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Study of Adductor Canal Block Using Ropivacaine Alone and in Combination with Additive (Fentanyl) For Post-Operative Analgesia in Patients Undergoing Knee Arthroscopic Surgeries

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Abstract **Original Research Article**

Background: Knee arthroscopy is a common orthopedic procedure done worldwide. Despite its minimally invasive nature compared to the traditional knee surgery, post-arthroscopic pain may be severe, and the patients generally require a significant amount of opioid-based analgesics after such procedures. ***Aim:*** The objective of present study was to compare the block of femoral nerve at adductor canal using ropivacaine with additives like Fentanyl with regard to longevity and density of the block in comparison to plain ropivacaine. ***Methods:*** Patients of either sex in the age group of 18-75 years, having body mass index (BMI) of 20-35 kg/m2 and belonging to ASA (I & II), who were scheduled to undergo elective knee arthroscopic surgeries were observed in this study. On the evening before surgery, the visual analogue scale (VAS) Scoring was explained to all patients. All the included patients were categorized into two groups viz. GROUP A: Received 20ml of 0.2% Ropivacaine + 2ml of Normal Saline (Total 22ml), GROUP B: Receiving 20ml of 0.2% Ropivacaine + Fentanyl 1mcg/kg diluted in 2ml of Normal Saline (Total 22ml). ***Results:*** Sedation score was assessed by using Ramsay Sedation Score (RSS). There was no significant difference in demographic profile of the patients among various groups. Difference in the duration of analgesia was statistically significant among the two groups with longest duration in Group B (7.6+1.20 hours) and was least in Group A (4.3+1.70 hours) (p value <0.01). Total consumption of analgesia (Injection Tramadol 1mg/kg, IV) over a period of 24 hours in Group A was 200+28.76mg and in it Group B it was 108.9+30.64mg. Total quantity of rescue analgesia consumed was more in Group A as compared to Group B among the two study groups (P value <0.001).Incidences of side effects in the subjects were insignificant and only few side effects were noted like, 3.4% of patients in Group A had nausea. 3.2% patients in Group B had vomiting. Bradycardia was noted in 3.4% in Group A and 3.2% in Group B. 3.2% patients had hypotension in Group B. (P value >0.05). ***Conclusion:*** The results of this study showed that addition of 1mcg/kg Fentanyl added to ropivacaine (0.2%) had a significantly better duration of postoperative analgesic effect in comparison to plain (0.2%) Ropivacaine, without causing any significant side effects.

Keywords: Pain, Arthroscopy, RSS, Bradycardia, Ropivacaine, Fentanyl.

INTRODUCTION

The International Association for the Study of Pain defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage [1]." Different categories of pain can be defined according to the duration, etiology, or perception of the painful experience [2]. These include acute pain, chronic pain, neuropathic pain, nociceptive pain and inflammatory pain. Acute pain has been defined as "the normal, predicted, physiologic response to an adverse chemical, thermal or mechanical stimulus [3]." Nociceptive pains are often regarded as key feature of acute postoperative pain [4]. For an anesthesiologist, pain control is a significant part of delivering a safe and balanced anaesthesia [5]. One of the common complaints in postoperative period is acute postoperative pain.

Knee arthroscopy is a common orthopedic procedure worldwide [6, 7]. Despite its minimally

invasive nature compared to the traditional knee surgery, post-arthroscopic pain may be severe, and the patients generally require a significant amount of opioid based analgesics after such procedures. Several patients experience narcotic-related complications, such as sedation, respiratory depression, nausea, vomiting and constipation following excessive use of opioid analgesics. Peripheral nerve blocks offer effective analgesia and decrease the need for opioids, thereby reducing the complications associated with the use of this class of drugs [8-11]. Other benefits of peripheral nerve blocks include reduction in hospital resource utilization [12, 13]. Improved postoperative recovery [14, 15] and improvement in patient satisfaction.16 Moreover, postoperative pain relief is an important factor in the early ambulation and rehabilitation of patients after knee surgery [17].

Multimodal analgesia is achieved by combining different analgesics that act by different mechanisms and at different sites in the nervous system, resulting in additive or synergistic analgesia with lowered adverse effects of sole administration of individual analgesics [18]. As peripheral nerve block (PNB) provide effective and synergistic pain relief when used as part of a multimodal regimen, they are considered to be an essential part of the current multimodal pain management protocol following arthroscopic knee surgery [19-22].

