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INTRAPLEURAL BUPIVACAINE ANALGESIA IN THORACOTOMY

Rommy Geever T¹

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ABSTRACT: Post-operative pain after thoracotomy should be controlled for adequate respiratory effort, for this intrapleural bupivacaine was tried in this study and also evaluated complications and effectiveness. Intrapleural space anatomy explained, pharmacology of bupivacaine and its dose and toxicity explained. Previous studies on intrapleural bupivacaine reviewed. 50 cases that underwent thoracotomy with a male to female ratio 24:76. Under general anesthesia before closure of chest, surgeon inserts a Epidural catheter of 16 FG or a vacuum drain catheter of 12 or 14 FG into intrapleural space. After surgery 0.375% bupivacaine 15-20 ml injected, clamping the chest drain tube for 10 minutes. Duration for onset of action found to be more in first dose compared to second and third dose. Duration of action was found to be average 6 hours. Pain control was found to improve from first to fourth dose with visual analogue scale. Respiratory rate also improved. There was only 10 mmHg BP change. Supplemental analgesic was needed only in 16% of patients. Concluding that intra pleural bupivacaine is technically simple and highly efficient for controlling post thoracotomy pain improving the respiratory effort.

KEYWORDS: Intrapleural, bupivacaine, thoracotomy, visual analogue scale.

INTRODUCTION: Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage¹ it is one of the commonest symptom to lead a patient to seek medical advice, whatever the cause, it demands relief.

The need for adequate post-operative pain control, in order to ensure adequate respiratory effort, have been recognized for years. Following thoracotomy there is reduction in lung volumes. This result in generation of ineffective cough as well as to the collapse of alveoli which leads to pneumonia and reduction in arterial partial pressure of oxygen.²

Adequate analgesia would facilitate deep breathing and clearing of secretions from the airway. Vigorous chest physiotherapy, deep breathing exercises, coughing and early mobilization can be undertaken effectively only after adequate analgesia has been achieved.

The traditional use of parental opiates often does not provide adequate pain relief. Other methods like, Patient controlled analgesia (PCA) in which patient controls the rate of intravenous opioid infusion. Intercostal nerve blocks, Thoracic epidural, Opioids in the epidural space, and transcutaneous electrical nerve stimulation, can produce adequate analgesia but have their limitations along with possible side effects. Centrally acting analgesics produce hypoventilation due to their sedative and depressant actions by reducing respiratory rate and diminishing tidal volume. Recently, Reiestad and Stromskag (1986)³ developed a new technique for sole treatment of postoperative pain relief i. e., Intrapleural Block.

This technique involves the insertion of an extradural catheter into the pleural space and the administration of local anaesthetic through the catheter. The technique has the advantage of only single needle puncture. In addition, lack of generalized sympathetic blockade, systemic hypotension and respiratory depression are other advantages associated with this procedure.

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This technique produces excellent pain relief after operation. Mode of production of analgesia is by reverse diffusion of local anaesthetic from pleural space back into subpleural space, reaching and blocking intercostal nerves, and to some extent sympathetic chain and splanchnic nerves depending on the dose and position of the patient. Rarely phrenic nerve paralysis is involved as a complication.⁴

This study has been undertaken to determine the efficacy of intrapleural Bupivacaine in achieving post-operative analgesia in patients undergoing thoracotomy.

AIM OF THE STUDY:

1. To evaluate the efficacy of intrapleural Bupivacaine in achieving satisfactory post-operative analgesia in patients undergoing thoracotomy.
2. To note the complications during postoperative period and failure rate of this technique so that it can assume a major role in treatment of post thoracotomy pain, thereby making the routine use of this technique possible.

Anatomy of the Pleura and Pleural Cavity:⁵ Each lung is covered by a serous membrane arranged in the form of a closed invaginated sac termed the pleura. A part of this serous membrane covers the surface of the lung and lines the fissures between its lobes; it is called the visceral or pulmonary pleura. The rest of the membrane lines the inner surface of the corresponding half of chest wall, covers a large part of the diaphragm, and is reflected over the structures occupying the middle part of thorax; this portion is termed as the parietal pleura.

The pulmonary and parietal pleura are continuous with each other around the root of the lung and the potential space between them being known as pleural cavity.

The right and left pleural sacs are distinct from each other, and come into immediate contact for just a short distance behind the upper half of the body of sternum; they are separated only by a narrow margin behind the oesophagus in mid thoracic region. The interval between two sacs is called mediastinum.

Right pleural cavity is wider than the left, because heart extends further to the left than to the right side. The upper and lower limits of pleural sacs are approximately the same, but the left sac sometimes descends to a lower level in the mid axillary line.

Pulmonary pleura: It is an integral part of the lung and is not easily separable from it. It is adherent to all surfaces, including those which bound the fissures between the lobes of the lung, it is absent, however, over an area where the lung root enters.

