e-ISSN: 0975-1556, p-ISSN:2820-2643
Available online on www.ijpcr.com
International Journal of Pharmaceutical and Clinical Research 2024; 16(8); 1453-1467

Original Research Article

A Comparative Study between Epidural Analgesia with Bupivacaine 0.5% along 25 Mcg Fentanyl with Bupivacaine 0.5 with Dexmedetomidine 25 Mcg in Radical Cholecystectomy

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Received: 25-05-2024 / Revised: 23-06-2024 / Accepted: 25-07-2024
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Conflict of interest: Nil

Abstract:

Background and Objectives: Pain is defined by the international association for study of pain as an "unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage, Based on the present clinical comparative study epidural analgesia with bupivacaine 0.5% along 25 mcg fentanyl with bupivacaine 0.5% with dexmedetomidine 25 mcg in radical cholecystectomy.

Material and Methods: This study was an interventional, prospective, double blind, parallel group, randomized clinical study conducted on patients undergoing elective lower limb and upper abdominal surgeries.in Department of Anaesthesiology at NMCH Jamuhar, Rohtas.

Conclusion: Based on the present clinical comparative study, Epidural analgesia bupivacaine 0.5% with 25 mcg dexmedetomidine when administered for radical cholecystectomy was superior to bupivacaine 0.5% with 25 mcg fentanyl in providing longer duration of pain relief. we conclude that isobaric 0.75% Ropivacaine, when administered through epidural route, provides adequate anaesthesia for gall bladder surgeries.

Keywords: Bupivacaine, Fentanyl, Dexmedetomidine, Cholecystectomy.

Introduction

Pain is defined by the International Association for study of pain as an "unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage". [1] The greatest gift God has given to mankind is not in happiness, but in relief of pain. In pursuit of relief of pain, particularly pain during and after surgery, many attempts have been made since time immemorial. [2] A recent meta-analysis of multiple comparisons of neuraxial blockade to general anaesthesia has shown a significant reduction in mortality and morbidity with regional techniques. [3] Despite many advances in pain management, postoperative pain still remains an important cause of suffering. [4] Neuraxial routes of drug administration have been used for postoperative analgesia since long. [5] Also there is no limitation for the duration of surgery if an epidural catheter is in place. It can also be used as a modality for post operative pain relief. Local anaesthetics alone have been used for many years for central neuraxial blockade. In recent years, use of intrathecal and epidural adjuvants to local anaesthetics has gained popularity with the aim of prolonging the duration of block, better success rate, patient satisfaction, decreased resource utilization and faster recovery as compared to general anaesthesia. Adequate pain management is essential to facilitate rehabilitation and accelerate functional recovery, enabling patients to return to their normal activity more quickly. Epidural Bupivacaine had been used extensively in the past for providing adequate post-op pain relief in patients undergoing lower abdominal surgeries. Adjuvants like morphine, fentanyl, ketamine, neostigmine, midazolam, clonidine etc. have been commonly used for this purpose.

Bupivacaine: Bupivacaine is an amide-type, long-acting local anesthetic. It reversibly binds to specific sodium ion channels in the neuronal membrane, resulting in a decrease in the voltage-dependent membrane permeability to sodium ions and membrane stabilization; inhibition of depolarization and nerve impulse conduction; and a reversible loss of sensation. It is a widely used local anesthetic agent that blocks the generation and conduction of nerve impulses. This could be by increasing the threshold for electrical excitation in

the nerve, slowing the propagation of the nerve impulse, and by reducing the rate of rise of the action potential. Bupivacaine binds to the intracellular portionof sodium channels and blocks sodium influx into nerve cells, which prevents depolarization.

Fentanyl: Fentanyl is a synthetic, lipophilic phenylpiperidine, opioid agonist with analgesic and anaesthetic properties. It selectively binds to the mu-receptor in the central nervous system (CNS), thereby mimicking the effects of endogenous opiates. Stimulation of the mu-subtype opioid receptor stimulates the exchange of GTP for GDP on the G-protein complex and subsequently inhibits adenylate cyclase.

Dexmedetomidine: Dexmedetomidine is a new addition to the class of alpha-2 agonist which has got numerous beneficial effects when used through epidural route. It acts on both pre and post synaptic sympathetic nerve terminal and central nervous system thereby decreasing the sympathetic outflow and nor-epinephrine release causing sedative, anti-anxiety, analgesic, sympatholytic and haemodynamic effects.

Material and Methods

Vertebral Column: Composed of 33 vertebrae, 7 cervical, 12 thoracic, 5 lumbar, 5 fused sacral and 4 coccygeal. It has 4 curves. The cervical and lumbar curves are convex anteriorly while the thoracic and sacral curves are convex posteriorly. The curves have a significant effect on the spread of local anaesthetic in the subarachnoid and epidural space. The vertebral column is bounded together by several ligaments which give it stability and elasticity.

a. Supraspinous ligament
b. Interspinous ligament
c. Ligamentum flavum
d. Longitudinal ligament

The cervical, thoracic and lumbar vertebrae have differentiating features. A typical lumbar vertebra is made up of the following parts:

1. The body
2. Vertebral arch
3. Transverse and spinous processes
4. Superior and inferior articular processes

Epidural space

It is the potential space within the bony cavity of the spinal canal and outside the dural sac. It is bounded anteriorly by the vertebrae, the intervertebral discs and the posterior longitudinal ligament covering them. Posteriorly it is bounded by the anterior surface of the vertebral laminae and the ligamentum flavum. Superiorly it is closed by the fusion of the dura and periosteum at the foramen magnum, inferiorly by the sacrococcygeal ligament at the sacral hiatus and laterally by the pedicles of the vertebrae and the intervertebral foramina.

The shape of the epidural space in cross section is nearly circular in the cervical region and thoracic region, but becomes triangular in the lumbar region. The depth of the epidural space is greatest in the midline in the lumbar region, where it is said to be 5-6mm in adult males. For this region midline approach is advocated for entering the lumbar epidural space.

Epidural space communicates with the paravertebral spaces via the intervertebral foramina. The paravertebral spaces in the thoracic region lie between the head of the ribs and are in direct contact with the pleura. The negative intrathoracic pressure is thus conducted via the paravertebral spaces to the thoracic epidural space. To reach the epidural space in the midline of saggital plane, the following structures are penetrated:

Skin and subcutaneous tissue
Supraspinous ligament
Interspinous ligament
Ligamentum flavum

The ligamentum flavum is an important landmark for the technical identification of epidural space during induction of epidural analgesia. The first three structures offer little resistance to the advancing needle, but when the ligamentum flavum is reached, the resistance increases. As the needle passes through this tissue, there is sudden disappearance of resistance. In performing epidural anaesthesia, it is essential that, this point to be recognized, little further advancement results in subarachnoid penetration.

Contents of Epidural Space

It is a potentially empty space with negative pressure with following contents

I. **Spinal Nerve Roots:** Along with their dural cuffs they traverse the epidural space on their way to their respective intervertebral foramina. They become more inclined owing to the discrepancy between the length of the spinal cord and the spinal canal, until the lower lumber and sacral roots are almost vertical. The roots vary greatly in size and thickness. The thoracic roots are thin, while the cervical and lumbosacral roots subserving the limbs are thick. The great differences in size and neural populations within the roots are interrelated. The very large diameter and high neural population of the dorsal and ventral roots of the first sacral segment are associated with great resistance to epidural blockade. Prolonged latency and poor analgesia of S_1 segment are due to poor penetration of local anaesthetic and it deserve a special mention as they have an important role in the mechanism of the action of epidural anaesthesia. In the region of the dural cuff the arachnoid villi and granulations

invaginate the epidural veins and drain the CSF from the subarachnoid space, into the blood stream. Those villi, which are not in contact with the vessels, drain the CSF into the epidural fat, from where it is drained by lymphatics.

