Intrapleural Analgesis for Post Thoractomy Pain Management

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ABSTRACT

Introduction: Intrapleural administration of local anesthetic is known to be an excellent method of pain relief after surgery in the upper abdomen and thorax. Intrapleural analgesia consists of the injection of a local anesthetic into the pleural space and is used for postoperative analgesia. The aim of the study was to see the effect of intrapleural analgesia with intermittent injection (0.25 – 0.5%) bupivacaine at 1mg/kg body weight.

Material and Methods: The present study was conducted in the department of Cardiothoracic Surgery. All the patients underwent thoracotomy and were randomly distributed into two groups. Group I had 25 patients who received post-operative analgesia in the form of Parenteral Tramadol HCl + Diclofenac Sodium 1mg/kg 8th hourly. Group II had 25 received Intrapleural (0.25 to 0.5%) Bupivacaine HCl 1mg/kg 8th hourly. The pain assessment was done by visual analogue score and visual rating score of Prince Henry.

Results: There were 10 male and 15 female patients in group I (mean age: 17.64 years) and 11 male and 14 female patients in group II (mean age: 17.16 years). The mean weight of group I was 28.88 Kg and that of group II was 26.8 Kg. Group I had 15 cases of mitral stenosis and 10 cases of PDA while group II had 14 cases of mitral stenosis and 11 cases of PDA. There was no significant difference in the demographic characteristics between the two groups. At 2nd post-operative hour, in Group-I most of patients (15/25) were at VAS – 4 where as in Group-II (14/25) were at VAS-2. All were treated with chest physiotherapy and appropriate antibiotics.

Conclusions: Intra pleural analgesia, is simple, safe and effective method for post-operative analgesia following thoracotomy procedures. The requirement of opioids and NSAIDS is drastically reduced during post-operative period with minimal adverse effects noted related to intrapleural analgesia. It can be used as safe alternative for post thoracotomy pain management like thoracic epidural analgesia.

Keywords: Thoracotomy, Epidural analgesia, Intrapleural analgesia

INTRODUCTION

Adequate pain relief in the post-operative period increases patient comfort, decreases the stress response, minimizes the effects of surgery on pulmonary function, and allows early patient ambulation, thereby, decreasing post-operative complications.

Traditional use of postoperative narcotic analgesics is associated with troublesome side effects. Parenteral and epidural narotics may cause respiratory depression. Epidural local anesthetics may cause hypotension and prevent early patient ambulation.

Intrapleural administration of local anesthetic has recently been reported to be an excellent method of pain relief after surgery in the upper abdomen and thorax. It has also proven to be useful for management of patients with multiple rib fractures.[1]

Intrapleural analgesia consists of the injection of a local anesthetic into the pleural space and is used for postoperative analgesia. Its advantages are that it can be used unilaterally, has a rapid onset of action and gives analgesia to thorax and upper abdomen.Hemodynamic and ventilator functions are well maintained in this type of anesthesia. Adverse effects are rare and if at all occur, are in the form of pneumothorax.[2]

Our aim was to study the effect of intrapleural analgesia with intermittent injection (0.25 – 0.5%) bupivacaine at 1mg/kg body weight and to compare the side effects of intrapleural analgesia with regular analgesia.

MATERIAL AND METHODS

The present study was conducted in the department of Cardiothoracic Surgery, Osmania Medical College over a period of three years from 2011 to 2014. This study was carried out in a randomized manner in 50 patients of either sex, between the age groups of 5 – 40 years. The patients were randomly distributed into two groups I and II, and each group had 25 patients. The inclusion criteria were diagnosed and operable cases of patent ductus arteriosus and mitral stenosis. The exclusion criteria included patients with lung and pleural pathology, patients who did not understand VAS and VRS, and patients allergic to bupivacaine, diclofenac sodium and tramadol.

Pre-operatively, all the patients were given instructions about the use of a 10cm vertical visual analog scale (VAS; with end points labeled as 'no pain' and 'worst possible pain'), and verbal rating Prince Henry pain score.