The parietal pleura: The parietal pleura may be subdivided into:

1. Costo vertebral pleura: It is the part lining the internal aspects of the bony rib cage and sides of vertebral bodies.
2. Diaphragmatic pleura: That which covers the thoracic surface of the diaphragm.
3. Cervical pleura: That ascending into the neck over the summit of the lung is the cervical pleura or sometimes referred to as the dome of the pleura. It extends as high as the neck of the first rib posteriorly, it is related to trachea and oesophagus medially. Anteriorly carotid and subclavian arteries are closely related. The vascular structures indent and produce grooves in the contour of the pleura. Immediately subpleural are the stellate ganglion, sympathetic nerve and the lower most components of brachial plexus.

4. Mediastinal pleura: It is the part which is applied to the structures occupying the inter-pulmonary region.

The extent of the pleura in relation to the chest wall and lung: Anteriorly, the lung extends no lower than the sixth rib in the mid clavicular line, whereas the pleural cavity extends to the seventh rib, laterally the lung extends to the eighth interspace in the mid axillary line and pleura to the ninth interspace or 10th rib. Posteriorly, the inferior margin of the lung extends to the 11th rib and the pleural cavity to the 12th rib. The pleural space and lung extend well above the first rib and the clavicle anteriorly.

Blood Supply: The parietal pleura derives its arterial supply from the intercostal, internal thoracic and musculophrenic arteries.

The veins join the systemic veins in the neighbouring parts of the chest wall.

The lymphatic's also join those in the body wall and drain into the intercostal, parasternal, posterior mediastinal and diaphragmatic nodes. The visceral pleura: Which is an integral part of the lungs itself derives its vascular supply from the terminal division of the bronchial arteries. Venous drainage is to the bronchial veins the lymphatic's join those of the lungs.

Nerve Supply: The parietal pleura is supplied by the spinal nerves supplying the muscle and skin of body wall (Intercostals and phrenic nerves).

The costal pleura and the pleura on the peripheral part of the diaphragm are supplied by the intercostal nerves. The mediastinal pleura and pleura on central part of diaphragm are supplied by phrenic nerve. Stimulation of former parts of pleura results in pain referred along the intercostal nerves to the thoracic or abdominal wall, whereas irritation of latter parts results in pain referred to lower part of the neck and over the shoulder.

The visceral pleura derive its nerves supply from the autonomic nerves innervating the lungs and accompanying the bronchial vessels. It is devoid of sensory nerves; on stimulation of visceral pleura pain is not elicited.

PHARMACOLOGY OF BUPIVACAINE.^{6,7,8:}

Chemical and Physical Properties: It is a white crystalline powder with a bitter taste. Molecular weight is 342.9. Melting point is 248°C with decomposition. It is soluble 1 in 25 parts of water, 1 in 8 parts of alcohol and slightly soluble in acetone, chloroform and ether. A 1% solution in water has a pH in the range of 3.5 to 6. Density is 0.997g/ml at 37°C. Solutions are sterilized by autoclaving or by filtration and stored in airtight containers. It is stable and can withstand multiple heat sterilization without undergoing decomposition.

It shares a common basic structure with other modern local anesthetics i. e. it is an aminoacyl amide. Aromatic ring – Intermediate amide chain – Hydrophilic tertiary amine.

The lipophilic aromatic ring helps the molecules to penetrate the tissue barriers. Its high lipid solubility facilitates its passage across the membrane and thus makes it highly potent.

Bupivacaine is four times potent than Lignocaine. Acute toxicity is 4-5 times more than that of lignocaine. The action of Bupivacaine is considerably longer lasting than lignocaine, but the speed of onset is marginally slower than that of lignocaine. It produces a low incidence of motor blockade.

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Pka of Bupivacaine is 8.2 hence at body pH it is only 5-6% in the unpronated form. But this form is important for reaching the site of action, where it changes into active form i. e., the cation.

It is available commercially in 0.25% and 0.5% concentrations in isotonic saline solution.

PHARMACOKINETICS OF INTRAPLEURAL BUPIVACAINE: The range of maximum plasma concentrations following 20ml of 0.5% bolus of Bupivacaine into the pleural space via intrapleural catheter over 40 seconds was 1.29-3.18 mg/L arterial, and 0.88-2.31 mg/L venous within maximum time of 10-38 minutes for arterial and 10-45 minutes for venous. Equilibrium between these two concentrations occurring usually by 45 minutes to one hour.

It is absorbed from pleural space at a rate similar to other areas of body. Bupivacaine is extensively bound to proteins i. e. 90-97%. It is metabolized in liver by hydroxylation of aromatic nucleus and excreted in the urine to about 6%. There are also indications that glucoronide conjugates of hydroxylated Bupivacaine are excreted in urine. Dose: 1 to 2mg/kg body weight

ADVERSE EFFECTS:⁹

Central Nervous System: It readily crosses the blood brain barrier causing central nervous system stimulation, followed by depression at higher concentrations. The earliest signs of toxicity are circumoral and tongue numbness, which may proceed to tinnitus, nystagmus and dizziness. Excitation of central nervous system may be manifested by yawning, restlessness and excitement, nervousness, blurred vision, nausea, vomiting, muscle twitching, tremors and finally convulsions. Excitation may be transient, being followed later on by depression manifesting as drowsiness, convulsions, cardiorespiratory failure and coma. Plasma levels causing central nervous system toxicity is 3ug/ml i. e. 3mg/L.