II. **Epidural Vessels:** The branches of subclavian, aortic and iliac arteries cross the epidural space and enter the subarachnoid space in the region of dural cuffs. These branches supply blood as far as spinal roots. Apart from the cervical region, the entire blood supply to the spinal cord passes through the epidural space. The epidural veins are arranged in the form of longitudinal plexuses on either side of the midline they drain the spinal cord, vertebral canal and CSF from the subarachnoid space. They do not possess valves.

III. **Fat:** The contents of the spinal canal lie cushioned in a packet of semifluid, lobulated fat. Solutions injected into the epidural space, track up and down between the fatty areolar tissue. The epidural fat constitutes an important pharmacological space and depot for injected local anaesthetics and drugs and it is one of the three competitors for the share of drug. The other two competitors are nervous tissue of spinal roots, spinal cord and blood vessels within the spinal canal. Drugs with high lipid solubility and lipoprotein binding characteristics will tend to enter the fat phase and remain there for a period of time, depending on their pharmacodynamics and on briskness of local blood flow competing for uptake. The compliance of epidural fat varies from person to person and with age. In children and young adults it offers very little resistance.

IV. **Lymphatics:** Surrounding and draining the dural sac, lymphatics run anteriorly from each intervertebral foramen and empty into the longitudinal channels in front of vertebral column.

Size of the Epidural Space:

Table 1: Regional epidural space width and dural thickness

	Epidural space (mm)	Thickness of dura (mm)
Cervical	1 – 1.5	1.5 – 2.0
Upper thoracic	2.5 – 3.0	1
Lower thoracic	4.0 – 5.0	1
Lumbar	5.0 – 6.0	0.33 – 0.66

Cerebrospinal Fluid (CSF): The CSF is an ultrafiltrate of plasma and is a clear and colourless fluid bathing the brain and spinal cord. Its main function is to cushion the neural structures. CSF is produced by the choroid plexus of the lateral, 3rd and 4th ventricles. It is reabsorbed via the arachnoid villi. Total volume of CSF is about 150 ml. With the patient lying in the lateral position normal CSF pressure is 70-80 mm of H_2O.

Blood Supply of the Spinal Cord: The anterior spinal artery is a midline vessel formed at the foramen magnum by a branch of each vertebral artery in the substance of piamater, overlying the anterior median fissure. It supplies the whole cord (3/4th of the substance of the cord) in front of the posterior grey column. Thrombosis of this artery causes paralysis sparing the posterior column.

The posterior spinal artery comprises of one vessel on either side derived from the posterior inferior cerebellar arteries they supply the whole posterior column. The spinal branches of the vertebral arteries, ascending cervical arteries, posterior intercostals arteries reinforce the spinal arteries. Communicating branches at the level of T_2 are larger than the others and supply the enlargements of the cord (arteries of Adamkiewicz).

Applied aspects of anatomy of epidural blockade: The epidural space is not as voluminous as the subarachnoid space. Nevertheless it extends from the base of the skull to the sacrococcygeal membrane and has direct communications with the paravertebral space and indirect communications with the cerebrospinal veins, which connect with intracranial veins. This is a potential direct route to the brain for drugs, air or other material when inadvertently injected into an epidural vein. Within the cranium there is no epidural space, as meningeal dura and endosteal dura are closely adherent, except where they separate to form venous sinuses. Between the spinal dura and the spinal periosteum lies the epidural space. Since the spinal canal is approximately triangular in cross section, articular processes indent the triangle, the epidural space narrows posteriorly and then widens again laterally towards the intervertebral foramina. Thus the safest point of entry into the epidural space is in the midline.

Detection of Epidural Space

Negative Pressure Techniques:

1. **Hanging drop sign:** After the needle has been introduced to the level of resistance indicating the beginning of ligamentum flavum, a small drop of sterile distilled water is placed on the hub of the needle. When needle is advanced through the ligamentum flavum drop will be “sucked into” epidural space.

2. **Capillary Tube Method**: Odom devised a small capillary tube filled with sterile saline in which 1 or 2 bubbles of air were placed. These acted as

meniscus. As needle enters epidural space, saline sucked in, and air bubbles advanced into space.

3. **Manometer Technique:** Small 'U' shaped glass tube about 3 to 4 inch height is used as a H_2O manometer. As the needle advances into the intraspinous ligament, the sterile glass manometer is attached. As it advances into the epidural space the immediate movement of liquid signifies negative pressure.

Lower lumbar area	0.5 cm H_2O or less
Upper lumbar area	2.0 cm H_2O
Lower thoracic area	2.0 cm H_2O

Clinical factors affecting epidural spread:

I. Spread increases with age: Escape from the epidural space is less due to intervertebral foramina being more fixed and epidural vessels less penetrable.

II. Spread is greater in pregnant women.

III. In arteriosclerosis and occlusive arterial disease the spread is also greater than the normal.

IV. Spread is decreased in dehydration, shock and cachexia.

V. Extent of anaesthesia is greater with more concentrated solutions.

VI. A greater dose is required in taller persons.

Physiological effects of epidural anaesthesia: The primary site of action of local anesthetic solutions injected into everse order.

Effect on brain: It may be considered as secondary to the physiologic sequence occurring, such as hypotension due to sympathetic blockade. Effect on cerebral blood flow is secondary to hypotension occurring and as a result of cerebral hypoxia. It is more sensitive in hypertensive than normotensive patient. If severe arterial hypotension occurs during epidural anaesthesia, a moderate head down position should be employed in order to maintain as great a cerebral blood flow the hypotension may allow. Respiratory and cardiovascular collapse can occur with high epidural anaesthesia due to paralysis of medullary centres. But such paralysis is not attributable to direct action of local anaesthetic on brain stem.

Action on Cardiovascular system:

Block Below T4: The effect of epidural anesthesia on the cardiovascular system depends on the level and the degree of sympathetic blockade. Vasomotor tone is maintained by sympathetic fibers from T5 to L1 that innervate vascular smooth muscle. The decrease in venous return can then lead to an increase in cardiac vagal tone, [31] especially for blocks near the T5 level. Clinically, the patient can be hypotensive without a change or a decrease in heart rate.

The compensatory mechanism for the decrease in mean arterial pressure is a reflex increase in vasoconstriction above the level of the block as well as a release in catecholamines from the adrenal medulla.

Block Above T4: The cardiovascular effects of a block above T4 are the result of a high sympathetic block. The cardiac sympathetic fibers arise from T1 to T4, and when blocked, profound hypotension (the result of a decrease in cardiac contractility) and bradycardia can occur. In addition to the cardiac effects, a high level of sympathetic blockade causes:

- Increased central venous pressure without an increase in stroke volume
- Vasoconstriction in the head, neck, and upper limbs
- Splanchnic nerve blockade with blockade of medullary secretion of catecholamines
- Blockade of vasoconstrictive effect on the capacitance vessels of the lower limbs.

When a sympathetic block occurs at such a high level, the cardiovascular system may be left without its mechanisms for responding to low cardiac output states. This can be detrimental to a patient with limited cardiac reserve because profound hypotension with bradycardia and decreased contractility can result. The anesthesiologist must be prepared to take over the control of the circulatory system until the block subsides and the patient stabilizes.

