110/70	112/70	110/70	110/72	110/72		83	83	80	7	81	73	77	82	83	83	83	84	83	8					
25	115/73	120/68	101/64	99/66	98/76	99/72	123/75	118/79	103/68	113/60	115/75	116/74	118/72	118/72	118/74	116/74	116/70	118/70		87	85	76	77	83	81	91	92	80	78	88	88	87	8					
26	130/80	110/80	100/70	100/68	98/70	100/70	102/70	124/70	116/80	126/76	126/80	124/80	126/78	126/80	124/80	124/82	126/80	126/80		97	90	80	79	79	80	81	88	92	93	95	95	94	9					
27	114/86	117/68	119/66	99/39	97/48	122/61	116/67	118/74	124/82	122/69	106/69	110/70	112/70	112/72	114/72	114/72	116/80	116/82		95	84	84	56	64	81	83	89	96	87	81	83	84	8					
28	120/80	130/76	130/76	120/70	110/70	100/70	110/70	110/80	120/80	110/70	120/80	110/70	116/72	118/70	118/72	118/74	118/72	118/72		93	94	94	87	83	80	83	90	93	83	93	83	87	8					
29	120/80	120/80	120/80	104/70	102/70	96/66	110/90	106/80	120/70	122/80	120/80	122/80	124/80	122/80	120/80	120/80	120/80	120/80		93	93	93	81	81	76	97	89	87	94	93	94	95	9					
30	130/82	137/87	130/70	127/68	121/70	109/60	109/69	112/60	113/60	119/69	120/70	118/74	120/74	122/70	120/72	120/74	120/72	120/72		98	104	90	88	87	76	82	77	78	86	87	89	89	8					
31	110/80	120/80	116/80	110/70	112/74	114/70	110/80	112/80	112/80	110/80	112/82	110/80	112/80	114/82	114/80	116/80	116/80	114/80		90	93	92	83	87	85	90	91	91	90	92	90	91	9					
32	136/70	105/68	111/67	116/61	124/76	119/96	93/69	106/67	117/70	113/65	109/68	106/69	110/64	112/70	114/70	112/70	114/70	112/70		92	80	82	79	92	104	77	80	86	81	82	81	79	8					

Sl.No.	Haemodynamic parameters																																		
	BP in mm Hg																			Mean arterial pressure																
	Pre SP	0	2	4	6	8	10	15	30	45	60	90	120	150	180	210	240	270	Pre SP	0	2	4	6	8	10	15	30	45	60	90	120	15
1	130/80	110/66	108/65	124/90	110/80	89/40	124/84	110/66	106/64	110/70	120/80	120/80	122/82	122/80	124/80	129/80	120/80	124/80	97	81	79	101	90	56	97	81	78	83	93	93	95	9
2	116/82	116/70	108/66	99/66	102/62	106/60	86/57	108/62	114/68	116/68	126/78	13/74	126/80	126/80	120/80	122/80	120/80	124/80	93	85	80	79	75	75	67	77	83	84	94	93	95	9
3	130/86	120/70	111/60	117/65	123/70	122/66	130/73	134/68	130/80	60/40	90/50	96/60	100/60	106/68	110/70	110/68	112/70	110/72	101	87	77	82	88	85	92	90	97	47	63	72	73	8
4	122/74	109/68	104/45	102/50	106/60	115/62	112/65	115/62	117/60	116/60	118/60	110/70	116/70	116/74	118/70	120/70	120/70	120/70	90	82	65	67	75	80	81	80	79	79	79	83	85	8
5	125/74	125/90	128/84	123/90	129/81	129/82	122/77	121/73	107/61	112/63	114/70	114/70	116/70	118/74	120/74	120/74	120/70	120/70	91	101	99	101	97	98	92	89	76	79	85	85	85	8
6	124/76	122/68	121/64	129/63	124/61	117/66	124/61	119/69	119/67	131/65	128/67	128/75	126/70	124/72	126/70	124/70	124/72	126/74	92	86	83	85	82	83	82	86	84	87	87	92	89	8
