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Comparative Clinical Study of Clonidine and Fentanyl as Adjuvant to Intrathecal Ropivacaine for Lower Limb Orthopaedic Surgeries

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Abstract

Backround and Aims: Effectiveness of Ropivacaine in spinal anaesthesia for hemodyanamic stability and anaesthesia quality for lower limb orthopaedic surgeries when used with adjuvants also improves the quality of anaesthesia & analgesia. *Methods:* Seventy patients ASA I or II received intrathecal injection isobaric ropivacaine (0.5%) with adjuvant. Group RC (n=35) received 15 mg isobaric ropivacaine (0.5%) with 60 mcg clonidine. Group RF (n=35) received 15 mg isobaric ropivacaine (0.5%) with 25 mcg fentanyl. The onset and duration of sensory & motor block, hemodyanamic parameters were recorded. Statistical analysis was done using Statistical Package of Social Science (SPSS Version 20; Chicago Inc., USA). *Results:* Sensory block duration (in seconds) in RC (329.42 ± 33.86) RF(226 ± 46.98) and motor block in RC (248.51 ± 55) RF (212.60 ± 43.52) out lasted duration of surgery (125.61 + 64.46). In clonidine group, there was significant prolongation of sensory block ($p < 0.001$), motor block ($p < 0.01$) and the total analgesia time ($p < 0.001$). Hypotension and bradycardia occurred in 8.6% patients in clonidine group, whereas pruritus was experienced by 8.6% patients in fentanyl group. *Conclusion:* clonidine or fentanyl when added to ropivacaine provided adequate subarachnoid block for lower limb orthopaedic surgeries, where clonidine was better than fentanyl, in terms of duration of subarachnoid block and postoperative analgesia.

Keyword: Ropivacaine; Clonidine; Fentanyl; Lower Limb Orthopaedic Surgery.

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Introduction

When compared to bupivacaine and lignocaine use of isobaric ropivacaine intrathecally has been proved and accepted as safer choice due to less neuro and cardiotoxicity [1,2]. In recent years, use of intrathecal adjuvants has acquired popularity with the aim of prolonging the duration of block, a good success rate, patients satisfaction, decreased resources utilization, faster recovery compared with the general anaesthesia.

The quality of the Subarachanoid block has been reported to be improved by addition of adjuvants like opioids (such as fentanyl, sufentanil and morphin) and alpha 2 agonists like clonidine & dexmedetomidine (DXM), other drugs such as neostigmine, magnesium sulphate, ketamine and midazolam, but no drug to inhibit nociception is without associated adverse effects.

Inj. Clonidine and inj. Fentanyl are two such adjuvants which are used with 0.5% isobaric inj. ropivacaine to increase the onset and duration of

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anaesthesia and analgesia. Clonidine is a partial agonist of alpha 2 adrenoceptors and acts as an analgesic and sedative. When administered intrathecally along with local anaesthetics, it improves the quality of the block and postoperative analgesia [3,4]. Fentanyl is an opioid that has shown to enhance the analgesic potency of Ropivacaine for spinal anaesthesia. Its addition to Ropivacaine for spinal anaesthesia has been shown to prolong the duration of analgesia in the early postoperative period, thus improving the quality of anaesthesia [3,4].

The aim of conducting this study in patients undergoing lower limb orthopaedic surgeries is to evaluate the efficacity of adjuvants like fentanyl and clonidine to intrathecal ropivacaine.

Materials and Methods

The study was conducted after approval from Institutional Ethics Committee, written informed consent was obtained from all 70 patients of ASA grade I & II, 20-50 years in age scheduled for elective operations requiring subarachnoid block for lower limb orthopaedic surgery, after explaining nature of the clinical study and drugs to be used. Preoperatively all patients were explained regarding Visual analogue score (VAS) for pain.

Patient refusal, Local skin infection, Patient with allergy to study medication. Spinal deformity, bleeding diathesis, neurologic disease, Patients on antihypertensives, antipsychotics, anticoagulants, sedatives, beta blockers, MAO- inhibitors, were excluded from the study.

All eligible patients were assigned into two groups of 35 each. Group RC (n=35) - 15 mg of 0.5% isobaric Ropivacaine (3 ml) with 60 mcg Clonidine (0.4 ml + 0.1 normal saline). Group RF (n=35) - 15 mg of 0.5% isobaric Ropivacaine (3 ml) with 25 mcg Fentanyl (0.5 ml).

Detailed medical and surgical history and any previous anaesthetic exposure with its outcome were assessed. General examination including General condition, Built, Weight, Pulse rate, Blood pressure, Respiratory rate and presence of Cyanosis, Anaemia, clubbing, Jaundice or Edema were noted. Systemic examination to rule out any Cardiaovascular, Respiratory, Gastrointestinal and Neurological or any other systemic illness.