Effect on Respiratory system: Epidural blockade to midthoracic levels have minimal effect on patients with adequate lung function. Rarely, respiratory arrest during high epidural blockade has been reported. Contrary to what may seem a logical explanation, the arrest is not due to the effects of sensory or motor blockade or any effect of the local anesthetic on the brain. The reported causes of rare instances of respiratory arrest is from the sympathetic block, leading to decreased cardiac output with subsequent reduced blood flow to the brain.

Effect on Gastrointestinal system: The gastrointestinal effects of epidural anaesthesia are largely the result of blockage of the sympathetic

splanchnic fibers from the T5 through L1 level. Unopposed vagal dominance leads to an increase in gastrointestinal secretions; peristalsis; and a small, contracted gut. Postoperatively, gastrointestinal motility returns more quickly when epidural analgesia with a local anesthetic is instituted. Several studies suggested that thoracic epidural anesthesia prevented the decrease of intramucosal pH during major abdominal surgery as an effect of stable visceral perfusion. When thoracic epidural anesthesia is used as an adjunct to general anesthesia for major thoracic, cardiac, or abdominal surgery, a segmental block of T1 through T5 is typically the goal.

Effect on Renal/Genitourinary system: Since renal blood flow is maintained through autoregulation, an epidural block has very little effect on renal function. Neuraxial blockade at the lumbar level has been postulated to impair control of bladder function secondarily to blockage of the S2 to S4 segments. Urinary retention may occur until the block wears off. If a continuous epidural is used, then urinary catheterization may be necessary.

Effect on Neuroendocrine system: Surgical stress produces a variety of changes in endocrine and metabolic function. Increased protein catabolism and oxygen consumption are common. Increased plasma concentrations of catecholamines, vasopressin, growth hormone, renin, angiotensin, cortisol, glucose, antidiuretic hormone, and thyroid-stimulating hormone have been documented and referred to as the surgical stress response.The response can be completely abolished by an appropriate level of sensory blockade produced by regional anesthesia.

Gall bladder cancer and risk factors: Scientists have found some risk factors that make a person more likely to develop gallbladder cancer. Many of these are related in some way to chronic inflammation (long-lasting irritation and swelling) in the gallbladder.

Gallstones: Gallstones are the most common risk factor for gallbladder cancer. Gallstones are pebble-like collections of cholesterol and other substances that form in the gallbladder and can cause chronic inflammation. Up to 4 out of 5 people with gallbladder cancer have gallstones when they're diagnosed.

Porcelain gallbladder: Porcelain gallbladder is a condition in which the wall of the gallbladder becomes covered with calcium deposits. It sometimes occurs after long-term inflammation of the gallbladder (cholecystitis), which can be caused by gallstones. People with this condition have a higher risk of developing gallbladder cancer, possibly because both conditions can be related to inflammation.

Gender predilection: In the US, gallbladder cancer occurs 3 to 4 times more often in women than in men. Gallstones and gallbladder inflammation are important risk factors for gallbladder cancer and are also much more common in women than men.

Obesity: Patients with gallbladder cancer are more often overweight or obese than people without this disease. Obesity is also a risk factor for gallstones, which might help explain this link.

Choledochal cysts: Choledochal cysts are bile-filled sacs along the common bile duct, the tube that carries bile from the liver and gallbladder to the small intestine. The cells lining the sac often have areas of pre-cancerous changes, which can progress to gallbladder cancer over time.

Abnormalities of the bile ducts: The pancreas is another organ that releases fluids through a duct into the small intestine to help digestion. Some people have a defect where these ducts meet that lets juice from the pancreas flow backward (reflux) into the bile ducts. This backward flow also keeps bile from flowing out of the bile ducts as quickly as it should. People with these abnormalities are at higher risk of gallbladder cancer.

Gallbladder polyp: A gallbladder polyp is a growth that bulges from the surface of the inner gallbladder wall. Polyps larger than 1 centimeter (almost a half inch) are more likely to be cancer.

Bupivacaine

Bupivacaine is a potent local anesthetic with unique characteristics from the amide group of local anesthetics, first discovered in 1957.

Mechanism of Action: All local anaesthetics contain three structural components: an aromatic ring, a connecting group which is either an ester (procaine) or an amide (bupivacaine), and an ionizable amine group. All LAs have two chemical properties that determine their activity:

1. Lipid solubility
2. Ionization constant (pKa)

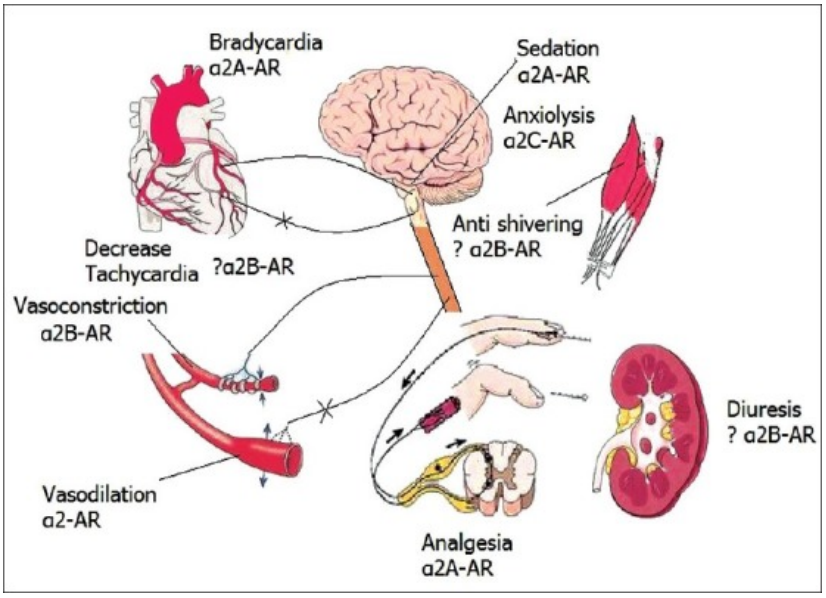
Lipid solubility determines potency, duration of action, and plasma-protein binding of local anesthetics. Local anesthetics enter nerve fibers as a neutral free base. Ionized forms and the cationic form blocks conduction by its interaction on the inner surface of the Na+ channel. Moreover, LAs with lower pKa have a more rapid onset of action, meaning more of it exists in an uncharged form, which renders faster diffusion to the cytoplasmic side of the Na+ channel.

Conduction of nerve impulses is through the generation of an action potential along an axon — local anesthesia results when LAs bind Na+ channel and inhibit the Na+ permeability necessary for the

action potential. Na+ channel blockade results in the decrease or elimination of conduction in vascular smooth muscle, leading to relaxation. In the heart, this leads to decreased pacemaker activity and prolongation of the refractory period. This action is unique to bupivacaine due to its decreased rate of dissociation from blocked sodium channels, which leads to prolongation of the maximal rate of depolarization (Vmax) and potential for ventricular arrhythmias.[

Administration: Bupivacaine is offered in three different concentrations: 0.25%, 0.5%, and 0.75% by local infiltration (post-surgical analgesia), peripheral nerve blocks (dental or other minor surgical procedures, orthopedic surgery), spinal anesthesia (injected into the CSF to produce anesthesia for orthopedic surgery, abdominal surgery, or cesarean delivery), epidural anesthesia/analgesia for labor pain, and for caudal block (anesthesia and analgesia below the umbilicus, usually for pediatric surgery).