7	130/72	120/75	120/60	110/70	108/70	106/72	106/72	104/70	110/74	112/74	110/70	114/72	114/70	114/70	118/70	118/74	120/70	118/70	91	90	80	83	83	83	83	81	86	87	83	86	85	8
8	120/80	120/80	110/80	120/80	110/80	120/80	120/90	104/70	100/60	110/80	126/90	120/70	130/70	120/90	124/90	124/90	126/80	126/80	93	93	90	93	87	93	100	81	73	90	102	87	90	1
9	118/81	117/70	113/60	87/47	108/60	103/66	102/69	109/65	98/52	108/66	110/80	120/80	118/80	122/80	110/70	114/70	116/70	120/80	93	86	78	60	76	78	80	80	67	80	90	93	93	9
10	132/84	132/77	106/69	101/63	97/47	93/63	99/67	99/66	98/69	124/80	126/80	120/80	130/70	130/80	130/80	126/80	132/80	126/80	100	95	81	70	64	73	78	77	79	95	95	93	90	9
11	130/90	100/70	102/70	100/70	90/70	92/70	80/60	100/60	100/70	110/80	120/80	130/90	120/70	110/70	110/70	120/70	122/70	124/70	103	80	81	80	77	77	67	73	80	90	93	103	87	8
12	127/90	110/63	110/63	99/67	97/63	103/63	105/63	105/63	110/70	110/70	100/60	120/90	120/90	110/70	110/70	120/70	110/80	114/70	102	79	79	78	74	76	77	77	83	83	73	100	100	8
13	105/69	108/72	108/72	97/68	96/67	96/60	98/60	109/65	115/74	103/65	106/64	92/70	90/70	96/74	114/80	110/80	110/80	110/82	81	84	84	78	77	72	73	80	88	78	78	77	77	8
14	107/80	90/60	83/34	85/42	106/50	120/60	110/60	113/62	116/60	110/70	112/70	110/70	120/70	116/70	120/70	120/70	120/90	122/90	89	70	50	56	69	80	77	79	79	83	84	83	84	8
15	114/71	112/61	112/63	107/66	111/62	111/62	98/65	98/45	110/57	111/65	116/69	112/61	118/80	120/80	120/70	124/70	122/70	130/70	85	78	79	80	78	78	76	63	75	80	85	78	93	9
16	130/90	120/90	87/43	90/53	95/60	100/66	127/90	107/60	100/60	110/70	120/74	126/77	120/70	118/70	124/70	120/80	118/80	126/80	103	100	58	65	72	77	102	76	73	83	89	93	87	8
17	120/90	120/90	120/90	104/80	100/80	110/90	100/90	120/80	116/80	120/84	124/80	120/80	122/80	120/80	120/80	120/70	118/90	120/80	100	100	100	88	87	97	93	93	92	90	95	93	94	9
18	110/70	106/70	110/80	110/70	108/70	120/80	130/80	126/80	126/80	120/80	130/80	130/80	120/80	118/80	120/80	116/80	110/80	116/80	83	82	90	83	83	93	97	95	95	93	97	97	93	9
19	130/80	130/78	112/73	108/71	119/75	117/76	116/74	121/67	117/68	120/65	122/75	120/70	122/70	120/70	120/80	120/80	122/80	122/88	97	95	86	83	90	90	88	85	84	83	91	87	87	8
20	132/82	136/69	127/76	119/69	123/73	119/72	112/63	119/63	129/83	126/86	128/80	126/84	128/82	128/80	126/86	122/88	126/90	126/90	99	91	93	86	90	88	79	82	98	99	96	98	97	9
21	130/80	130/80	110/70	107/90	110/70	96/60	94/60	90/60	116/80	120/80	106/80	106/70	100/70	100/80	106/70	110/80	116/80	116/80	97	97	83	96	83	72	71	70	92	93	89	82	80	8