Ultrasound imaging is rapidly emerging as a very promising regional anaesthesia tool since the size, depth and precise location of many nerves in their surrounding environment can be determined with correct interpretation of the visual image. The proposed benefits of Ultrasound guidance, as compared to nerve stimulation, for peripheral nerve improved block success rate [23], reduced block performance time and onset time [24, 25] prolonged duration of blocks and lead to reduction in complications (intravascular injection, local anesthetic toxicity, and a failed block) [26].

METHODS

This study was conducted from November 2018to October 2020 in the Bone and Joint Hospital, an associated hospital of Government Medical College, Srinagar, during routine working hours for various elective knee arthroscopic surgical procedures. Patients of either sex in the age group of 18-75 years, having body mass index (BMI) of 20-35 kg/m2 and belonging to ASA (I & II), who were scheduled to undergo elective knee arthroscopic surgeries were included in this study.

A detailed history, thorough physical examination and relevant laboratory investigation were conducted in all patients. On the evening before surgery, the visual analogue scale (VAS) Scoring was explained to all patients.

All the included patients were categorized into two group's viz. GROUP A: Received 20ml of 0.2% Ropivacaine + 2ml of Normal Saline (Total 22ml) and GROUP B: Receiving 20ml of 0.2% Ropivacaine + Fentanyl 1mcg/kg diluted in 2ml of Normal Saline (Total 22ml). All patients were anesthetized using a Standardized Subarachnoid block (SAB) by injecting 3.5ml of 0.5% Bupivacaine in L3-4 space through 25G quinkes spinal needle in sitting position. After confirming the level of block, the patients were handed over to surgical team and hemodynamic parameters were recorded at specified time intervals. After completion of surgery patients received Adductor Canal Block (ACB) for postoperative analgesia using ultrasound guided technique. Postoperative analgesia was assessed using Visual Analogue Scale (VAS) of 0 to 10 with (0 = no pain) and (10 = worst imaginable pain). Patients were assessed 2 hourly for first 12 hours post operatively and then 4 hourly up to 24 hours. Rescue analgesia using Tramadol 1mg/kg (i/v) was administered anytime the VAS was found ≥3. Sedation score was assessed by using Ramsay Sedation Score (RSS).

STATISTICAL ANALYSIS

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Statistical software SPSS (version 20.0) and Microsoft Excel were used to carry out the statistical analysis of data. Continuous variables were expressed as Mean±SD and categorical variables

Were summarized as percentages. Student's independent t-test wasemployed for comparing continuous variables.

RESULTS

The parameters studied were hemodynamic parameters, duration of analgesia, total analgesia consumed in 24 hours and any adverse drug effects.

No significant difference was found between the groups in terms of demographic profile of the study groups (Table 1).

Table-1: Demographic profile of the study population.

Parameters	Group A(n=50)	Group B(n=50)	P value
Age (yrs)	56.34±14.80	58.54±16.55	0.71*
Sex M/F	36/14	34/16	1.0*
Weight (kgs)	61.50±8.87	62.50±10.99	0.82
ASA I/II	32/18	28/22	0.576*
Height (cm)	166.3±4.61	168.4±5.54	0.264*
Duration of surgery (minutes)	84.67±12.15	88.90±14.55	0.306*

(Mean, SD= standard deviation,* = level of significance)

In light of VAS pain score postoperatively at different time intervals for 24 hours among two study groups. The VAS pain scores between two groups shows significant difference (p<0.001). The general VAS score in group B was lower than in group A (Table 2).

Table-2: VAS score of patients at different intervals in the two groups

Time	Group A	Group B	P Value
0hr	1.28±1.10	0.8±1.04	>0.05
2hr	1.80±0.52	0.9±1.20	<0.05
4hr	3.64±0.38	1.30±0.56	<0.05
6hr	4.92±0.20	2.01±1.21	<0.05
8hr	5.04±0.47	1.52±0.93	<0.05
10hr	4.8±0.35	1.92±0.91	<0.05
12hr	4.68±0.54	2.24±0.62	<0.05
16hr	4.48±0.51	2.20±0.62	<0.05
20hr	4.00±0.64	2.00±0.28	<0.05

(Mean, SD= standard deviation,* = level of significance)

Difference in the duration of analgesia was statistically significant among the two groups with duration of analgesia in Group B (7.6+1.20 hours) and in Group A (4.3+1.70 hours). (p value<0.01)(Fig 1).