Dexmedetomidine: Dexmedetomidine seems to have higher α2A-AR and α2C-AR affinity. Locus ceruleus of the brain stem is the principal site for the sedative action and spinal cord is the principal site for the analgesic action, both acting through α2A-AR. In the heart, the dominant action of α2-AR agonists is a decrease in tachycardia (through blocking cardioaccelerator nerve) and bradycardia via α2A-AR (through a vagomimetic action). In the peripheral vasculature, there is sympatholysis-mediated vasodilatation and smooth muscle cells receptor-mediated vasoconstriction.[29]



Physiology of various α2-adrenergic receptors: The responses to activation of the receptors in other areas include decreased salivation, decreased secretion, and decreased bowel motility in the gastrointestinal tract; contraction of vascular and other smooth muscle; inhibition of renin release, increased glomerular filtration, and increased secretion of sodium and water in the kidney; decreased intraocular pressure; and decreased insulin release from the pancreas. Combining all these effects, dexmedetomidine avoids some of the side effects of multiagent therapies.

Pharmacokinetics

Absorption and distribution: Dexmedetomidine exhibits linear pharmacokinetics in the recommended dose range of 0.2 to 0.7 μg/ kg/ hr administered as intravenous infusion up to 24 hours. The distribution phase is rapid, with a half-life of distribution of approximately 6 minutes and elimination half-life of 2 hours.

Metabolism and excretion: Dexmedetomidine undergoes almost complete biotransformation through direct N-glucuronidation and cytochrome P-450 (CYP 2A6)-mediated aliphatic hydroxylation to inactive metabolites. Metabolites are excreted in the urine (about 95%) and in the faeces (4%).

Clinical pharmacology

Cardiovascular system: Dexmedetomidine evokes a biphasic blood pressure response: A short hypertensive phase and subsequent hypotension. In younger patients with high levels of vagal tone, bradycardia and sinus arrest have been described which were effectively treated with anticholinergic agents (atropine, glycopyrrolate).

Central nervous system: Dexmedetomidine reduces cerebral blood flow and cerebral metabolic requirement of oxygen but its effect on intracranial pressure (ICP) is not yet clear. Dexmedetomidine modulates spatial working memory, enhancing

cognitive performance besides having sedative, analgesic, and anxiolytic action through the α2-AR

Respiratory effects: Dexmedetomidine affect on respiration appears to be similar in order of magnitude to those seen in the heavy sleep state. Dexmedetomidine does not suppress respiratory function, even at high doses. It has no adverse effects on respiratory rate and gas exchange when used in spontaneously breathing ICU patients after surgery.

Clinical applications of Dexmedetomidine

Premedication: Dexmedetomidine is used as an adjuvant for premedication, especially in patients susceptible to preoperative and perioperative stress because of its sedative, anxiolytic, analgesic, sympatholytic, and stable hemodynamic profile. Premedication dose is 0.33 to 0.67 mg/kg IV given 15 minutes before surgery (this dose minimizes side effects of hypotension and bradycardia).

Intraoperative use: Intraoperative administration of dexmedetomidine in lower concentrations has reduced the requirement of other anaesthetic agents; fewer interventions to treat tachycardia; and a reduction in the incidence of myocardial ischemia.

Locoregional analgesia: Dexmedetomidine has been successfully used in intravenous regional anaesthesia (IVRA), brachial plexus block, and intraarticularly. Dexmedetomidine added to levobupivacaine for axillary brachial plexus block shortens the onset time and prolongs the duration of the block and postoperative analgesia.

Sedation in intensive care unit: Dexmedetomidine has become popular sedative agent in ICU because of its ability to produce cooperative sedation, i.e., patients remain awake, calm, and are able to communicate their needs. Dexmedetomidine, when compared with conventional sedatives and opiates has been demonstrated to be associated with both sedative and analgesic sparing effects, reduced delirium and agitation, minimal respiratory depression, and desirable cardiovascular effects.

Procedural sedation: Dexmedetomidine is an attractive agent for short-term procedural sedation and has been safely used in transoesophageal echocardiography, colonoscopy, awake carotid endarterectomy, shockwave lithotripsy, vitreoretinal surgery, elective awake fibreoptic intubation, pediatric patients undergoing tonsillectomy, and paediatric MRI. The usual dose of dexmedetomidine for procedural sedation is 1 μg/ kg, followed by an infusion of 0.2 μg/kg/h. Its onset of action is less than 5 minutes and the peak effect occur within 15 minutes.

Controlled hypotension: Dexmedetomidine is an effective and safe agent for controlled hypotension mediated by its central and peripheral sympatholytic action. Its easy administration, predictability with anaesthetic agents, and lack of toxic side effect while maintaining adequate perfusion of the vital organs makes it a near-ideal hypotensive agent.

Analgesia: Dexmedetomidine activates α2-AR in the spinal cord reducing transmission of nociceptive signals like substance P. It has significant opioid sparing effect and is useful in intractable neuropathic pain.

Cardiac surgery: Dexmedetomidine has been successfully used to manage patients with pulmonary hypertension undergoing mitral valve replacement, with reduction in pulmonary vascular resistance, pulmonary artery pressure, and pulmonary capillary wedge pressures.

Neurosurgery: Dexmedetomidine provides stable cerebral hemodynamics without sudden increase in ICP during intubation, extubation, and head pin insertion. It attenuates neurocognitive impairment (delirium and agitation) allowing immediate postoperative neurological evaluation. It does not interfere with neurological monitors and has an upcoming role in "functional" neurosurgery.

Obesity: Dexmedetomidine does not cause respiratory depression and has been infused at a dose of 0.7 μg/kg intraoperatively to avoid respiratory depression due to narcotic usage in a morbidly obese patient.

Obstetrics: Dexmedetomidine provides maternal hemodynamic stability, anxiolysis, and stimulation of uterine contractions. It is retained in placental tissue and passes less readily into the fetal circulation than clonidine because of high lipophilicity and thereby has less susceptibility to cause fetal bradycardia.

Pediatrics: It is currently being used off-label as an adjunctive agent in pediatric patients for sedation and analgesia in the critical care unit and for sedation during noninvasive procedures in radiology like computed tomography and magnetic resonance imaging.

Fentanyl

Fentanyl is a synthetic, lipophilic phenylpiperidine opioid agonist with analgesic and anesthetic properties. Fentanyl selectively binds to and activates the mu-receptor in the central nervous system (CNS), thereby mimicking the effects of endogenous opiates.

Dosage: Surgery Premedication: 50-100 mcg/dose IM or slow IV 30-60 min prior to surgery

Adjunct to regional anesthesia: 25-100 mcg/dose slow IV over 1-2 min

General Anesthesia: Minor surgical procedures: 0.5-2 mcg/kg/dose IV

Major surgery: 2-20 mcg/kg/dose initially; 1-2 mcg/kg/hr maintenance infusion IV; discontinue infusion 30-60 min prior to end of surgery; limit total fentanyl doses to 10-15 mcg/kg for fast tracking and early extubation

Adjunct to general anesthesia (rarely used): 20-50 mcg/kg/dose IV

Analgesia: 1-2 mcg/kg IV bolus or 25-100 mcg/dose PRN or 1-2 mcg/kg/hr by continuous IV infusion or 25-200 mcg/hr

Severe pain: 50-100 mcg/dose IV/IM q1-2hr PRN (patients with prior opioid exposure may tolerate higher initial doses)

Side effects of fentanyl: Persistent or recurrent depression of ventilation due to fentanyl is a potential postoperative problem. Secondary peaks in plasma concentrations of fentanyl and morphine have been attributed to sequestration of fentanyl in acidic gastric fluid (ion trapping).

