Efficacy of Thoracic Epidural Infusion of Ropivacaine Vs Ropivacaine with Fentanyl for Post Thoracotomy Analgesia

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Abstract

Background: Posterolateral thoracotomies, being one of the most painful procedures, require adequate pain relief in order to reduce the incidence of atelectasis and postoperative pneumonia. Numbers of analgesic techniques have been tried for post thoracotomy pain relief, out of which continuous thoracic epidural analgesia is now preferred and has been proven superior to IV patient-controlled analgesia (PCA). Hence, we evaluated the analgesic efficacy and side effects of an epidural infusion of Ropivacaine versus Ropivacaine along with Fentanyl. **Methodology:** 80 cases were equally divided into 2 groups, out of which Group A (n=40) was given 0.1 ml/kg/hr, 0.2% Ropivacaine infusion, and Group B (n=40) was given 0.1 ml/kg/hr, 0.2% Ropivacaine with 4µg/ml Fentanyl infusion. The infusions were given postoperatively, on admission of the patients to the ICU and the patients were assessed for a pain score (at rest and spirometry), spirometry values (pre operative and post operative), vital data, side effects (sedation, pruritus, nausea, vomiting), and a need for i.v analgesia (tramadol) for 48 hrs. **Results:** Cases of group B (0.1ml/kg/hr 0.2% Ropivacaine with 4 µg/ml Fentanyl infusion) had better pain relief, better spirometry values and lesser side effects as compared to group A (0.1 ml/kg/hr 0.2% Ropivacaine infusion). **Conclusion:** Addition of Fentanyl improves the efficacy of Ropivacaine in providing analgesia without any significant adverse effects.

Key Words : Thoracic epidural, Fentanyl, Ropivacaine, Thoracotomy

Introduction :

Posterolateral thoracotomies are one of the most painful procedures. The sources of perceived pain are the surgical incision, disruption of the ribs and intercostal nerves, inflammation of the chest wall structures adjacent to the incision, incision or crushing of the pulmonary parenchyma or pleura, stretching of the shoulder joint and placement of thoracostomy drainage tubes.[1] Optimum pain relief is essential in order to reduce the incidence of atelectasis and postoperative pneumonia.[2,3] Patients must be pain free at rest, should be able to breathe deeply, cough effectively and comply with postoperative physiotherapy. Numbers of analgesic techniques have been tried for post thoracotomy pain relief, out of which continuous thoracic epidural analgesia is now preferred and has been proven superior to IV patient-controlled analgesia (PCA).

One of the drugs used for this, Ropivacaine, is an amino-amide local anesthetic with an efficacy broadly similar to that of bupivacaine. [4] It may be a preferred option because of its reduced central nervous system and cardio toxic potential, which is because of the replacement of the butyl- by a propyl-terminal group. Furthermore, its decreased propensity for motor block helps in rapid patient mobilization in the postoperative period, thus improving respiratory therapy.

Furthermore, epidural opioids have been widely used for post thoracotomy pain relief. One such drug, Fentanyl, a short-acting lipophilic opioid analgesic, is structurally related to pethidine for its opioid activity. [5]

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Over time, great interest has been developed in attempts to improve the quality of thoracic epidural opioid analgesia by adding a low concentration of local anesthetic. Hence, this study shows the comparison of quality of post thoracotomy analgesia with Ropivacaine and Ropiovacaine Fentanyl, in a continuous epidural infusion with a vigil on complications.

Methodology

Over a period of two years from June 2010 to June 2012, eighty patients were selected for the study. They were listed on a computer, which randomly allotted and grouped them into two groups. The age, gender and religion in both the groups were matched. Single blinding was done.

After an informed written consent, we selected 80 cases undergoing elective lung surgery via a posterolateral, mid thoracic incision into two groups (A, B) for postoperative continuous epidural analgesia. The exclusion criteria for patients included an American Society of Anesthesia (ASA) physical status of III or more, patients of age less than 18 years or more than 60 years, and patients having a BMI of more than 30 kg/m^2. Patients with known drug allergies, especially to local anesthetics or opioids, and patients currently using opioids were excluded. Furthermore, neurological, renal or hepatic disorders, abnormal coagulation tests, lack of co-operation, or inability to comprehend or perform verbal and physical assessments, were other factors considered in excluding patients.