22	130/80	130/80	120/80	120/70	120/90	122/90	120/90	120/80	122/80	124/90	120/90	122/90	120/90	124/90	124/90	126/90	126/90	126/90	97	97	93	87	100	101	100	93	94	101	100	101	100	1
23	120/80	114/80	110/86	110/76	112/63	130/80	126/80	110/80	100/60	110/70	114/70	116/70	120/80	120/82	120/80	120/84	126/80	124/80	93	91	94	87	79	97	95	90	73	83	85	85	93	9
24	123/70	122/76	113/80	117/76	118/68	108/72	118/73	110/63	108/62	105/61	106/60	108/60	108/60	108/60	110/70	110/70	110/70	112/74	88	91	91	90	85	84	88	79	77	76	75	76	76	7
25	130/90	130/80	120/90	110/70	120/80	110/80	120/80	120/80	120/60	120/70	130/90	128/90	126/86	120/90	122/90	120/86	124/86	124/86	103	97	100	83	93	90	93	93	80	87	103	103	99	1
26	130/79	98/66	106/69	108/61	108/69	129/63	122/66	119/67	108/45	118/67	117/70	120/78	116/80	118/70	118/80	116/80	118/70	118/80	96	77	81	77	82	85	85	84	66	84	86	92	92	8
27	120/75	120/82	109/66	91/37	96/46	96/56	112/65	110/70	115/69	110/70	114/68	110/70	112/70	114/70	116/70	118/70	120/70	118/70	90	95	80	55	63	69	81	83	84	83	83	83	84	8
28	111/60	105/60	107/61	110/63	109/68	102/63	107/61	102/63	110/68	103/68	110/73	110/80	110/70	114/70	120/70	120/70	120/70	126/70	77	75	76	79	82	76	76	76	82	80	85	90	83	8
29	116/84	117/69	112/68	103/63	123/80	112/75	124/74	119/76	115/70	122/82	116/80	110/84	112/80	110/84	114/80	116/80	116/84	120/80	95	85	83	76	94	87	91	90	85	95	92	93	91	9
30	113/82	113/82	128/79	121/90	94/74	94/74	106/80	124/80	111/66	109/61	110/70	112/70	112/70	116/70	120/70	118/70	120/70	120/70	92	92	95	100	81	81	89	95	81	77	83	84	84	8
31	128/73	133/94	133/71	128/69	122/63	116/52	88/68	113/61	119/68	128/67	126/70	124/70	124/68	126/70	126/72	126/70	124/70	126/70	91	107	92	89	83	80	75	78	85	87	89	88	87	8
32	126/77	126/77	97/64	96/58	98/67	108/65	109/61	102/68	105/60	109/60	110/60	110/64	110/70	110/70	110/72	110/70	110/70	110/70	93	93	75	71	77	79	77	79	75	76	77	79	83	8

Sl.No.	Respiratory parameters																																	
	Respiratory rate per minute																			Oxygen saturation (SPO_2) in percentage															
	Pre SP	0	2	4	6	8	10	15	30	45	60	90	120	150	180	210	240	270	Pre SP	0	2	4	6	8	10	15	30	45	60	90	120	150	180
1	26	26	24	24	24	24	22	22	22	22	22	22	22	22	22	22	22	22	99	96	99	98	99	99	99	99	98	98	98	99	99	98	99
2	24	24	24	24	24	24	24	24	22	22	20	20	20	20	20	20	20	20	98	98	99	99	99	99	99	99	98	98	98	97	97	98	97
3	24	24	24	24	24	24	24	22	22	22	22	22	22	22	22	22	22	22	98	97	99	99	99	99	99	98	99	99	98	98	98	98	98
4	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	98	97	98	98	99	99	99	99	98	98	97	97	97	98	98
5	16	16	16	16	16	16	16	15	14	14	16	16	16	16	16	16	16	16	98	99	99	99	99	99	99	99	99	99	99	99	99	99	99