Cardiovascular Effects: Carotid sinus baroreceptor reflex control of heart rate is markedly depressed by fentanyl, 10 mg/kg IV, administered to neonates Therefore, changes in systemic blood pressure occurring during fentanyl anesthesia have to be carefully considered because cardiac output is principally rate dependent in neonates. Bradycardia is more prominent with fentanyl than morphine and may lead to occasional decreases in blood pressure and cardiac output.

Seizure Activity: Seizure-like activity has been described to follow rapid IV administration of fentanyl, sufentanil, and alfentanil.

Intracranial Pressure: Administration of fentanyl and sufentanil to head injury patients has been associated with modest increases (6 to 9 mm Hg) in ICP despite maintenance of an unchanged Paco2. These increases in ICP are typically accompanied by decreases in mean arterial pressure and cerebral perfusion pressure.

Drug Interactions: Analgesic concentrations of fentanyl greatly potentiate the effects of benzodiazepines and decrease the dose requirements of propofol. The opioid-benzodiazepine combination displays marked synergism with respect to hypnosis and depression of ventilation. In clinical practice, the advantage of synergy between opioids and benzodiazepines for the maintenance of patient comfort is carefully weighed against the disadvantages of the potentially adverse depressant effects of this combination.

Methodology

This prospective randomized study was conducted after obtaining approval and informed consent from 50 adult patients, aged between 40-70 yr, with ASA I and II physical status. Patients who were scheduled to undergo open cholecystectomy for carcinoma gall baldder were enrolled for the study.

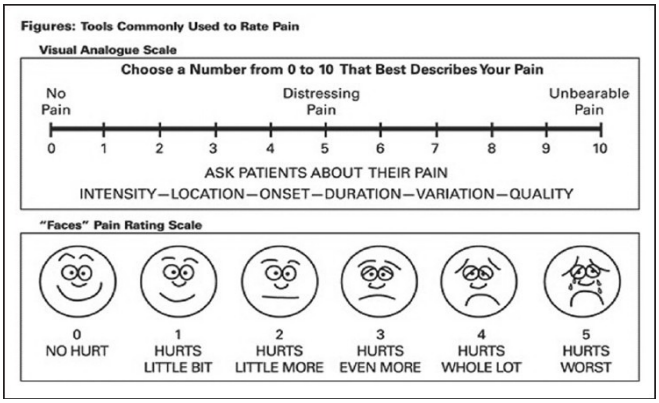
Inclusion Criteria: Patients belonging to American Society of Anaesthesiologist (ASA) Grade- I & II, having weight 40 to 80 Kg were included in the study.

Exclusion Criteria: Patients allergic to any of the stated drug, hemodynamically unstable patients, patients who refused to be the part of study, patients suffering with hypertension and bleeding diathesis were excluded from study.

Routine monitors like NIBP, pulse oximetry, ECG were connected and all baseline parameters i.e blood pressure, heart rate and respiratory rate were recorded. Peripheral I.V. line was secured with 18 G cannula. Following infusion of 15 ml/kg of ringer lactate solution and under aseptic preparation, epidural catheter would be placed at appropriate level (for the purpose of epidural analgesia). Intraoperatively fentanyl 50micrograms at 30 minutes interval upto 2 doses ,1g paracetamol infusion (as antipyretic), tramadol 100 mg was used in all patients.

Patients were randomized into two groups, each using a sealed envelope technique. Group A received 2.5 ml of bupivacaine plain +0.5 ml of 50mcg/ml fentanyl+ 7.0 ml of 0.9% normal saline to a total volume of 10 ml. Group B received 2.5 ml plain bupivacaine + 0.5 ml of 5 µg of dexmedetomidine with 7ml of 0.9% saline to a total volume of 10 ml at the time of suturing. The intrathecal drug formula was prepared by a separate anesthesiologist under a sterile technique who was blinded to the study. Pulse rate, blood pressure and respiratory rate was monitored at appropriate intervals.

Pain was assessed by VAS grading:



The readings for all parameters at baseline and at various time intervals were recorded.

Results

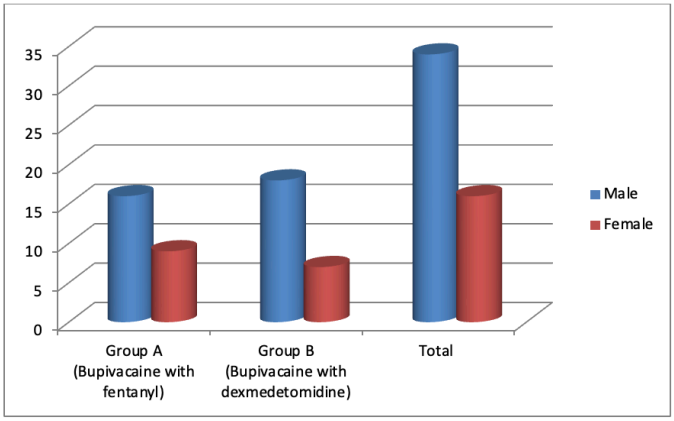
This prospective randomized study was conducted after obtaining approval from ethical committee. Informed consent was obtained from 50 adult patients, aged 40-70 yr, having ASA I and II physical status. Patients who were scheduled to undergo open cholecystectomy for carcinoma of gall baldder were enrolled for the study. Routine monitors like NIBP, pulse oximetry and ECG were recorded. Baseline blood pressure, heart rate and respiratory rate were noted. Peripheral I.V. line was secured with 18 G cannula. Following infusion of 15 ml/kg of ringer lactate solution and under aseptic preparation, epidural catheter would be placed at appropriate level (for the purpose of epidural analgesia). Intraoperatively, fentanyl 50micrograms at 30 minutes interval upto 2 doses, 1g paracetamol infusion (as antipyretic), tramadol 100 mg was used in all patients.

Patients were randomized into two groups using sealed envelope technique. Group A received 2.5 ml of bupivacaine plain +0.5 ml of 50mcg/ml fentanyl+ 7.0 ml of 0.9% normal saline to a total volume of 10 ml. Group B received 2.5 ml plain bupivacaine + 0.5 ml of 25 µg of dexmedetomidine with 7ml of 0.9% saline to a total volume of 10 ml at the time of suturing. The intrathecal drug formula was prepared by a separate anesthesiologist under a sterile technique who was blinded to the study. Pulse rate, blood pressure and respiratory rate were monitored at appropriate time intervals.

The data collected was analyzed using statistical package SPSS version 20.0. Data was expressed as mean and standard deviation. The demographic data of the patients was studied for each of the three groups and expressed in frequency and percentages. Continuous covariates (age, hemodynamic variables, SPO_2 and pain score) were compared with baseline and different time intervals using one-sample t-test. The level of significance was determined at p-value= 0.05.