Cardiovascular System: The local anaesthetic exerts effects on cardiac muscle and on peripheral vascular smooth muscles causing arteriolar dilatation and myocardial depression. At toxic concentration, the combined effects of peripheral vasodilation, decreased myocardial contractility and depressant effect, on cardiac rate and conduction causing hypotension and bradycardia leading to circulatory collapse and cardiac arrest. Bupivacaine has a dose dependent negative action. It is relatively more toxic to heart than lignocaine as it is slow binding and slow releasing drug from receptors. This results in wide QRS complex, prolongation of PR interval on ECG. It causes nodal and ventricular arrhythmias at concentrations associated with CNS toxicity. The cardiovascular effects are usually evident after accidental systemic injection and attainment of high blood concentration of >4ug/ml or 4mg/L. The pregnant patients may be more susceptible to the toxic effects of Bupivacaine. Acidosis especially hyperkalemia, respiratory and metabolic acidosis and hypoxia markedly potentiates the CVS toxicity of Bupivacaine.

Neuromuscular Junction: Bupivacaine potentiates the effects of depolarizing and non-depolarizing muscle relaxants.

Hypersensitivity: To the amide local anesthetics is rare, although it has been reported.

Interactions: Bupivacaine is highly bound to plasma proteins, hence pethidine, phenytoin and quinidine increases the amount of unbound Bupivacaine in plasma.

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Review of Literature: Although block of the intercostal nerve is not new, interest in this technique was revived when Nunn and Salvin (1980)¹⁰ re-examined the anatomy of the intercostal space in cadavers.

The first series of patients in whom this technique was described by Murphy. D. F¹¹ in 1983, who used it in patients with multiple fractured ribs and in post-operative patients after gall bladder and kidney surgery. One year later Reiestad and Kvalheim published their results of continuous intercostal nerve block for post-operative pain relief and presented their modification of the technique, which is now termed intrapleural analgesia.

At County hospital, Molde, Norway in 1986 Dr. Finn Reiestad and Stromskag K. E. developed a new technique as a sole treatment of postoperative pain by the intermittent administration of local anaesthetics into the pleural space through an intrapleural catheter.

Method was used in 81 patients. 42 of them had undergone cholecystectomy, 25 patients had renal surgery while 14 underwent unilateral breast operations. Effective and long lasting pain relief was achieved with this technique alone in 78 cases. Onset of action was rapid 1-2 minutes after injection. Patients suffered no pain and respiration was unlaboured.

Duration of analgesia after 20ml of Bupivacaine 0.5% with epinephrine was 6-27 hrs, with mean time of 10 hrs. No complications pertaining to the technique were encountered. Adequate analgesia was not obtained in one patient of pulmonary fibrosis due to tuberculosis.

The technique involves percutaneous administration of a catheter into the thoracic cage between the parietal and visceral pleura. In their study, they introduced intrapleural catheter after completion of surgery but before extubation. A 16 gauge Tuohy needle was inserted at 8th or 9th intercostal space just above the upper edge of lower rib, 10 cms away from midaxillary line with the patient in apnoea. Then they introduced epidural catheter (portex 16 gauge, with three lateral eyes) 5-6 cms in the pleural space through the needle.

Considering the mechanism of action they suggested that the local anaesthetic solution diffuses from the pleural space through the parietal pleura and innermost intercostal muscles to reach the intercostal space, where local anaesthetic causes blockade of intercostal nerves. They suggested that sympathetic chain that is separated from pleural cavity only by the parietal pleura is also a potential site of action.

Reiestad. F. et. al. (1986)¹² They studied intrapleural analgesia with 0.25%, 0.375% and 0.5% Bupivacaine for various surgical procedures of the upper abdomen with regard to, pain relief, side effects and arterial plasma concentration of Bupivacaine.

Pain score was studied using visual analogue scale using a 0-100 scale. With intrapleural analgesia, they found a medium pain score not higher than 11mm in all the three patients.

None of the patients had pneumothorax. Neither cardiovascular changes nor, signs of local anaesthetic toxicity of the C-N. S or the C. V. S system, were observed.

Arterial plasma concentration of Bupivacaine was a median of 0.57microg/ml. in 0.25% group, 0.73microg/ml in 0.375% group and 1.18microg/ml in 0.5% group.

Median duration of analgesia was, in group I (0.25%) 285 mins. group II (0.375%) 360 mins and in group III (0.5%) 500 mins.

They concluded that 0.25%, 0.375% and 0.5% Bupivacaine intrapleurally provides pain relief and increasing the dose does not improve the quality of analgesia. Low arterial plasma concentration

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were obtained and no signs of pneumothorax or other side effects suggesting this method to be reliable and safe technique in the management of post-operative pain.