6	24	24	24	24	24	22	22	22	22	22	22	22	22	22	22	22	22	22	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
7	24	24	24	24	24	24	22	22	22	22	22	22	22	22	22	22	22	22	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
8	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
9	22	22	22	22	22	20	20	20	20	20	20	20	20	20	20	20	20	20	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
11	22	22	22	24	24	24	24	22	22	22	22	22	22	22	22	22	22	22	98	98	99	99	99	99	99	99	98	98	98	98	98	98	97
12	22	24	22	24	22	22	22	22	22	24	20	20	20	18	18	18	18	20	98	97	99	98	99	99	99	98	98	97	99	98	97	98	99
13	20	20	20	24	24	24	24	20	22	22	22	22	20	20	20	20	20	20	99	97	99	99	99	99	99	98	98	99	99	99	99	99	99
14	24	24	24	24	24	24	22	22	20	20	20	18	18	18	20	18	18	20	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
15	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
16	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
18	26	26	24	24	24	22	22	24	24	22	24	24	24	24	24	22	22	22	97	97	98	98	98	98	99	99	98	98	98	98	98	98	99
19	24	24	24	22	20	20	20	20	20	20	20	20	20	20	20	20	20	20	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
20	22	22	22	22	22	20	20	20	20	20	20	20	20	20	20	20	20	20	99	97	98	98	98	99	98	99	99	98	98	98	98	98	98
21	20	19	20	20	20	18	18	18	20	20	20	20	20	20	20	20	20	20	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
23	22	22	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
24	20	22	22	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	99	99	99	99	99	99	98	98	99	98	99	99	98	98	98
25	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
26	26	26	24	24	24	24	22	22	22	22	22	22	22	22	22	22	22	22	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
27	24	24	24	24	22	22	22	22	22	22	22	22	22	22	22	22	22	22	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
28	26	26	24	24	22	22	22	22	22	22	22	22	22	22	22	22	22	22	99	97	99	99	99	99	99	98	98	98	98	98	99	99	99
29	22	24	22	22	20	20	20	20	20	20	20	20	20	20	20	20	20	20	99	99	99	99	99	99	99	99	99	98	98	99	99	99	99
30	26	26	24	24	24	24	24	24	22	22	22	22	20	20	22	22	22	22	98	98	99	99	99	99	99	98	98	98	98	98	98	98	98
31	24	22	24	24	22	22	22	22	22	22	22	22	22	22	22	22	22	22	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
32	26	26	24	24	24	24	24	22	22	22	22	22	22	22	24	24	24	24	98	98	97	99	99	99	99	99	99	98	98	98	98	98	98

Sl.No.	Respiratory parameters																																					
	Respiratory rate per minute																			Oxygen saturation (SPO_2) in percentage																		
	Pre SP	0	2	4	6	8	10	15	30	45	60	90	120	150	180	210	240	270	Pre SP	0	2	4	6	8	10	15	30	45	60	90	120	150	180					
1	20	22	23	22	22	24	22	23	24	24	24	22	22	22	22	22	22	22	98	99	99	98	98	98	99	99	99	99	99	99	99	98	98					