Table 1: Distribution of study subjects according to gender in both study groups

Gender	Group A (Bupivacaine with fentanyl)	Group B (Bupivacaine with dexmedetomidine)	Total
Male	16 (64%)	18 (72)	34 (68)
Female	9 (36)	7 (28)	16 (32)
Total	25 (50)	25 (50)	50 (100%)

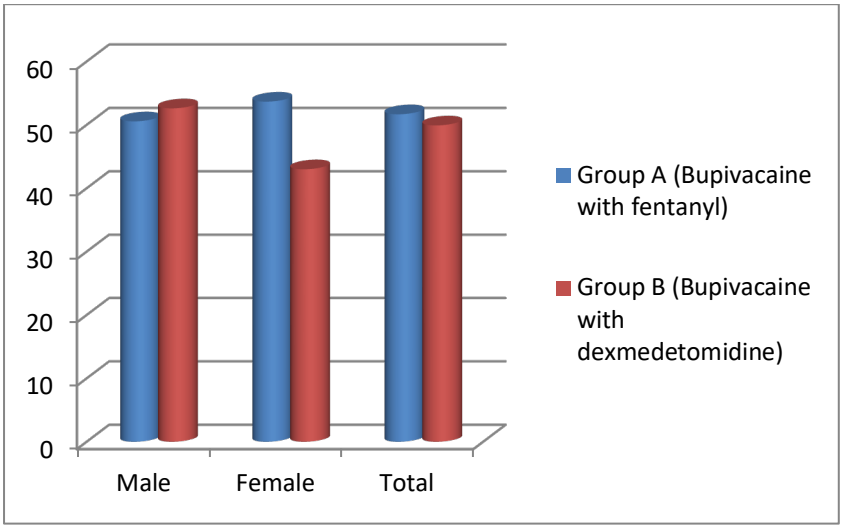


Graph 1: Distribution of study subjects according to gender in both the groups.

Table no. 1 and Graph no. 1 represents an equal distribution of number of study subjects in Group A and B (n=25 each). Around 68% subjects were males and 32% were females.

Table 2: Mean age of study subjects in both the study groups

Mean age (yrs)	Group A (Bupivacaine with fentanyl)	Group B (Bupivacaine with dexmedetomidine)
Male	50.56	52.61
Female	53.67	43
Total	51.68	49.92



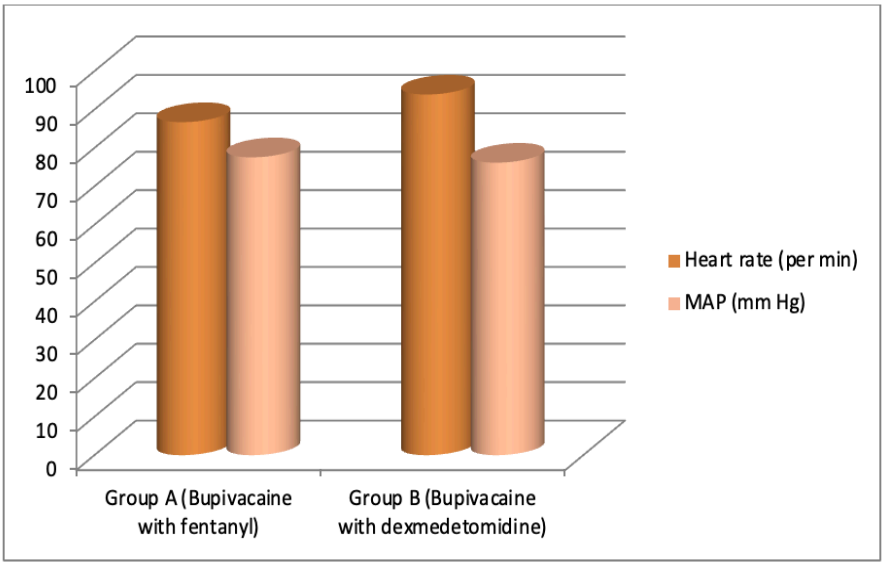
Graph no. 2: Mean age of study subjects in both the groups

Table no. 2, Graph no. 2 represents the mean age of both male and female subjects in both the groups. In Group A, mean age was found to be 51.68yrs; whereas in Group B it was 49.92yrs.

Table 3: Mean values and intergroup comparison between both the groups for Hemodynamic variables recorded pre-operatively

Hemodynamic variables	Group A (Bupivacaine with fentanyl)	Group B (Bupivacaine with dexmedetomidine)	t-test	df	p-value*
Heart rate (per min)	86.72±11.133	93.91±16.80	-1.874	24	0.073
MAP (mm Hg)	77.56±11.58	76.16±7.255	0.545	24	0.591

*p-value>0.05 is insignificant.



Graph 3: Mean values and intergroup comparison between both the groups for Hemodynamic variables recorded pre-operatively

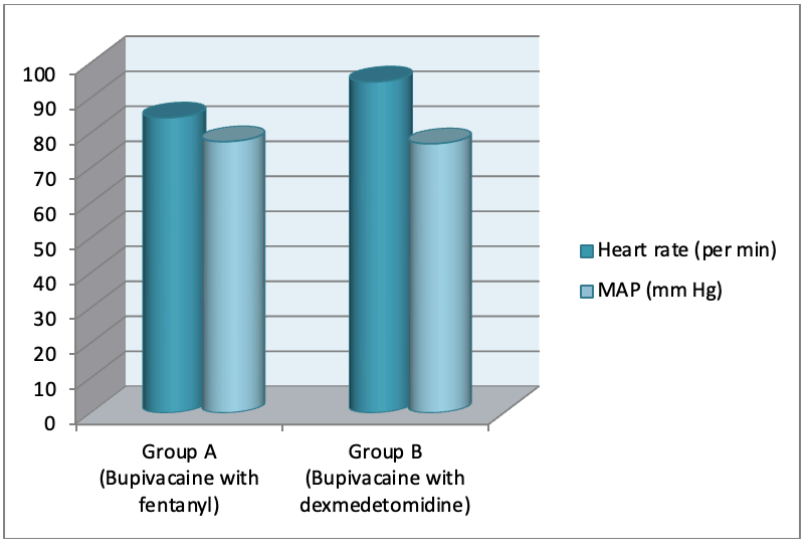
Table no. 3, Graph no. 3 shows more mean heart rate in Group B (93.91±16.80) than Group A; whereas mean MAP was recorded to be more in Group A (77.56±11.58) than in Group B. One sample t-test was conducted to analyse the level of significance between Group A and B for hemodynamic parameters i.e Heart rate (per min) and Mean Arterial Pressure (mm Hg). The level of significance

was found to be statistically insignificant (p-value>0.05) between both the groups for both the parameters.

Table 4: Mean values and intergroup comparisons between both the groups for Hemodynamic variables at baseline

Hemodynamic variables	Group A (Bupivacaine with fentanyl)	Group B (Bupivacaine with dexmedetomidine)	t-test	df	p-value
Heart rate (per min)	84.3200±9.38	94.6000±9.57	0.118	23	0.907*
MAP (mm Hg)	77.52±11.28	76.92±23.16	-3.996	24	0.001**

*p-value>0.05 is insignificant; **p-value<0.05 is significant



Graph 4: Mean values and intergroup comparisons between both the groups for Hemodynamic variables at baseline

Table no. 4, Graph no. 4 revealed higher mean heart rate and lower mean arterial pressure in Group B. The level of significance was found to be statistically insignificant between both the groups for heart rate (p-value>0.05); whereas statistically significant (p-value<0.05) for MAP.