Seltzer J. L. (1987)¹³ while studying kinetic and dynamic evaluation of intrapleural Bupivacaine for cholecystectomy patients observed that with successful block, maximum plasma concentration of Bupivacaine was well below the reported toxic level of 4mg/L. They used 30ml of 0.5% of Bupivacaine plus 1 in 1 lac adrenaline with mean duration of 4-6 hrs.

In one of his patients 5 ml of pleural fluid was obtained on insertion of catheter. With injection of Bupivacaine he developed transient seizures and had prolonged awakening. They concluded that pleural inflammation should be a contraindication for this technique.

They were not able to obtain adequate pain relief using a volume of 20ml of Bupivacaine and found the additional 10 ml was necessary for uniformly successful blocks. The maximum levels of Bupivacaine in plasma were reached at 20 minutes with maximal concentration for 0.5% Bupivacaine being 1.18 ug/ml. The study indicated that Bupivacaine with epinephrine is absorbed from pleural space at a rate similar to other areas of body.

In 1987 Victor C. Lee and Stephen E. Abrham¹⁴ utilized successfully, indwelling chest tube for administrations of local anaesthetic intrapleurally. However this route, should only be utilized when there is no demonstrable air leak present and patients can tolerate clamping of chest tube, they cautioned.

E. L. Naggar M. A. et al (1987)¹⁵ used 30 ml of 0.75% bupivacaine in 38 patients and found profound pain relief with a mean duration of 9.5 hours, They also checked blood levels of bupivacaine using gas chromatography, maximum blood levels of bupivacaine obtained at 30 minutes was in the range of 2.5" 2.75mg/ml

Kambam. R. J. et. al. (1987)¹⁶ studied intrapleural analgesia for post thoracotomy pain relief in 14 patients. In his study there was significant difference in the peak plasma concentration of Bupivacaine between adrenaline containing (0.32 ± 0.02 mg/L) and plain (1.2 ± 0.48 mg/L) solution of Bupivacaine. The time required to reach peak plasma concentration of Bupivacaine following intrapleural injection was 53 ± 27 minutes for adrenaline containing solution and 10 ± 2 minutes for non-adrenaline containing solution.

He suggested that intrapleural analgesia should not be used in presence of pleural effusion, bronchopleural fistula, pneumonia and local infections as these conditions may lead to increase absorption of drug resulting in cardiovascular or CNS toxicity.

In 1988 for the first time, the use of Bupivacaine via intrapleural catheter, for analgesia after thoracotomy in children was reported by William. B. Mac Ilaine, Richard F. Knox and Paul V. Fennessay et. al.¹⁷

A 24 hour continuous infusion of 0.25% Bupivacaine via I. P. C at 0.5ml/kg/hr was given. Narcotics were not required during the period of infusion and there was very little effect on blood pressure or heart rate. Pain free child still suffered from anxiety and emotional distress which was allayed by use of sedative or anxiolytics. There was no CVS or CNS toxicity.

This technique provides safe and effective analgesia in children because of lack of side effects or complications related to either catheter or local anaesthetic.

Moustafa A. El-Naggar et. al. (1988)¹⁸ undertook the study to examine the possible role of bilateral intrapleural regional analgesia for patients undergoing thoraco abdominal or major abdominal surgical interventions which necessitated midline or across the midline surgical incisions.

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They reported that bilateral intrapleural injection of 20 ml of 0.5% Bupivacaine with Epinephrine was ineffective for post-operative pain relief whereas bilateral injection of 20 ml of 0.75% Bupivacaine resulted in good relief without symptoms of toxicity.

Sabaratnam S., Philip J. B. S, Gautam N. P, et. al. (1988).¹⁹ They studied intercostal analgesia on 81 patients. 28 patients had operations for esophageal diseases, and 53 had lung resection. They inserted portex epidural catheter through a 16 gauge disposable tuohy needle. Positioned the catheter to lie against angles of exposed ribs. They obtained a result of 92.6%, analgesia was adequate for the 1st 24 hours. There were no adverse reactions to the drug. Post operatively recovery was smooth.

Rosenberg et al (1989)²⁰ used intrapleural technique for post-thoracotomy pain relief in 20 patients.

According to them inadequate pain relief in their patients was due to:

1. Loss of local anaesthetic via chest tube.
2. Dilution of local anaesthetic by residual irrigation fluid and or blood.
3. Binding of local anaesthetic to the blood product in the presence of haemothorax.
4. Possible rapid absorption of local anaesthetic via injured lung.

Timothy R. V. et. al. (1989)²¹ did a comparative study of intrapleural bupivacaine and saline on morphine requirements, and pulmonary function test were evaluated, in patients after cholecystectomy.

Intrapleural injection of 20ml of 0.5% bupivacaine significantly and reproducibly reduced P. C. A. morphine use. Patients receiving intrapleural bupivacaine also showed increases in FEV1 and FVC over pre injection values; conversely group who received intrapleural saline did not decrease their PCA use and showed no change in results of pulmonary function tests. These results indicate that intrapleural bupivacaine provides sustained pain relief after cholecystectomy and improves pulmonary functions.