2	21	20	20	20	20	18	18	18	18	20	24	24	22	20	22	20	20	20	99	99	99	99	99	99	98	98	99	98	99	99	99	99	98					
3	24	26	23	24	22	22	23	24	24	24	24	22	22	24	24	24	24	24	97	99	99	98	98	99	99	99	99	98	98	98	99	99	98					
4	20	26	22	22	20	24	22	22	20	20	20	20	20	20	20	20	20	20	99	99	99	98	99	99	99	99	99	99	99	98	99	99	99					
5	18	18	18	20	20	20	20	20	18	18	20	18	20	18	18	18	18	18	99	98	99	98	98	99	99	99	99	99	99	99	99	99	99					
6	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99					
7	24	24	22	22	22	22	22	22	22	22	22	20	20	20	20	20	20	20	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99					
8	22	24	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	98	97	98	97	98	98	97	97	97	97	98	99	98	98	98					
9	22	22	22	22	22	22	20	20	20	20	20	20	20	20	20	20	20	20	99	99	99	98	99	99	99	97	97	98	98	98	99	98	99					
10	22	22	22	22	22	20	20	20	22	22	22	20	22	20	20	20	20	20	97	98	97	98	99	99	98	99	98	98	99	98	99	98	99					
11	24	22	22	20	20	20	22	22	22	20	20	22	22	20	22	22	22	22	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99					
12	20	20	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	97	99	99	98	98	98	98	98	98	99	99	99	99	98	98					
13	18	18	18	18	18	16	17	18	18	18	19	18	18	18	18	18	18	18	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99					
14	24	24	24	24	22	22	20	20	22	20	20	22	20	22	22	22	22	20	99	99	99	97	97	96	98	97	98	99	98	99	99	99	98					
15	18	18	16	16	16	17	16	18	18	18	16	16	18	18	18	18	18	18	99	98	99	98	98	99	99	99	98	99	99	99	99	98	98					
16	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99					
17	18	20	20	20	20	18	20	20	20	18	18	18	20	20	20	20	20	20	98	99	99	99	99	99	98	98	98	99	99	98	98	99	99					
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19	18	20	20	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	98	98	98	99	99	99	99	99	99	99	99	99	99	99	99					
20	15	16	16	16	18	18	16	16	16	16	16	16	16	18	18	16	16	16	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99					
21	24	24	24	24	24	24	24	24	24	24	22	22	24	24	24	24	22	22	99	99	99	99	99	99	99	99	99	99	99	99	99	99	98					
22	22	22	21	21	22	22	22	22	22	22	22	22	22	22	22	22	22	22	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99					
23	16	16	18	18	16	16	18	18	18	16	16	16	18	18	18	18	16	16	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99					
24	22	24	24	22	24	24	23	24	24	24	24	22	22	22	22	22	22	22	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99					
25	20	24	22	24	24	22	22	24	24	22	22	22	22	22	22	22	22	22	98	98	99	99	98	98	98	99	99	99	99	99	99	99	99					
26	24	24	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	97	95	96	96	96	97	97	97	98	98	98	97	97	98	98					