Table 5: Mean values and intergroup comparisons between both the groups at various time intervals for Heart rate

Time inter-val	Mean±SD		95% CI		Statistical analysis		
	Group A	Group B	Lower	Upper	t-test	df	p-value
pre-operative	86.7200±11.13	93.9600±16.8	-.73502	15.21502	1.874	24	.073
baseline	84.3200±9.37	94.6000±9.57	4.97036	15.58964	3.996	24	.001*
30min	80.2000±8.89	84.2400±8.21	-1.31353	9.39353	1.558	24	.132
60min	76.5200±8.4	79.9200±12.04	-3.23878	10.03878	1.057	24	.301
90min	71.7600±8.59	79.2400±8.21	2.53651	12.42349	3.123	24	.005
120min	70.0000±8.48	75.2000±13.88	-1.79293	12.19293	1.535	24	.007
3hrs	66.1200±14.78	70.2400±17.81	-5.26285	13.50285	.906	24	.012
6hrs	70.4800±7.9	73.6000±12.81	-2.44401	8.68401	1.157	24	.259
9hrs	74.0800±8.19	76.2400±13.03	-3.20042	7.52042	.832	24	.414
12hrs	77.7200±8.26	77.5200±21.39	-9.80914	9.40914	-.043	24	.966

*p-value<0.05 is significant

Table no. 5 revealed higher mean values of heart rate in Group B, with maximum value at baseline. The level of significance was analysed using one sample t-test. Statistically it was found to be insignificantly correlated (p-value>0.05) between both the groups except at baseline and at 90min.

Table 6: Mean values and intergroup comparisons between both the groups at various time intervals for MAP

Time interval	Mean±SD		95% CI		Statistical analysis		
	Group A	Group B	Lower	Upper	t-test	df	p-value
pre-operative	77.5600±11.58	76.16±7.25	-6.70225	3.90225	-0.545	24	0.591
baseline	77.5417±4.94	76.9167±11.05	-11.59099	10.34099	-0.118	23	0.907
30min	76.2917±5.03	70.8333±6.61	-8.94925	-1.96742	-3.235	23	0.004*
60min	69.2167±13.9	68.25±5.5	-7.47353	5.54020	-.307	23	0.761
90min	68.5000±4.6	66.12±3.8	-4.92326	0.17326	-1.928	23	0.066
120min	66.3333±4.07	65.50±2.96	-2.76103	1.09436	-0.894	23	0.380
3hrs	65.5833±2.74	65.6667±5.03	-2.15078	2.31745	0.077	23	0.939
6hrs	68.6667±5.58	67.0833±2.12	-3.94563	0.77897	-1.387	23	0.179
9hrs	71.3333±5.82	69.2917±2.80	-4.67864	0.59530	-1.602	23	0.123
12hrs	73.9167±5.12	70.8333±3.48	-5.23976	-0.92691	-2.958	23	0.007*

*p-value<0.05 is significant

Table no. 6 revealed higher mean values of MAP in Group A than Group B, with maximum value at preoperative and baseline levels. The level of significance was analysed using one sample t-test. Statistically it was found to be insignificantly correlated (p-value>0.05) between both the groups except at 30min and at 12hrs.

Table 7: Mean values and intergroup comparisons between both the groups at various time intervals for SPO_2

Time interval	Mean±SD		95% CI		Statistical analysis		
	Group A	Group B	Lower	Upper	t-test	df	p-value
baseline	99.08±1.34	100.75±4.12	-3.59436	0.26103	-1.789	23	0.087
30min	98.12±1.94	98.33±1.001	-1.07978	0.66311	-0.495	23	0.626
60min	98.37±1.06	97.79±1.25	-0.12013	1.28680	1.715	23	0.100
90min	98.46±1.18	97.71±1.52	-0.07831	1.57831	1.873	23	0.074
120min	98.17±1.09	98.29±0.99	-0.77575	0.52575	-0.397	23	0.695
3hrs	99.08±0.93	98.83±1.00	-0.37570	0.87570	0.827	23	0.417
6hrs	98.62±1.05	98.75±2.09	-1.09203	0.84203	-0.267	23	0.792
9hrs	97.54±2.93	99.33±0.76	-3.12104	-0.46229	-2.788	23	0.010*
12hrs	98.58±1.93	99.58±0.88	-01.81652	-0.18348	-2.533	23	0.019

*p-value<0.05 is significant

Table no. 7 revealed mean values of SPO_2 in Group A and B. The maximum value was observed at baseline levels and at 12hrs. The level of significance was analysed using one sample t-test. Statistically it was found to be insignificantly correlated (p-value>0.05) between both the groups except at time interval of 9hrs.

Table n8: Mean values and intergroup comparisons between both the groups at various time intervals for VAS

Time interval	Mean±SD		95% CI		Statistical analysis		
	Group A	Group B	Lower	Upper	t-test	df	p-value
baseline	**10±0**	**10±0**	**The correlation and t cannot be computed because the standard error of the difference is 0**				
30min	3.28±1.37	3.12±1.05	-0.40748	0.72748	0.582	24	0.566
60min	2.68±0.69	3.08±3.97	-2.04250	1.24250	-0.503	24	0.620
90min	2.6±0.64	2.24±0.53	0.04745	0.67255	2.377	24	0.026*
120min	2.88±0.72	2.44±0.86	-0.05246	0.93246	1.844	24	0.078
3hrs	3.76±0.87	3.00±0.81	0.26466	1.25534	3.167	24	0.004*
6hr 6hrs	5.9±1.03	3.92±0.90	1.41624	2.58376	7.071	24	0.000*
9hrs	7.68±0.94	5.44±1.00	1.66506	2.81494	8.041	24	0.000*
12hrs	9.52±5.82	8.08±2.86	0.25990	2.62010	2.518	24	0.019*

*p-value<0.05 is significant

Table no. 8 shows the mean pain scores using visual analogue scale for both the groups. The score was found to be highest at baseline, followed by 12hrs time interval. Statistically the level of significance

was analysed using one sample t-test. Statistically it was found to be significantly correlated (p-value<0.05) between both the groups except at time intervals 30, 60 and 120min.

The results obtained from the study observed that use of Dexmedetomidine and fentanyl as an adjunct causes fluctuation in SPO2, mean arterial pressure; heart rate and significant VAS score changes. The pain relief by using Dexmedetomidine as adjunct with Bupivacaine was significantly more over a follow up period of 12 hours, when compared with fentanyl a adjuvant to epidural anaelgesia with bupivacaine in radical cholecystectomy in carcinoma gallbladder patients.

Discussion

Lower abdominal and lower limb surgeries may be performed under local, regional (spinal or epidural), or general anaesthesia, but neuraxial blockade is the preferred mode of anaesthesia. In recent years, use of adjuvants during epidural anaesthesia has gained popularity with the aim of prolonging the duration of block, better success rate, patient satisfaction, decreased resource utilization compared with general anaesthesia, and faster recovery. The addition of fentanyl to hyperbaric bupivacaine improves the quality of intraoperative and early postoperative block. The addition of opioid provides a dose sparing effect of local anaesthetic and superior analgesia, but there is always a possibility of an increased incidence of pruritus, urinary retention, nausea, vomiting, and respiratory depression. [7,8]

Dexmedetomidine is a new addition to the class of α agonist which has got numerous beneficial effects when used through epidural route. [9] It acts on both pre- and post-synaptic sympathetic nerve terminal and central nervous system, thereby decreasing the sympathetic outflow and norepinephrine release, thus causing sedative, anti-anxiety, analgesic, sympatholytic, and hemodynamic effects. Dexmedetomidine causes a manageable hypotension and bradycardia, but the striking feature of this drug is the lack of opioid-related side effects such as respiratory depression, pruritus, nausea, and vomiting. Both dexmedetomidine (α agonist) and fentanyl (opioid) are being used as adjunct with bupivacaine to increase duration of regional anesthesia. Multimodal analgesia is a pharmacologic method of pain management which combines various groups of medications for pain relief such as local anesthetics, opioids, NSAIDs, and α agonists. It has been seen that dexmedetomidine has been used successfully as part of a multimodal analgesic plan and can be an alternative choice for opioid-tolerant patients. [10-14]

With this background, the present study was carried out with an aim to evaluate the efficacy of epidural dexmedetomidine with bupivacaine versus epidural fentanyl with bupivacaine for postoperative pain relief. [15]

Epidural anesthesia is the most commonly used technique for providing not only peri-operative surgical anesthesia but post-op analgesia in lower abdominal surgeries. Bupivacaine is the most commonly used local anesthetics in epidural and spinal anesthesia with a standard dose of 13-15 mg. For epidural analgesia, various authors used a dose of 12.5 mg bupivacaine. In present study, we also used 12.5mg of Bupivacaine, along with adjuncts.