On the day before the surgery, patients received instructions on how to perform a simple spirometry, measure pain with a visual analog scale (VAS) that consisted of an unmarked 100-mm line, with 0 mm representing no pain and 100 mm representing the worst pain imaginable. Basal spirometry, including forced vital capacity (FVC), peak expiratory flow rate (PEFR), and forced expiratory volume in 1 second (FEV_1) were recorded.

In the OT, all routine monitors i.e., ECG, non-invasion blood pressure (NIBP) and pulse oximetery instruments were applied to the patient. A wide bore venous access was secured and a Ringer lactate drip was started. Patients were premedicated with Inj. Glycopyrrolate 0.2 mg, Inj. Ondansetron 4mg and Inj. Fentanyl 2µg/kg IV. All the patients received a combined epidural-general anesthesia. An epidural catheter was placed 5 cm into the epidural space at the T3 T4 vertebral inter-space in the sitting position.

General anesthesia was induced with Inj. Thiopentone Sodium 6 mg/kg, and Inj. Succinylcholine 2mg/kg and then the patients were intubated with a left-sided double-lumen tube for one-lung ventilation. Correct position of the endobronchial tube was confirmed by performing fiber-optic bronchoscopy. The radial artery was cannulated for invasive blood pressure monitoring and blood gas analysis, and a urinary bladder catheter was placed to monitor the urine output. Operative position of patient was lateral decubitus. General anesthesia was maintained with oxygen, air, and Isoflurane and muscle relaxation was maintained with intermittent doses of Vecuronium.

More than 20% rise in the blood pressure or the heart rate was considered as an inadequate depth of anesthesia. Incremental doses of Fentanyl (100µg i.v.) were given for achieving hemodynamic control and adequate depth of anesthesia. Isoflurane administration was stopped at the beginning of parietal pleura closure. At the conclusion of the surgery, standard extubation criteria were followed for extubation of the patient.

The patients were transferred to the ICU for close monitoring over the next 48 hour. At the time of skin closure, patients were randomly assigned to two groups for postoperative epidural analgesia where Group A received 0.1 ml · kg^{-1} · h^{-1} of 0.2% ropivacaine, and Group B: 0.1 ml · kg^{-1} · h^{-1} of 0.2% ropivacaine with 4µg/ml fentanyl.

Infusion was started on admission in the ICU. Data were collected at 2, 6, 12, 24, 36, and 48 hours after the patients' arrival into the ICU. Patients were asked to score their pain at the time of admission in the ICU, and received Inj. Tramadol 100 mg with Inj. Ondansetron 4 mg IV as a rescue analgesic when the VAS was more than 40 mm at rest.

We assessed the VAS scores for pain at rest and during PEFR measurement with the patient in semi reclined position. Further, the assessment included the spirometry values, Forced vital capacity (FVC), Peak Expiratory Flow Rate (PEFR), and Forced Expiratory Value at one second (FEV_1), the Vital data (heart rate, blood pressure, respiratory rate), and side effects such as postoperative nausea and vomiting (PONV) and pruritus. Also, sedation scores were given, where 1 was wide awake, 2 was given for an intermittent drowsy or dozing state, 3 to patients who were mostly asleep but could be easily awakened, 4 to patients who were asleep and had difficulty in responding to verbal commands, and 5 to patients who were awakened only by shaking.[6]

Statistical Analysis

All continuous data are presented as mean and standard deviation (SD). Categorical data were examined by unpaired t test. All reported P values are two-tailed, and $P < 0.05$ was considered significant. Since we had chosen to do the study over a two-year period, we had estimated that we would be able to get a patient size of 80 based upon the flow rate of patients requiring thoracotomies and out of those that would be available for the study after applying the exclusion criteria.

Results

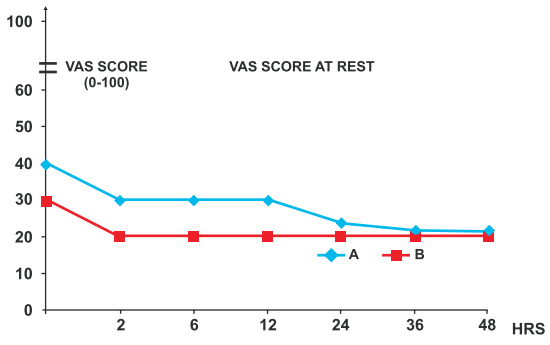
Both the groups were comparable in demographic data, ASA classification, lung function test, duration of surgery and other pre-operative variables (Table 1).