After confirming fasting patients were kept in supine positionin the operation theatre and received intravenous ringer lactate solution 10 ml/kg through large intravenous line before induction of subarachnoid block and infusion continued during surgery. Baseline values of Heart rate (HR), blood pressure (BP), oxygen saturation (SpO_2), Respiratory rate (RR) and electrocardiogram(ECG) were recorded. Subarachnoid block was performed after all aseptic precaution 25/23 gauge Quinke spinal needle was inserted in left lateral or sitting position between the L3-L4 or L4-L5 inter vertebral space. After confirmation of CSF flow study drugs were administered slowly. The spinal needle was removed and patient was immediately turned to supine position. And onset of sensory block, motor block and level of sensory block was checked with the pin prick test and the motor block level was determined according to the modified Bromage Scale:

1. Complete block (unable to move feet or knees)
2. Almost complete block (able to move feet only)
3. Partial block (just able to move knees)
4. Detectable weakness of hip flexion while supine (full flexion of Knees)
5. No detectable weakness of hip flexion while supine
6. Able to perform partial knee bend.

PR, BP, RR, SpO_2, pain score, discomfort and occurrence of side effects were recorded in every 2 minutes interval for first 10 minutes and then every 10 minutes for 120 minutes for rest of the operation. Any reduction in mean arterial pressure more than 20% from baseline or < 90 mmHg was recorded and treated with increasing dose of fluids and 5-10 mg of intravenous (I.V) administration of bolus dose of inj. mephentermine, Bradycardia (Heart rate <60/min) with.inj. atropine (0.6 mg). Nausea and Vomiting with inj. Ranitidine 50 mg and inj. ondansetron 4 mg. Severe pruritus with inj.chlorpheniramine maleate, 10 mg as and when required.

Parameters noted were, Time of drug injection. Onset, Maximum height (level), Duration of sensory block. And onset and duration of motor block. Duration of analgesia (first rescue analgesia for pain postoperatively). Incidence of side effects.

Onset, height and duration of sensory block were assessed by pin prick method. The onset and duration of motor block was assessed by modified Bromage Scale. Pain intensity was evaluated using a 10 cm visual scale and patients were asked to grade the severity of their pain using this scale as mild (0-3), moderate (4-7) and severe (8-10). The level of sedation was assessed using Ramsay sedation score:

Grade 0: Wide awake.

Grade 1: Calm and comfortable, responding to verbal commands.

Grade 2: Sleeping but arousable.

Grade 3: Deep sleep, not arousable.

Statistical analysis was done using Statistical Package of Social Science (SPSS Version 20; Chicago Inc., USA). Data comparison was done by applying specific statistical tests to find out the statistical significance of the comparisons. Quantitative variables were compared using mean values and qualitative variables using proportions. The difference in proportion was analyzed by using chi square test and the difference in means were analyzed by using student t test. Significance level for tests was determined as 95% ($p < 0.05$).

Results

The two groups were comparable with respect to demographic data and there were no significant differences in patient demographics and duration of surgery in both groups (Table 1).

Table 1: Patients characteristics

Demographic data (Mean ± SD)	Group RC	Group RF
Patients	35	35
Age (years)	32.37 ± 9.397	35.66 ± 9.084
Sex (male/female)	26:9	26:9
Weight (kg)	57.77 ± 9.861	64.37 ± 9.991
Duration of surgery (min)	271.57 ±17.564	228.43 ± 10.345

$p > 0.05$ Not significant.

RC: Ropivacaine + clonidine group; RF: Ropivacaine + Fentanyl group.

The onset of sensory blockade was found early with fentanyl (RF4.80 ± 0.719) compared to clonidine group (RC5.46 ± 0.505) P<0.001. In our study the maximum sensory block achieved was T6 level in both the groups ($p < 0.05$).

The onset of Motor block was significantly more in RC (6.80 ± 0.797) as compared to RF (6.00 ± 0.767) p=0.001.

Mean duration of sensory block was significantly prolonged in Group RC (259.71 ± 16.085) as compared to Group RF (226.43 ± 10.402) p=0.001.

Mean duration of motor block was prolonged with clonidine (RC 225.71 ± 15.298) compared to fentanyl group (RF 210.29 ± 9.151) p=0.001.

Mean Duration of Analgesia also was significantly more among Group RC (271.57 ± 17.564) as compared to Group RF (228.43 ± 10.345) p=0.001.

Table 2: Characteristics of Sabarachnoid blockade

Characteristics	RC	RF	p value
Onset of Sensory Block (Min)	5.46 ± 0.505	4.80 ± 0.719	p<0.001
Onset of Motor Block (Min)	6.80 ± 0.797	6.00 ± 0.767	p<0.001
Level of Sensory Block	T6	T6	p=0.005
Duration of Sensory Block (Min)	259.71 ± 16.085	226.43 ± 10.402	p<0.001
Duration of Motor Block (Min)	225.71 ± 15.298	210.29 ± 9.151	p<0.001
Duration of Analgesia (Min)	271.57 ± 17.564	228.43 ± 10.345	p<0.001

Values in mean ± standard deviation. $p > 0.05$ Not significant, $p < 0.05$ significant, $P < 0.01$ Highly significant, $p < 0.001$ Very highly significant. RC: Ropivacaine + clonidine group; RF: Ropivacaine + Fentanyl group.