In our study, patients in Group A (n=25) undergoing radical cholecystectomy for carcinoma gallbladder received 12.5 mg of bupivacaine along with 25mcg of fentanyl, in 10ml solution slowly after skin suturing. In Group B, patients (n=25) received 12.5 mg of bupivacaine, with 25mcg of dexmedetomidine in 10ml solution in similar fashion. Time of analgesia with VAS score was evaluated up to 12 hours along with heart rate, mean arterial pressure, and SPO2. Study conducted by Gupta R et al. and Al-Ghanem et al. advocated the use of 5 μg dexmedetomidine and 25 μg fentanyl with hyperbaric bupivacaine that significantly prolonged both sensory and motor block. Thus, in our study, we also used the similar concentration of adjuncts with local anaesthetic agent.[16-18]

In our study, Group A had 16 male patients with a mean age 50.6yrs and 9 female patients with a mean age of 53.67yrs. In Group B, 18 male patients were taken with a mean age of 52.61yrs and 16 female patients with a mean age of 43yrs. Hemodynamic parameters (heart rate and MAP), SPO2 levels and pain score was evaluated for each patient before surgery; and after surgery at baseline and at various time intervals.[19]

The mean heart rate in Group A was 84.3200±9.38, whereas in Group B it was 94.6000±57 at baseline after giving anesthesia. Our study revealed a higher mean heart rate and lower means arterial pressure in Group B ((Bupivacaine with dexmedetomidine). The level of significance was found to be statistically insignificant between both the groups for heart rate (p-value>0.05); whereas statistically significant (p-value<0.05) for MAP.[20]

Higher mean values of heart rate were recorded in Group B, with maximum value at baseline. Statistically it was found to be insignificantly correlated (p-value>0.05) between both the groups except at baseline and at 90min time interval. Mean heart rate was recorded to be lower in Group B than Group A at 12hrs time interval, but it was statistically insignificant. Contrary results were noticed with MAP measurements for both the groups (except at 12hrs), when compared with heart rate. Our study showed higher mean values of MAP in Group A (Bupivacaine with fentanyl) than Group

B, with maximum value at preoperative and baseline levels. Statistically it was found to be insignificantly correlated (p-value>0.05) between both the groups except at 30min and at 12hrs. [21-14]

Thus, use of dexmedetomidine with bupivacaine caused increase in heart rate (except at 12hrs) and lowered the mean arterial pressure than fentanyl as adjunct. This depicts that dexmedetomidine use offer a better hemodynamic stability than fentanyl.

The results of the present study are in accordance with the findings of various studies reported in the literature. A study by Gupta R et al. revealed that use of dexmedetomidine has created a stable hemodynamic condition, and good patient satisfaction as compared to fentanyl. Mahendru et al. also found that adjuvant dexmedetomidine provided a better hemodynamic stability as compared to fentanyl when used as adjuvant to epidural bupivacaine. Shaikh SI et al. revealed that cardio-respiratory parameters remained stable throughout the study period, which reaffirms the established effects of α-2 agonists i.e dexmedetomidine, in providing a hemodynamically stable peri-operative and postoperative period. We found that use of dexmedetomidine as an adjunct (except at 12hrs time interval) caused increase in heart rate than fentanyl, which was in contrast to study conducted by Sekhar DP et al., but at 12hrs bradycardia was observed, that was similar with results of Sekhar DP etal. Dexmedetomidine is an alpha-2 agonist drug, which affects the alpha-2 receptors that are found in peripheral and central nervous systems, platelets, and many other organs, including the liver, pancreas, kidney, and eye. Stimulation of the receptors in the brain and spinal cord inhibits neuronal firing, causing hypotension, bradycardia, sedation, and analgesia. [25,26]

The mean values of oxygen saturation levels (SPO_2) were measured in Group A and B. The maximum value was observed at baseline levels and at 12hrs. Dexmedetomidine as an adjunct has saturation values on higher side than fentanyl. But statistically, the level of significance was found to be insignificantly correlated (p-value>0.05). It was observed that both the drugs maintain the respiration adequately. Similar findings was observed in study by Sheikh et al. who observed that there was absence of clinically detectable respiratory depression with the use of epidural dexmedetomidine and clonidine with bupivacaine in patients undergoing lower limb orthopedic surgeries. Results of our study are similar to study by Bajwa S et al., who observed that none of the patients in either of the groups (dexmedetomidine and fentanyl) experienced any respiratory difficulty warranting active intervention but patients in group using dexmedetomidine exhibited a significantly a lower PaCO2 post operatively.

Limitation of study:

1. Limitation of the present study involves the exact dose equivalence of dexmedetomidine and fentanyl when used in epidural anesthesia.
2. The present study was conducted with relatively small number of patients. Thus there is a need for an elaborated clinical research taking more number of patients into consideration.

Taking limitations into consideration, we observed that use of Dexmedetomidine and fentanyl as an adjunct causes fluctuation in SPO2, mean arterial pressure; heart rate and significant VAS score changes. The pain relief by using Dexmedetomidine as adjunct with Bupivacaine was significantly more over a follow up period of 12 hours, when compared with fentanyl as adjuvant to epidural anaelgesia with bupivacaine in radical cholecystectomy in carcinoma gallbladder patients. Dexmedetomidine group showed visible superiority over fentanyl in terms of hemodynamic parameters, oxygen saturation and pain scores.

Conclusion

The present study revealed that use of Dexmedetomidine and fentanyl as an adjunct causes changes in hemodynamic parameters, SPO2 levels and pain score. The pain relief by using Dexmedetomidine as adjunct with Bupivacaine was significantly more over a follow up period of 12 hours, when compared with fentanyl as adjuvant to epidural anaelgesia with bupivacaine in radical cholecystectomy in carcinoma gallbladder patients. Dexmedetomidine group showed visible superiority over fentanyl in terms of various parameters studied.

Thus, dexmedetomidine seems to be a better alternative to fentanyl as an epidural adjuvant, as it provides comparable stable hemodynamics, early onset and establishment of sensory anesthesia, prolonged post-op analgesia, lower consumption of post-op LA for epidural analgesia, and much better sedation levels. Our study concludes that 25 μg dexmedetomidine seems to be an attractive alternative to 25 μg fentanyl as an adjuvant to epidural bupivacaine in surgical procedures. It provides good quality of intraoperative and postoperative analgesia, hemodynamically stable conditions, minimal side effects, and excellent quality of postoperative analgesia.

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