Visual analogue scale of pain (for spontaneous pain)[3]

0 – 1	No pain
2 – 3	Mild Annoying pain
4 – 5	Nagging uncomfortable, troublesome pain
6 – 7	Distressing miserable pain
8 – 9	Intense, dreadful, horrible pain
10	Worst possible, unbearable, exhausting pain

Verbal rating Prince Henry pain score (VRS)[4]

Score:	0	: No pain on coughing
Score:	1	: Pain on coughing but not on deep breathing
Score:	2	: Pain on deep breathing but not at rest
Score:	3	: Slight pain at rest
Score:	4	: Severe pain at rest

All the patients were informed before surgery that they could request an analgesic if pain should set in. All the patients were selected with diagnosis of mitral stenosis and patent ductus arteriosus. Patent ductus arteriosus patients were operated through left postero-lateral thoracotomy and mitral stenosis

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patients were operated through left antero-lateral thoracotomy under general anesthesia.

All patients received standard anesthetic protocol.

Premedication: Ranitidine HCl 50 mg.
Promethazine HCl 0.5 to 1mg/kg
Tramodol HCl 1mg/kg
Diclofenac Sodium 1mg/kg

Induction of Anesthesia

Thiopental sodium 5mg/kg

Endotracheal Intubation

Vecuronium Bromide 0.08 – 0.1mg/kg

Maintenance of Anesthesia

N2O;O2 and Halothane mixture and Vecuronium Bromide – 0.015mg/kg

Neuromuscular blockadereversal

Neostigmine 0.05 – 0.08+Atropine 0.02mg/kg

Intra-operative monitoring was done by pulse oximetry, ECG, IBP/NIBP. Average surgery time was 45 – 90 minutes. At the end of surgery, patients were randomly distributed into two groups. Group I had 25 patients who received post-operative analgesia in the form of

Parenteral Tramadol HCl + Diclofenac Sodium 1mg/kg 8th hourly. Group II had 25 patients who received post-operative analgesia in the form of Intrapleural (0.25 to 0.5%) Bupivacaine HCl 1mg/kg 8th hourly.

In patients assigned to Group II, an 18G epidural catheter was introduced along with inter-costal tube drain before the closure of the thoracotomy wound. The catheter tip was positioned one space above the line of vertebral end of skin incision in the para-vertebral gutter at the level of T3 vertebra. A dose of 1mg/kg of (0.25 – 0.5%) bupivacaine was injected through the catheter immediately after the closure of the thoracotomy wound, before reversal of the patient from anesthesia. The intercostal tube drain was clamped for a period of 20 minutes following every dose of injection. Subsequent top up doses were given at 8th hourly interval for 24 hours. Group I patients received conventional analgesic regime with injection tramadol + injection diclofenac sodium 1mg/kg at 8th hourly interval.

The degree of postoperative pain was assessed using visual analog score (VAS for spontaneous pain) and verbal rating score of Prince Henry (VRS for induced pain) on arrival at the recovery room. The VAS was assessed every 2 hour interval and VRS was assessed at every 4 hour interval. Assessment also included performance of incentive spirometry at 4-hour interval from 8 hours after surgery and number of the rescue analgesic doses. Incentive spirometry was used as a feed-back system to encourage patients to take deeper breaths and produce sustained maximal inspiration so as to open atelectatic areas of lung. It is cheap to provide, non-invasive and when taught well, needs minimum supervision.

Bastin et al[5] observed that deterioration in incentive Spiro meter performance could be used as a warning of pulmonary deterioration. All the patients were hemodynamically monitored. The rescue analgesia consisted of injection diclofenac sodium 1mg/kg body weight when the VAS score was 6 or more and VRS score was 3 or more, depending on patient request.

STATISTICAL ANALYSIS

Microsoft excel 2007 was used for making tables and graphs. Descriptive statistics like mean and percentages were used to interpret data collected.

RESULTS

There were 10 male and 15 female patients in group I (mean age: 17.64 years) and 11 male and 14 female patients in group II (mean age: 17.16 years). The mean weight of group I was 28.88 Kg and that of group II was 26.8 Kg. Group I had 15 cases of mitral stenosis and 10 cases of PDA while group II had 14 cases of mitral stenosis and 11 cases of PDA.

There was no significant difference in the demographic characteristics between the two groups (table-1). The post-operative pain score of VAS and VRS in group I and II were recorded (tables-2 and 3).

At 2nd post-operative hour, in Group-I most of patients (15/25) were at VAS – 4 where as in Group-II (14/25) were at VAS-2. Similarly at all intervals the VAS and VRS pain scores were less in Group-II when compared to Group-I (table-4).