Changes in hemodyanamic parameters were comparable in both groups. 3 patient (8.4%) in RC had hypotension (drop >25% SBP) compared to 2 patients (5.7%) in RF group and responded to inj. ephedrine, 6 mg alongwith IV fluids. (5.7%) & 1 in RF group patient had bradycardia (hazard ratio <50/min) requiringinj. atropine 0.6 mg.

2 patients from both group experienced nausea/ vomiting and responded to inj.ondensetron 4 mg, Pruritus was present in 3 patients (8.4%) in RF group only and inj. chlorpheniramine maleate 10 mg was given to control the same. There was no evidence of shivering and respiratory depression among both group patients. 9 patients in RC and 6 in RF required sedation and remaining patients in both the groups were calm and sleeping comfortably.

Table 3: Side effects

Side effects	Group RC N (%)	Group RF N (%)	Total N (%)
Hypotension	3 (8.4%)	2 (5.7%)	5 (14.1%)
Bradycardia	2 (5.7%)	1 (2.8%)	3 (8.5%)
Pruritis	0	3 (8.4%)	3 (8.4%)
Resp.depresion	0	0	0
Nausea/Vomiting	2 (5.7%)	2 (5.7%)	4 (5.72)
Shivering	0	0	0
Chi Square Value		5.081	
Significance 'p' Value		0.024 (S)	

Discussion

The present study established that both RC and RF as an adjuvant provided satisfactory anaesthetic requisites for lower limb orthopaedic surgeries. Most features of subarachnoid block being comparable, there was significant early motor recovery with RF whereas RC provided prolonged postoperative analgesia.

Ropivacaine is a pure S enantiomer of bupivacaine with similarities in structural, pharmacological, physiochemical properties, and mechanism of action, with a shorter duration of motor blockade but with less cardiotoxic and neurotoxic effects than bupivacaine. Ropivacaine has been showed to be a well admissible anesthetic agent. Its efficacy for spinal anesthesia, as compared with bupivacaine is in the ratio of 3:2, i.e.15 mg ropivacaine provided similar motor and hemodynamic effects but less potent anesthesia than 10 mg bupivacaine [5].

The main concern of our study was to evaluate the efficacy of ropivacaine with adjuvant for major lower limb orthopedic surgeries. Yegin et al. [6] evaluated the effect of spinal fentanyl 25 mcg with 18 mg of ropivacaine for transurethral resection of prostrate and found significant in hancement in the duration and qualityof anesthesia without considerable increase infrequency of major side effects. This is comparable to ourstudy with the fentanyl group, where the subarachnoid features were satisfactorily met for the major lower limb surgeries. Our study showed the early onset of sensory blockade with fentanyl (RF) compared to clonidine (RC) when added to ropivacaine which is similar with the studies done by Anita R. Chhabra, Sheetal R. Jagtap, Sunny F. Dawoodi [7] And contrast to the same study who observed quick onset of motor blockade in clonidine group compared to fentanyl group and was 6.02±2 min in RC and 7.05 ± 3.2 min in RF ($p > 0.05$).

Clonidine, an alpha-2-agonist, when given intrathecally as an adjuant provides better quality of subarachnoid block and prolong the postoperative analgesia [8,9].

A study done by De Kock et al. [10] who used a small doseof intrathecal ropivacaine (8 mg) with different doses of clonidine (15, 45, 75 mcg) in four groups, for ambulatory surgery.

Two different doses of spinal ropivacaine 2.5 ml of 0.75% & 1% without adjuants by McNamee et al. [11] in total hip arthroplasy patients, Intraoperative hypotension found in 24% of patientsin both the groups. This could be because of higher concentration of ropivacaine used. De Kock et al. [10], and Sagiroglu et al. [12], also noted a statistically significant decrease in mean BP with higher doses of clonidine when added to ropivacaine [8,16]. In our study,we used a lower dose of local anesthetic with adjuvants and the incidence of hypotension and bradycardia observed was lower in RF compared to RC group.

Thus present study showed adjuants offers prolong duration, excellent sensory & motor blockade with better sedation and comparitevely fewer side effects when used intrathecaly with isobaric ropivacaine, it could be concluded that the clonidine is a better alternative to fentanyl as an adjuant for spinal anaesthesia with isobaric ropivacaine for lower orthopaedic surgeries.

Whenever we use adjuants, it is needed to monitor hemodynamic parameters carefully.

Conclusion

Clonidine or fentanyl when added to ropivacaine provided adequate subarachnoid block for lower limb orthopaedic surgeries, where clonidine was better than fentanyl, in terms of duration of subarachnoid block and postoperative analgesia.

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Conflict of Interest: Nil

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