EL Naggar et. al. (1989)²² studied intrapleural analgesia for pain relief in 50 cholecystectomy patients. He utilized single dose of 30 ml of 0.75% Bupivacaine with 1 in 2 lac adrenaline and found that the mean duration of analgesia was in the range of 10-12 hrs.

Lee. A, Boon. B, Bagshaw. P et. al. (1990)²³ did a randomized double blind study of intrapleural analgesia after cholecystectomy.

Mogg et. al. (1990)²⁴ while studying pharmacokinetic of intrapleural Bupivacaine demonstrated that maximum systemic arterial and venous plasma concentrations of Bupivacaine occur at 10-40 minutes after intrapleural Bupivacaine. - The arterial concentration of Bupivacaine was found to be in the range of 1.29-2.4 mg/l and venous concentration was found to be in the range of 1.05-2.3 mg/1. They showed that plasma concentration reached with 20 ml of 0.25% Bupivacaine is far below the toxic concentration which is 4 mg/1.

Gin. T. et. al. (1990)²⁵ studied the effect of adrenaline on venous plasma concentration of Bupivacaine after intrapleural administration. They found that addition of adrenaline delayed and decreased peak plasma concentration of Bupivacaine after intrapleural injection, Whereas duration and quality of analgesia remained same in both the groups with and without adrenaline.

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Welte M et. al. (1992)²⁶ studied the effect of morphine injected intrapleurally. Mac Gill pain Questionnaire was used to assess pain score. Concluded that low dose of intrapleural morphine is not effective.

Hiroshi Iwama. (1993)²⁷ studied the catheter location and patient position affecting the spread of IPA by radio-opaque catheter and radioisotope images in sitting and supine position. They concluded that catheters should be inserted towards the apex of the pleural space and local anaesthetics should be administered with the patient supine to obtain the best pain relief in thoracotomy.

Lauder. GR (1993)⁴ Reported a case of phrenic nerve paralysis following intrapleural analgesia for cholecystectomy. The pre-operative chest X-ray was normal, but chest X-ray after cholecystectomy and intrapleural analgesia revealed a raised right hemidiaphragm. This resolved after discontinuation of the interpleural analgesia and was probably a result of phrenic nerve block produced by the intrapleural local anaesthetic.

Schung. S. A, Fry. R. A (1994)²⁸ Investigated continuous regional analgesia in comparison with intravenous opioid administration for routine postoperative pain control.

Dutta. D. & Hardey. P. A. J (1995)²⁹ Reported a case of intra bronchial catheter placement, an unusual complication of IPA in a patient with mesothelioma.

Minero. E., Sacco. R., Grande. L (1998). They applied intrapleural analgesia in 50 patients after thoracotomy they used 75mg of Bupivacaine 0.5% and confirmed the validity of this treatment in the pain control of thoracotomised patient with a positive answer in 45 out of 50 patients without remarkable complications.

Ramjoli. F, De-Amici. D (1998) They studied, to ascertain, by telethermography and clinical observation, the effect of injecting anaesthetic solutions into the intrapleural space on thoracic sympathetic chains and splanchnic nerves. They concluded that after monolateral intrapleural analgesia there is bilateral increase of the cutaneous temperature of the trunk (measured by telethermography) and the reduction of the diffuse visceral pain suggest a bilateral block of the sympathetic chain and of the splanchnic nerves.

Syed S, Y., Imtiaz. N., Abdul. Q et. al. (1999) They did a comparative evaluation of, single dose intrapleural block with Intercostal block, using bupivacaine, hydrochloride for postoperative pain relief after cholecystectomy in 100 female patient and came to a conclusion that both the intrapleural and inter costal blocks are effective for reducing post cholecystectomy pain.

MATERIALS AND METHODS: This study consists of 50 cases undergoing elective thoracotomy at Chigateri General Hospital and Bapuji Hospital attached to J. J. M. Medical College, Davangere, during the year 1999-2001.

Selection of Patients: Patients with pleural pathology, coagulopathy, history of allergy to local anaesthetics, abnormal spine, major CVS, renal and neurological problems were not included in this study.

Preparation of Patients: During preanaesthetic visit detailed history of all the cases along with findings including blood pressure, pulse and respiratory rate were noted.

As most of the patients are illiterate an illustration about the Visual analogue scale was given.

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Laboratory Investigations: Haemoglobin %, Blood urea, Fasting blood sugar, Urine for albumin, sugar and microscopy, X-ray chest and ECG were done in all cases, special investigations like Echocardiogram were done.

Through assessment and preoperative preparation was aimed at in all the patients.

Consent: The procedure was explained and patients consent was obtained. Also at the same time an attempt was made to reassure the patient.

Premedication: All patients received Diazepam (0.1-0.2mg/kg) night before the surgery. Injection Phenergan (0.5-mg/kg) and Injection Morphine (0.05-0.2mg/kg) was given intramuscularly 1 hour before surgery as premedication. Resulting in a patient who was calm, co-operative and sleepy, yet arousable.