Number of patients who are able to do incentive spirometry at

Variable	Group I - 25 cases	Group II - 25 cases
Hemodynamics		
1. Pulse Rate		
Mean	95.00	94.30
Median	96.00	98.00
Standard deviation	12.00	11.90
2. Respiratory Rate		
Mean	19.60	19.28
Median	19.00	19.00
Standard deviation	2.25	2.42
3. Systolic Pressure		
Mean	114.80	114.30
Median	116.00	116.00
Standard deviation	6.16	5.96
4. Diastolic Pressure		
Mean	75.12	72.60
Median	76.00	72.00
Standard deviation	5.66	5.99
5 Oxygen Saturation (SPO2) at room air.		
Mean	94.28	96.00
Median	94.00	96.00
Standard deviation	1.67	0.81

Table-1: Hemodynamic Variable in both the groups

Time	VAS score from 1 to 10									
	1	2	3	4	5	6	7	8	9	10
1/2 hr										
2		1	4	15	5					
4				1	13	11				
6					4	21				
8						5	16	4		
10				2	14	8	1			
12					3	17	5			
14					2	23				
16						4	14	7		
18			1	1	16	6	1			
20					11	12	2			
22					5	19	2			
24						19	6			

Table-2: VAS Score in Group-I

minimum resistance of 100mtr/s for children and 200mtr/s for adults in both groups are shown in table-5 and Figure-1 at 4th hourly interval from 8th hour of post-operative period.

In both groups no significant difference was noted in oxygen saturation and hemodynamics.

In Group-I, 4/25 patients had nausea and vomiting whereas, in Group-II only one patient had nausea and vomiting. In group I, 4/25 patients had lower respiratory tract infection where as in Group II only one patient had. All were treated with chest physiotherapy and appropriate antibiotics.

In Group-I, one patient had one episode of convulsion, who was diagnosed to have generalized convulsive disorder in Electroencephalography (EEG) and was treated with anticonvulsive agents. One patient had post-operative reactive hypertension for first 24 hours, who was treated by NTG(nitroglycerine) drip and slowly settled to normal arterial pressure. Both patients were of PDA. In Group-II, 2 patients had convulsions, one was due to generalized convulsion disorder diagnosed on EEG and one patient had convulsion secondary to low serum sodium (115 meq/L) and was corrected by normal saline infusion. 3 patients developed reactive hypertension and treated with NTG drip. All patients were from PDA group.

DISCUSSION

The aim of any analgesic regimen is an alert, pain-free patient with near normal physiological parameters who can cooperate with medical therapy. The inadequacy of pain control has prompted the use of new techniques, drugs and routes of administration. They include intravenous medication via patient controlled analgesia (PCA), epidural analgesia, intra pleural analgesia, peripheral nerve blocks, transdermal and transmucosal analgesia and adjuvant medication.

Time	VAS score from 1 to 10									
	1	2	3	4	5	6	7	8	9	10
1/2 hr										
2	8	14	3							
4		17	6	2						
6		6	12	5	2					
8			4	12	7	2				
10	1	4	11	6	3					
12		1	4	9	8	0	3			
14			2	4	9	10				
16				2	5	11	7			
18			3	11	8	3				
20				6	12	4	3			
22				2	14	8	1			
24					6	16	3			

Table-3: VAS Score Group-II

The first 6 – 12 hours after operation typically constitute the period when it is most difficult to control the severity of pain and the potential for side effects of the pain or therapy.

Effective pain management is one of the most important components of the treatment of patients undergoing thoracic surgery. Post thoracotomy pain is one of the most severe types of post-operative pain during the first 24 hours and is responsible for post-operative morbidity by compromising respiratory function [Takamori et al[6] and Kaiser et al[7]].