Table 1: Demographic characteristics and pre-operative variables of the two study groups

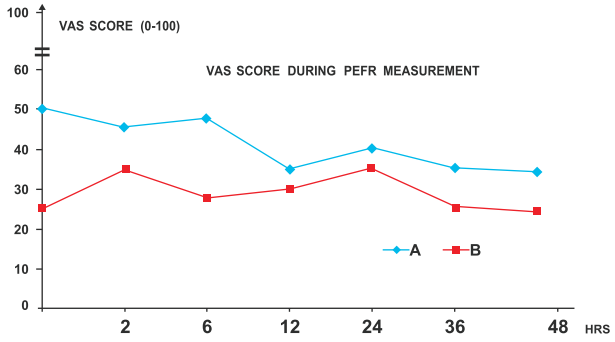
Parameter	Group A	Group B
Age (years)	45 ± 8	42 ± 18
Sex (M:F)	19:21	16:24
Height (cm)	175 ± 15	165 ± 15
Weight (kg)	70 ± 15	65 ± 14
Duration of Surgery (mins)	145 ± 35	150 ± 30
ASA (I:II)	16:24	19:21
Respiratory Rate (per min)	22 ± 4	23 ± 4
Hear Rate (per min)	86 ± 14	82 ± 12
SAP (mmHg)	150 ± 28	146 ± 30
FEV1 (lit)	1.9 ± 0.3	2.0 ± 0.4
FVC (lit)	2.4 ± 0.6	2.5 ± 0.3
PEFR (lit/min)	390 ± 110	380 ± 120

VAS pain score at rest was comparable in both the groups with P value > 0.05 (Graph 1). Patients in Group A experienced more pain as compared to patients in group B at the time of PEFR measurement at 2 and 12 hours after ICU admission with P value <0.05 (Graph 2). Respiratory rates were comparable in both the groups. Performance of group A was slightly worse in spirometry during FVC, PEFR (Graph 3) and FEV_1 (Graph 4) measurement.

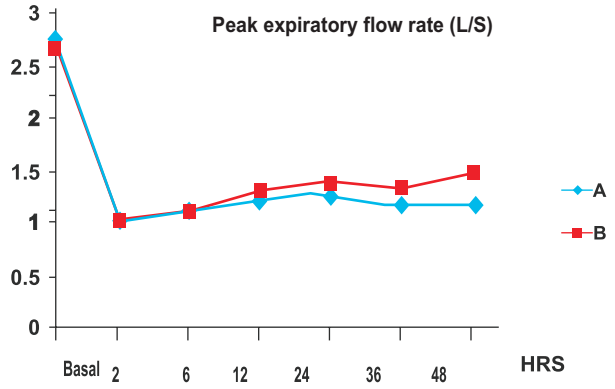
Graph 1: VAS pain score at rest



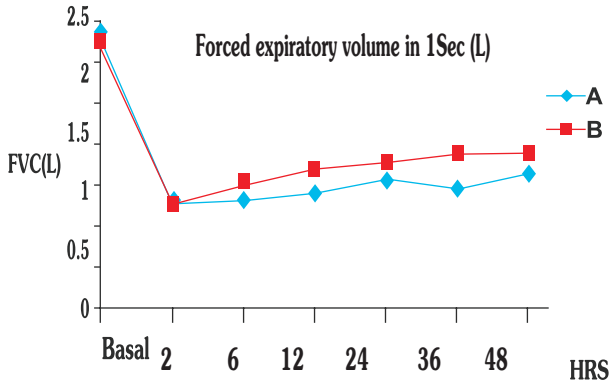
Graph 2: VAS pain score at the time of PEFR measurement



Graph 3:



Graph 4:



P value for FVC, PEFR and FEV_1 is < 0.05. Hemodynamic variables were comparable between both the groups but the incidence of pruritus was more in group B. PONV was more frequent in Group A (Table 2). The degree of sedation in the two groups was similar over the 48-h study period. There were no severely sedated patients in any group. No case of respiratory depression was observed.