Procedure: After the patient was brought to the operating table, blood pressure, respiratory rate and pulse rate were checked and recorded. Intravenous infusion was established and anaesthesia was induced with intravenous Thiopentone Sodium (3-7mg/kg) with Atropine (0.01-0.02mg/kg) or Glycopyrrolate, (10-20microg/kg), intubated with a cuffed endotracheal tube, intubation facilitated by Succinylcholine (1.5-2mg/kg), Patient was maintained with Nitrous oxide 60%, Oxygen 40%, Narcotic analgesic, Fentanyl (1-2microg/kg), Non-depolarising muscle relaxant, Vecuronium bromide (0.04-0.06mg/kg) or Pipecuronium 0.05-0.08mg/kg and Halothane in traces (0.05-1%). Early recovery and return of consciousness was aimed at.

A sterile catheter of 12-14 FG measuring about 12 inches in length was inspected for patency and any kink in the tube, and was kept ready for use. These catheters have the advantage of having multiple perforations which causes better distribution of the drug.

Before the closure of chest, the surgeon inserts the Romovac catheter of a fixed and measured length (8-12cms) into the intrapleural space. The site of insertion of the catheter was approximately 8-10 cms from the spinous process passing above the 6th or 7th rib. The catheter was threaded 5-6cms into the intrapleural space in a posterior and cephalad direction. The catheter was loosely sutured, at its entry site, with the skin and a sterile dressing was applied. The other end of the catheter was then connected with a sterile plastic syringe to make it an air tight seal.

Patients were then reversed with Neostigmine (0.03-0.06mg/kg) and Atropine /Glycopyrrolate mixture and after extubation, were transferred to the recovery room.

Bupivacaine 0.375% plain was used for all patients. The volume was adjusted so as not to exceed 2mg/kg (15-20ml). The injections were given over a period of 1 minute period, through the catheter.

The first intrapleural injection of a local anaesthetic was given when the patient was still in recovery room and complained of pain. Drainage tube was inspected for movement of fluid column with respiration. The drainage tube was clamped before injection of local anaesthetic and released after 10 minutes, thus allowing time for intrapleural distribution of drug. The clamping of the tube was combined with careful observation of respiration, pulse rate and blood pressure. All patients were shifted to ICU ward, where they were monitored and reinjected with the same dose of intrapleural Bupivacaine whenever the patient complained of pain for a 24 hours period, post operatively.

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Post operatively, the patient did not receive any other analgesics but supplemented if required with inj. Tramadol 50mg IM.

Pain was assessed on a Visual Analogue Scale, using a numerical scale. The scale ranges from 0 (no pain) to 10 (most severe pain). VAS measurements were taken immediately prior to and after the administration of local anaesthetic:

The following data were noted:

- Onset of Action: From the time of injection of local anaesthetic to the time when patient perceived reduction in pain by direct questioning.
- Duration of Action: From the time of injection to the time when patient next complained of pain.
- Pulse, Blood pressure and Respiratory rate were assessed 24-48 hours later the catheter was removed, after the administration of Bupivacaine through it. The resulting wound was then sealed by Tincture Benzoin and plaster. The length of the catheter was measured to rule out the possibility of the portion of catheter being left inside the pleural cavity.

OBSERVATION & RESULTS: The present study of intrapleural bupivacaine consisted of 50 cases who underwent thoracotomy during the period of 1999 to 2002 in Chigateri General Hospital, Davangere and Bapuji Hospital, Davangere.

Types of Operation	
Closed mitral valvotomy	47
Hydatid cyst enucleation	3
Total	50

Table 1: Showing types of operation

Out of 50 cases 47 patients were operated for closed mitral valvotomy, 3 for hydatid cyst enucleation.

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Total No. of cases	Age in years	No. of cases	Percentage
50	10 – 25	22	44
	26 – 40	23	46
	41 – 65	5	10

Table 2: Showing incidence of age group

This study shows 22 patients in the group of 10–25, 23 patient in the age group of 26–40 and 5 patients in the age group of 41–65.

Sex	No. of Patients	Percentage
Male	12	24
Female	38	76

Table 3: Showing Sex incidence

This study consisted of 38 female patients and 12 Male patients.

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Time in minutes	No. of Patients			
	I st Dose	II nd Dose	III rd Dose	IV th dose
4-6	35	30	35	28
7 – 9	9	18	13	19
10 – 12	6	2	2	3

Table 4: Showing the duration for onset of action in each dose

The minimum duration of onset of action was 4 minutes and maximum was 10 minutes, the average duration for onset of action was 6.24 minutes.

Duration in Hours	Interval between		
	I st & II nd Dose	II nd & III rd Dose	III rd & IV th dose
4-6	35	30	35
7 – 9	9	18	13
10 – 12	6	2	2

Table 5: Showing the duration of action

In this study of 50 cases the duration of analgesia varied from 5 hours to 7 hours. The mean duration of analgesia was 6 hours.

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Visual analog Score	Ist Dose	IIInd Dose	IIIrd Dose	IVth dose
0	24	29	37	38
1	12	16	13	12
2	13	5	-	-
3	1	-	-	-

Table 6: Showing pain score after injection of Bupivacaine

In this study pain score ranged from 3 to 0 (no pain). The average pain score 0.82.