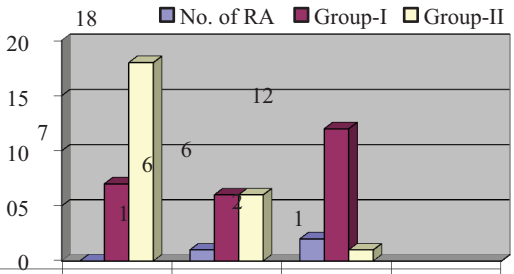
Because of the limitations of the former analgesia techniques as mentioned earlier, interest in the administration of long-acting anesthetic agents through an intrapleural catheter has recently moved to the center [Reiested – 1986[8] and Rocco – 1986[9]]. Although interpleural analgesia is the more correct terminology to describe this anesthetic technique, since the catheter lies between the parietal and visceral pleura, the term "intrapleural analgesia" has been used synonymously.

Semsroth[10] 1996 and colleagues reported that continuous intrapleural infusion of 0.25% bupivacaine provided effective analgesia as a safe and suitable method for pain relief in infants and children following thoracotomy.

This study was designed to evaluate the effectiveness of intra pleural bupivacaine with 1mg/kg body weight with varying concentration of 0.25% solution for children and 0.5% solution for adults, delivered by intermittent infusions instead of continuous infusion.

Effective analgesia has been obtained with concentrations of bupivacaine that have ranged from 0.25 to 0.75% with volumes ranging from 8 to 30ml. Reiested et al[8] reported mean duration of analgesia ranging from 285 minutes in the low concentration to 500 minutes with 0.5% bupivacaine.

Opioid analgesics are used for pain relief in severe cases and many times for post-operative analgesia too. They have serious side effects likenarcosis, depressing the peristaltic activity



No. of RA	0	1	2
Group-I	7	6	12
Group-II	18	6	1

Figure-1: Rescue Analgesia Requirement

Time	VRS Score							
	1		2		3		4	
	Group-I	Group-II	Group-I	Group-II	Group-I	Group-II	Group-I	Group-II
4hr	0	23	13	2	12	0	0	0
8hr	0	3	0	20	21	2	4	0
12hr	0	4	2	18	23	3	0	0
16hr	0	0	0	7	18	18	7	0
20hr	0	0	11	18	14	7	0	0
24hr	0	0	0	6	25	18	0	0

Table-4: Verbal Rating Score of Prince Henry (VRS for induced pain)

Time (hours)	Group-I		Group-II	
	Able to do	Unable to do	Able to do	Unable to do
8	0	25	23	2
12	2	23	22	3
16	0	25	7	18
20	11	14	17	8
24	0	25	19	6

Table-5: Incentive Spirometry

of the large and small intestine and increasing the tone of the ileo-cecal and anal sphincters. All of these actions can promote postoperative ileus. Patient controlled analgesia has been used by some workers to reduce the period of ileus following bowel surgery.Albert et al[11] have observed reduced period of ileus in patients using PCA when compared with those receiving conventional analgesia.

Also pruritus is a common complaint with the use of opiates via PCA as observed by Burch et al.[12] There is always an effort to find ways to reduce the opioid medications in patients due to the side effects of opioids. Intrapleural analgesia is one such alternative. Symreng et al[13] observed that the opioid drug requirements were significantly less in the intrapleurally medicated group

Patients with epidurally administered analgesia have adequate pain control with lesser sedation and they are able to mobilize earlier and more effectively after operation. Patients are able to cooperate with respiratory therapy, mobilize secretions, and commence physical therapy earlier.as observed by Craig et al.[14] Epidural anesthesiais beneficial as earlier mobility decreases the incidence of pulmonary complications and venous thrombosis as observed by Modig et al.[15]

Earlier return of bowel function and a decreased stress response may also contribute to shorter hospitalization and decreased morbidity as observed by Breslow et al.[16]

Berde et al[17] observed decreased sedation and more rapid recovery to pre-surgical levels of consciousness in patients whom epidural anesthesia was used as compared with systemic narcotic administration.

Epidurally administered analgesia has been effective in treating pain in the body below the upper thoracic level. Trauma victims can benefit from epidurally administered analgesia following a flail chest. The nociceptive pain impulse can be inhibited in epidural space by local anesthetics, opioids or the combination of local anesthetics and opioids.

Rosenberg et al[18] conducted a study using 0.25 % bupivacaine. They did not observe any adverse reactions with intrapleural analgesia. Side effects were not apparent probably because of either the slow rate at which the bupivacaine level rose or possibly due to altered pharmacokinetics in the post-operative patient. However, Seltzer et al[19] reported grand mal convulsions occurring in intrapleural analgesia. They attributed this to the inflammatory response in the pleural space that causes an increase in the speed of drug absorption.