27	22	22	24	24	22	22	22	22	22	22	22	22	22	22	22	22	22	22	98	99	99	99	99	99	99	99	99	99	99	99	99	99	99					
28	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	99	98	99	98	99	99	99	98	99	99	99	99	99	99	99					
29	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	98	99	99	99	99	99	99	99	99	99	99	99	99	99	99					
30	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	97	98	98	98	99	99	99	99	99	99	99	99	99	99	99					
31	26	26	26	26	26	24	24	24	24	24	24	24	24	24	24	24	24	24	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99					
32	26	26	26	26	24	24	24	24	24	24	24	24	24	24	24	24	24	24	98	99	99	99	99	99	99	99	98	98	98	98	98	98	98					

Sl.No.	Subarachnoid block to extraction of	Total duration of surgery (min)	Sensory character								Motor character			Sedation	Side effects
			TOSA upto T_{10} (min)	HSLA	TTAHLSA (min)	TTSR (min)	TDEA (min)	TSR to L1 (min)	TWPRA (min)	TDSA (min)	TOMB (min)	QMBBS Grade	TCMR (min)		
1	6	60	1'50"	T6	6'20"	90'	180'	160'	200'	180'	4'	3	135'	Nil	↓BP
2	6	55	1'48"	T6	3'18"	60'	90'	100'	100'	110'	1'12"	3	90'	Nil	↓BP
3	5	50	2'	T4	10'	105'	180'	180'	185'	180'	2'	3	120'	Nil	↓PR shivering
4	7	45	1'20"	T3	8'	100'	180'	200'	210'	200'	2'	3	120'	Nil	-
5	8	75	2'	T4	4'	75'	180'	190'	180'	200'	2'	3	180'	Nil	Vomiting
6	6	70	2'	T4	4'50"	90'	180'	195'	200'	195'	3'	3	105'	Nil	Shivering
7	6	70	2'	T6	5'	130'	180'	200'	190'	205'	4'	3	140'	Nil	↓BP
8	5	60	2'	T4	8'	80'	150'	180'	160'	180'	5'	3	120'	Nil	↓PR
9	7	65	2'	T6	6'	80'	150'	190'	165'	190'	3'	3	90'	Nil	↓BP Shivering
10	8	65	3'30"	T4	4'	70'	180'	180'	185'	180'	2'	3	130'	Nil	Vomiting
11	6	60	1'30"	T4	3'	90'	120'	130'	130'	130'	2'	3	100'	Nil	↓BP ↓PR
12	8	60	3'	T4	7'	90'	180'	170'	180'	190'	4'	3	90'	Nil	-
13	9	55	3'	T6	5'	90'	180'	150'	160'	180'	3'	3	100'	Nil	↓BP
14	10	50	1'56"	T4	3'	130'	180'	190'	200'	190'	2'44"	3	140	Nil	↓BP
15	7	45	3'	T3	6'	90'	190'	170'	180'	190'	3'	3	110'	Nil	-
16	6	65	1'50"	T4	6'	90'	190'	180'	190'	190'	3'	3	110'	Nil	-
17	5	60	1'30"	T6	3'	120'	145'	150'	160'	145'	2'	3	140'	Nil	Vomiting
18	8	60	1'50"	T4	3'	110'	170'	160'	170'	170'	1'50"	3	140'	Nil	↓BP ↓ PR
19	7	60	4'	T6	7'	90'	125'	125'	125'	125'	4'	3	120'	Nil	-
20	6	55	2'	T6	8'	100'	180'	150'	165'	180'	3'	3	120'	Nil	↓BP
21	6	60	2'	T4	4'	70'	120'	120'	130'	120'	5'	3	90'	Nil	↓BP
22	5	75	1'58"	T4	2'	90'	140'	120'	130'	150'	2'	3	120'	Nil	↓BP Vomiting
23	6	80	1'30"	T6	3'	100'	230'	200'	210'	230'	3'15"	3	100"	Nil	-
24	6	80	2'	T3	4'	90'	220'	200'	210'	230'	3'	3	100'	Nil	↓PR ↓BP
25	7	70	2'	T4	6'	80'	200'	180'	180'	205'	3'	3	90'	Nil	-
26	6	50	4'	T4	7'	100'	175'	160'	175'	180'	3'	3	120'	Nil	-
27	5	45	2'30"	T4	5'	90'	190'	180'	180'	190'	3'	3	90'	Nil	↓BP
28	7	60	2'	T4	4'	110'	260'	260'	270'	260'	3'	3	100'	Nil	Shivering