Respiratory Rate	Ist Dose	IIInd Dose	IIIrd Dose	IVth dose
15 – 20	5	8	12	14
21 – 25	16	15	15	25
26 – 30	29	27	23	11

Table 7: Showing change in respiratory rate

This study shows a decrease in respiratory rate relative to number of the dose.

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Change in blood Pressure	No. of Patients
-10 – 0	20
1 – 10	15
11 – 20	15

Table 8: Showing the change in blood pressure from Ist dose

In this study, from the Ist dose a fall in blood pressure of 10 mm Hg was found in 20 patients, other 30 patients showed an increase in blood pressure. When compared with IVth dose.

Change in pulse	No. of Patients
20 – 0	36
0 – 20	14

Table 9: Showing change in pulse rate from Baseline

In 36 cases a reduction in pulse rate is seen in IVth dose from Baseline and a raise in pulse rate was found in 14 patients.

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Total No. of Cases	No. of Patients	Percentage
50	8	16%

Table 10: Showing need for Supplemental Analgesic

Out of 50 cases done only 8 patients required supplemental analgesic with inj. Tramadol (50mg) that too for 1st dose only.

DISCUSSION: The terms interpleural and intrapleural have been used interchangeably to describe the space between the parietal and visceral pleura into which the local anaesthetic is deposited. Cavino suggested that the term interpleural to be used because the catheter is located and the local anaesthetic solution is deposited between the two layers of pleura rather than within the pleura, however as pointed out by other authors, parietal and visceral pleura are continuous around the hilar structures therefore injection of local anaesthetic through a needle has penetrated the parietal pleural membrane but not the visceral membrane of the pleural cavity so be called intra pleural. D. F. Murphy (1993).

In this clinical study, bupivacaine 0.375%, via intrapleural catheter, in postoperative period, provided safe and effective analgesia, and it lacked any side effects related to, either the catheter or the local anaesthetic, in 50 patients who underwent thoracotomy. Bupivacaine 0.375% is made by diluting 0.5% bupivacaine in normal saline.

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Many investigators have stated that intrapleural bupivacaine is safe and efficient in management of post-operative pain, in patients undergoing thoracotomy. Kambam et al 1986, Joseph L. Seltzer 1987 William B. Mc Ilivane 1988, Moustafa. EL. Naggar 1989, G. A. Mogg 1990, D. F. Murphy 1993.

Local Anaesthetic: In this study plain bupivacaine without adrenaline was used because most of the cases were closed mitral valvotomy and epinephrine is not advisable with such cases. Bupivacaine was chosen because of its longer duration of action.

Mechanism of Action: The mechanism of analgesia are possibly by direct effect on nerve endings and by reverse diffusion of local anaesthetic from the pleural space back into the subpleural space and then into intercostal spaces blocking the intercostal nerves.

METHOD: Bupivacaine is lost quite significantly via the chest tubes (Rosenberg 1987). To reduce the loss of intrapleural bupivacaine through the chest tubing, the drainage tube was clamped, but because of increased risk of development of atelectasis in thoracotomy patients, when drainage tube is clamped even for a short period, it was made sure to declamp within 10 minutes.

In this study of 50 cases the 1st intrapleural injection of local anaesthetic was given in the recovery room, as soon as the patient was awake and complaining of pain. This was followed to minimize the influence of general anaesthesia.

Another effect I noted was that the first dose was not that effective, this probably is due to the acidic blood in the intra pleural cavity, which can be either washed out with saline or addition of sodabarbonate to the first dose improved its efficacy, which was not mentioned in this study.

Dose and Volume of Bupivacaine: Bupivacaine 0.375% was chosen to avoid ineffectiveness of Bupivacaine 0.25% and toxicity with Bupivacaine 0.5%. The volume was adjusted according to the patient's weight, and advantage with 0.375% is that it will not exceed the maximum dose of 2mg/kg even with 20-25 ml in a 50 Kg patient. The volume chosen was adequate to ensure a rapid spread of local anaesthetic in the pleural space. This was confirmed in one of our patient using radiograph of the chest after injecting 20ml of contrast fluid (Urografm 76%) via the intrapleural catheter. The patient was a male patient with a weight of 55kg. The picture showed a total spreading of drug in the left pleural space.

Duration for Onset of Action: All the patients received injections of 0.375% bupivacaine, via intrapleural catheter, for 24 hours post operatively. The duration for onset of action ranged from 5 minutes to 10 minutes. Duration for onset of action was high for the 1st dose average was 6. 4 minutes and showed a lesser duration for onset in subsequent doses may be due to clearing of blood.

Duration of Analgesic Action: Duration of analgesic action varied from a maximum of 7 hours to a minimum of 5 hours. The mean duration of action was 5.52 hours between 1st dose and 2nd dose, and showed an increasing trend to a mean of 6.24 hours between 3rd and 4th dose.

This can be attributed to clearing of blood and reduced dilution of drug and also may be due to accumulation of drug. Reiestad & Stromskag has reported a mean duration of action of 4 hours.