Some previous studies have shown limited or no improvement in analgesia with this technique as discussed below. Scheinin[20] and colleagues compared patients who received interpleural analgesia plus oxycodone supplementation with a control group of patients who received systemic oxycodone alone, a decrease in opiate consumption was seen in the interpleural group during the first 24 hours, but not over a 48 hour period.

Schneider[21] and colleagues observed no subjective or objective clinical benefit of interpleural analgesia. Malte[22] and collegues also found no analgesic efficacy in patients undergoing antero-lateral or postero lateral thoracotomy when comparing patients receiving either interpleural bupivacaine or saline.

Kambam et al[23] reported that interpleural analgesia was effective in patients undergoing posterior and lateral thoracotomy but not in patients undergoing anterior thoracotomy.

Some possible mechanisms were explained in the limitation of the efficacy of intrapleural analgesia, such as loss of local anesthetic through the chest tube, dilution of local anesthetic with blood and exudative fluid accumulation in the pleural cavity, altered diffusion across the parietal pleura due to surgical manipulation, inflammation, and binding of local anesthetic with proteins. All these could lead to the decreased effectiveness of interpleural analgesia.

Non – steroidal anti-inflammatory drugs (NSAIDs) are used in the management of post-surgical pain. The NSAIDs may be sufficient to relieve pain after simple procedures or may have additive (or synergistic) effects with other forms of analgesics [Dahl et al[24]].

NSAIDs may reduce the requirements for opioids. NSAIDs may be used before, during or after a surgical procedure and in this way they may limit the potential toxicity and side effects of other analgesic regimes. NSAIDs all produce antipyretic, analgesic and anti-inflammatory effects, but the relative proportions of these effects vary with the different agents. Rectally, intramuscularly and intravenously administered NSAIDs have all demonstrated an opioids sparing effect in patients following thoracotomy.[25]

Addition of paracetamol or NSAIDs to opioids in post-operative period for pediatric population is not only effective but also improves the analgesia and reduces the requirement of opioids. It also reduces the adverse effects of opioids as observed by Wong et al.[26]

There is always the possibility of enhanced post-operative or gastric bleeding, potential for an anaphylactic reaction with NSAIDs. NSAIDs should be administered carefully or avoided in patients with significant renal impairment and peptic ulcer patients.

Easy management without a need for considerable experience, comfort of the patient without any risk of serious complications are the advantages of intrapleural analgesia.

The results of our study showed that intrapleural analgesia provided more effective and longer active pain control in group II than non-steroidal anti-inflammatory drug (Diclofenac)and opioid (Tramadol) administered in Group-I, on the VAS and Prince Henry pain scale scores. Rescue analgesia required in 7/25 patient in group II and 18/25 patients in group I.

Post operatively, performance efficiency of incentive spirometry was significantly high in group II at 8hr, 12, 20hr and 24hr post op-period when compared to Group I patients. In group II only one patient had nausea and vomiting and one patient had lower respiratory tract infection. When compared to 4/25 patients had vomiting and nausea and 4/25 patients had lower respiratory tract infection in group I.

In group I, one patient had convulsion secondary to generalized convulsive disorder diagnosed on EEG and one patient had

reactive hyper tension post operatively. In group II, 2 patients had convulsion, one patient with generalized convulsive disorder with EEG changes and one patient who had reactive hypertension treated with NTG drip had convulsion with low serum sodium and was treated with sodium chloride infusion. Another 2 patients had reactive hypertension and were treated with NTG drip. All patients were normotensive after 48 hours.

In conclusion, the lack of any technical challenge or complication related to intrapleural catheter insertion and better pain relief observed in this study suggest that intermittent pleural infusion of (0.25% to 0.5%) bupivacaine with 1mg/kg body dose is a safe and effective method for relief of post thoracotomy pain.[25]

CONCLUSIONS

Intra pleural analgesia, is simple safe and effective method for post-operative analgesia following thoracotomy procedures. The requirement of opioids and NSAIDS is drastically reduced during post-operative period. Almost nil adverse effects noted related to intrapleural analgesia. It can be used as safe alternative for post thoracotomy pain management like thoracic epidural analgesia. It may become a routine practice for patients undergoing thoracotomy procedures.

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