29	7	65	2'	T3	6'	100'	190'	175'	180'	200'	4'	3	90'	Nil	Vomiting
30	6	70	2'	T6	8'	100'	200'	190'	200'	210'	4'	3	90'	Nil	-
31	5	55	3'	T6	6'	100'	180'	160'	170'	180'	4'	3	90'	Nil	-
32	6	75	2'	T4	3'	90'	180'	170'	180'	190'	2'	3	95'	Nil	↓BP Shivering

			Sensory character								Motor character				
Sl.No.	Subarachnoid block to extraction of baby	Total duration of surgery (min)	TOSA upto T_{10}(min)	HSLA	TTAHLSA (min)	TTSR (min)	TDEA (min)	TSR to L1 (min)	TWPRA (min)	TDSA (min)	TOMB (min)	QMBBS Grade	TCMR (min)	Sedation	Side effects
1	6	50	2'	T4	4'	100'	270'	250'	260'	280'	3'	3	90'	Mild	↓BP
2	7	55	1'50"	T4	3'20"	100'	300'	280'	285'	300'	2'	3	115'	Mild	↓BP
3	8	78	2'	T4	3'	110'	310'	290'	290'	310'	2'	3	100'	Mild	↓BP
4	8	55	2'	T4	6'	100	300'	275'	290'	300'	3'	3	100'	Mild	↓BP
5	6	64	1'50"	T5	4'	110'	280'	250'	260'	280'	2'10"	3	100'	Mild	-
6	7	65	1'50"	T4	4'	90'	290'	260'	275'	290'	3'	3	100'	Mild	-
7	7	60	1'10"	T4	3'	90'	250'	230'	240'	250'	2'20"	3	120'	Mild	-
8	6	60	1'30"	T3	3'	150'	300'	280'	290'	300'	3'	3	120'	Mild	-
9	6	68	2'	T4	4'	150'	320'	310'	320'	310'	4'	3	120'	Mild	↓BP
10	8	68	1'20"	T4	2'54"	120'	290'	265'	270'	270'	2'20"	3	90'	Mild	↓BP
11	8	70	2'	T4	4'	150'	285'	280'	300'	285'	2'20"	3	180'	Mild	↓BP
12	8	55	2'30"	T4	10'	150'	280'	270'	300'	280'	3'30"	3	170'	Mild	↓BP
13	6	55	2'	T4	6'	170'	270'	340'	350'	270'	5'	3	150'	Mild	↓BP
14	7	50	1'30"	T4	3'22"	180'	220'	255'	260'	220'	3'	3	190'	Mild	↓BP
15	7	56	1'	T4	2'	185'	240'	235'	235'	240'	2'	3	120'	Mild	Shivering vomiting
16	7	65	3'	T5	4'	180'	270'	280'	290'	270'	4'	3	90'	Mild	↓BP ↓HR
17	8	65	2'	T3	4'	160'	180'	220'	240'	220'	2'	3	140'	Mild	-
18	8	60	1'40"	T4	4'	120'	280'	240'	250'	280'	2'	3	110'	Mild	↓HR
19	9	60	2'	T4	6'	100'	210'	180'	195'	210'	3'	3	105'	Mild	Vomiting
20	8	80	2'	T4	3'	150'	340'	300'	340'	340'	3'	3	200'	Mild	Vomiting
21	7	75	1'	T4	1'40"	105'	270'	260'	275'	270'	2'	3	200'	Mild	↓BP
22	7	70	1'30"	T4	8'	120'	280'	270'	280'	280'	4'	3	170'	Mild	Discomfort ↓HR
23	6	69	1'30"	T3	3'	120'	280'	280'	300'	280'	2'	3	150'	Mild	-
24	7	50	1'	T3	3'	200'	310'	270'	300'	300'	1'30"	3	200'	Mild	-
25	8	68	1'	T3	5'	100'	300'	280'	290'	300'	2'	3	105'	Mild	-
26	8	60	2'	T4	3'30"	90'	220'	220'	235'	220'	1'50"	3	120'	Mild	Vomiting ↓HR
27	6	60	1'	T4	3'30"	150'	280'	280'	295'	290'	2'	3	120'	Mild	↓BP Pru (mild) Vomiting
28	6	60	2'6"	T4	6'	90'	240'	250'	260'	240'	2'2"	3	200'	Mild	Vomiting Shivering
29	6	60	1'20"	T6	3'	180'	290'	280'	280'	290'	1'40"	3	190'	Mild	Pruritus shivering
30	8	55	1'20"	T4	3'	120'	290'	270'	290'	290'	2'	3	90'	Mild	Pruritus
31	6	63	2'	T4	4'	100'	260'	240'	250'	260'	3'	3	90'	Mild	↓BP
32	7	55	1'50"	T4	3'	110'	260'	250'	260'	260'	3'	3	120'	Mild	-