Table 2: Comparison of incidence of side effects in both the groups

Variable	Group A n (%)	Group B n (%)
Nausea		
2 h	6(14)	4(10)
6 h	7(16)	5(12)
12 h	15(36)	6(14)
24 h	26(34)	6(14)
36 h	7(16)	3(9)
48 h	5(13)	4(10)
Vomiting		
2 h	2(4)	2(4)
6 h	4(9)	0(0)
12 h	8(19)	1(3)
24 h	9(22)	2(4)
36 h	2(4)	1(2)
48 h	3(6)	1(2)
Pruritus		
2 h	5(12)	5(13)
6 h	4(10)	6(14)
12 h	3(8)	8(22)
24 h	3(7)	9(24)
36 h	3(7)	9(24)
48 h	4(8)	10(25)

Discussion

Post thoracotomy pain is one of the worst pains, which poses a unique challenge of controlling pain while keeping the chest wall in motion so as to allow deep breathing and coughing in order to reduce complications like pneumonia and atelectasis which can be detrimental. Currently continuous epidural infusion of local anesthetics with/without opioids is the choice for postoperative pain control. Ropivacaine is a new aminoamide local anesthetic, monohydrate of the hydrochloride salt of 1- propyl- 2', 6' pipecoloxylidideand has less cardiovascular and central nervous system toxicity than racemic Bupivacaine.[7] So in our study we compared Ropivacaine vs. Ropivacaine with Fentanyl infusion.

Our study showed better pain control especially during motion/spirometry in group B. In group A pain control was worse during movement (during PEFR measurement), despite IV Tramadol to obtain a similar VAS pain score at rest. Hence there was larger consumption of IV Tramadol, and increased incidence of PONV in group A. Epidural local anesthetic agents have an established role in post thoracotomy analgesia. Opioids administered via the epidural route have been found to be superior in terms of analgesia, side-effects, length of stay and postoperative complications after thoracotomy.[8]

Hypotension was the most common side-effect with the use of Ropivacaine 0.5% in thoracic epidural, occurring in 80% of cases in whom satisfactory analgesia was achieved.[5] The high incidence of hypotension with Ropivacaine can be attributed to sympathetic blockade.[9] Although epidural administration of opioids does not result in sympathetic block,[10] hypotension has been observed with an epidural Fentanyl,[11] which could be related to systemic uptake from epidural space. Continuous epidural infusion of Fentanyl in a lower concentration of Ropivacaine (0.2%) thus avoids hypotension, which could be a problem with bolus doses of either. Thoracic epidural Fentanyl with no local anaesthetic has a concentration-dependent reduction in pain intensity in patients undergoing thoracotomy for lung resection. In one RCT comparing thoracic epidural of Fentanyl 1, 2 and 4 µg/ml in Ropivacaine 0.2%, was used in patients undergoing major abdominal surgery. It was shown that pain intensity was significantly greater in patients receiving Fentanyl 1 to 2µg/ml than in those having Fentanyl 4 µg/ml. [7] Epidural opioids are associated with dose-dependent adverse effects of sedation, pruritus, nausea and respiratory depression.[11]

It has been observed that the addition of Fentanyl had a stronger effect than the change of local anesthetic concentration. [7] [13] Opioids improve the quality of postoperative epidural analgesia with Ropivacaine. We did not find any significant difference in motor block, which could affect spirometry values in both groups. The increased incidence of PONV in the Ropivacaine group could be because of larger consumption of IV Tramadol. Incidence of side effects, mainly PONV, was frequent in both the groups, thus prophylactic antiemetics were required. Despite an increased consumption of Tramadol in the Ropivacaine group, we could not observe any difference in the sedation scale among patients.

Conclusion

A continuous thoracic epidural infusion of 0.1 mL · kg^{-1} · h^{-1} of 0.2% Ropivacaine / Fentanyl 4 µg/mL provided better pain relief than Ropivacaine during the first 2 postoperative days after posterolateral thoracotomy.

The use of 0.2% Ropivacaine alone was associated with worse pain control during spirometry, larger consumption of IV Tramadol, and increased incidence of postoperative nausea and vomiting (PONV).

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