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Pain Score: Pain score is measured by Visual Analogue scale, numerical scale ranging from 0-10 (0- no pain and 10- maximum pain). In this study, observation of analgesia ranged from minimum 0 to a maximum of 3- The average pain score was 0.82.

It's also noticed in this study that pain score improved as the number of doses increase. This may be due to washing out of blood from the pleural cavity.

Supplemental analgesic was needed in 8 cases with inj. Tramadol along with first dose. Finn Reistad 1986 has also reported that supplementary analgesics were required during their study of intrapleural technique for 3 cases out of 81 cases.

Blood Pressure: In this study of 50 patients, 20 patients showed a fall in blood pressure to a range of 10 mm Hg. Rest 30 patients showed a raise in blood pressure, this rise in blood pressure can be attributed to the mitral valvotomy as most of the patients had undergone closed mitral valvotomy.

Considering even with the large amount of local anaesthetic used, none of the patients showed evidence of C. V. S toxicity.

Pulse Rate: Out of 50 patients studied, 36 patients showed a reduction in pulse rate of a range of 20 beats per minute. This can be attributed to the analgesia produced by the intrapleural local anaesthetic.

Respiratory Rate: Showed a downward trend in almost all the patients studied indicating that, pain stimulated tachypnoea, and was abolished following intrapleural injection of bupivacaine. Also patients did not experience pain even during bouts of coughing. An overall improvement in the respiratory status of the patient.

William B. McIlvaine during their study of continuous infusion of bupivacaine via intrapleural catheter for thoracotomy in children noticed that, prior to starting of infusion there was marked ipsilateral splinting of chest wall which disappeared within minutes of beginning the infusion.

Results of this study correlate well with their findings. But due to lack of facilities spirometry and blood gas analysis could not be undertaken in this study.

COMPLICATIONS: No complications were seen during the course of this study of 50 patients, using intrapleural 0.375% Bupivacaine.

The most complication reported was of pneumothorax by the investigators which was related to the procedure of placing the intrapleural catheter. In this study as the catheter was placed directly under vision, by the cardiothoracic surgeon and due to presence of chest drain tube, this possibility of lung injury can be ruled out. The clamping time of the chest drain tube was kept to a minimum of 10 minutes to reduce the chances of atelectasis. Other possible reported complication like toxicity to local anesthetics was not encountered in any patients in this study.

Advantages: The intrapleural technique has the advantage of requiring only single puncture. In addition to providing adequate analgesia, lack of generalised sympathetic blockade, systemic hypotension, urinary effects and respiratory depression are also associated with this procedure.

The technique permits supplementation with sedatives, tranquilizers, hypnotics, antiemetics or narcotics without the concern for adverse interactions.

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SUMMARY AND CONCLUSION: A novel approach to the treatment of the postoperative pain by the intermittent administration of local anaesthetics into the pleural space through an intrapleural catheter has been studied. This method was used in 50 patients, 47 of them had undergone Closed Mitral Valvotomy and 3 had undergone thoracotomy for Hydatid cyst enucleation.

Effective pain relief was obtained in all cases by intrapleural analgesia with Bupivacaine. The duration of analgesia, following a single injection of intrapleural Bupivacaine 0.375% through a sterile Romovac catheter of 12 inches length, which was placed in intrapleural space by the cardiothoracic surgeon, was a mean time of 6 hrs. The onset of analgesia occurred within a mean time of 6.4 minutes. These patients had lower average pain score (VAS 0.82) and a decreased supplementary analgesic requirement. There was a decrease in respiratory rate, breathing became unlaboured and movement of chest along with breathing was pain free, they were also able to cough out secretions easily. Only 8 patients required supplementary analgesic. No complications pertaining to the technique were encountered. Cardiovascular system was relatively stable in all patients under intrapleural analgesia.

This new technique certainly has advantage over other methods. Lack of facilities did not permit me for more intensive studies like Spirometry and estimation of Plasma level of Bupivacaine or Blood Gas analysis.

CONCLUSION:

- Intrapleural Bupivacaine 0.375% is highly effective, technically relatively simple, easy, safe and a promising technique for relief of post thoracotomy pain.
- The risk of complications appears to be small.

(Here as the catheter is placed under direct vision, a chest drain tube being already present, the chances of pneumothorax are minimal). The results have been encouraging and therefore it can be safely recommended as a routine procedure for post-operative analgesia in patients undergoing thoracotomy.

P. S, with the advent of newer less toxic long acting local anaesthetics like Ropivacaine and levobupivacaine this study has become interesting and I have already started a study in sternotomy patients.

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AUTHORS:

1. Rommy Geever T.

PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Anaesthesiology, Sree Mookambika Institute of Medical Sciences, Kulashekarum, Tamil Nadu, India.

FINANCIAL OR OTHER**COMPETING INTERESTS:** None**NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:**

Dr. Rommy Geever T,
Jasmine 10-A, Royal Gardens,
S N Junction, Thripunithura, Kerala, India.
E-mail: thapal69@yahoo.co.in

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