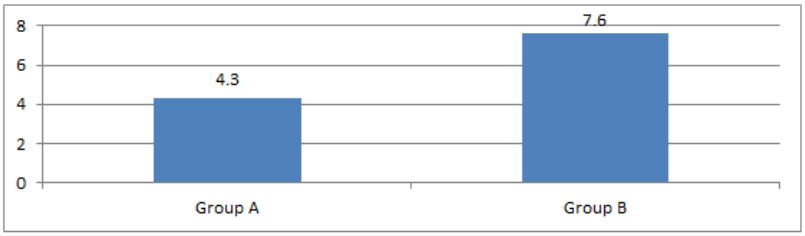

Fig-1

Total consumption of analgesia (Injection Tramadol 1mg/kg, IV) over a period of 24 hours in Group A was 200+28.76mg and in Group B it was 108.9+30.64mg. Total quantity of rescue analgesia consumed was more in Group A as compared to group B (P value <0.001) (Fig 2).

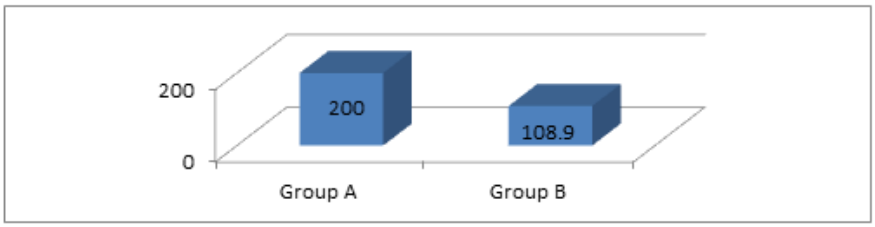

Fig-2

Incidences of side effects in the subjects were insignificant and only few side effects were noted like, 3.4% of patients in Group A had nausea. 3.2% patients in Group B had vomiting. Bradycardia was noted in 3.4% in Group A and 3.2% in Group B. 3.2% patients had hypotension in Group B. (P value >0.05).

DISCUSSION

Adductor Canal Block (ACB) is a highly successful approach to the saphenous nerve that was first described by Vander Wal [27]. In recent years adductor canal block has been introduced as a pure

sensory nerve block for postoperative analgesia following knee surgeries [28]. The rationale behind the ACB is that saphenous nerve (sensory nerve) and a part of obturator nerve are travelling through the adductor canal of thigh; so injecting local anesthetic in the adductor canal will provide adequate analgesia by blocking these nerves [29]. ACB also has an advantage of minimally effecting or preserving quadriceps strength [30].

In our study we have used local anesthetic ropivacaine (0.2%, 20ml). Since it is lipophilic and therefore is less likely to penetrate large myelinated motor fibres [31]. Hence theoretically it has lesser motor blockade in ACB, so it is hypothesised that it will facilitate early ambulation after surgery. Our hypothesis is supported by Manisha *et al*. [32] in a study who used (0.5% ropivacaine 30 ml) for ACB. We found that the mean duration of postoperative analgesia was 4.3+1.70 hours in Group A (Ropivacaine alone group) and 7.6+1.20 hours in Group B (Ropivacaine + Fentanyl). Difference in duration of analgesia among two groups was compared, it was found to be statistically highly significant. Duration of analgesia was longer in Group B than in Group A and was statistically significant ($p<0.005$ A vs B), so there was statistically significant difference in analgesia among adjuvant group as compared to plain ropivacaine. Our results are also in accordance with that of Farooq N *et al*. [33] who conducted a studyin which they compared dexmedetomidine (1mcg/kg) and fentanyl (1mcg/kg) as adjuvants to local anesthetic, in their study they also found that fentanyl was a better adjuvant as compared to dexmedetomidine and resulted in more prolongation of duration of analgesia. Rajkhowa *et al*. [34] also mentioned in their study that fentanyl when used as an adjuvant to ropivacaine resulted in prolonged duration of analgesia. Hassan S *et al*. in [35] also concluded that when fentanyl was used as an adjuvant to local anesthetic resulted in prolongation of duration of analgesia.

In our study, total analgesic consumption of (injection tramadol 1mg/kg, i/v) in24 hours postoperatively was 200+28.76 mg in Group A and 108+30.64 in Group B. Difference in analgesic consumption in 24 hours was statistically significant between the groups P value < 0.001). Analgesic consumption was more in Group A as compared to Group B. Farooq N *et al*. in [33] who also found that low analgesia was consumed in 24 hours postoperatively in group containing1mcg/kg fentanyl as compared to 1mcg/kg dexmedetomidine as an adjuvant. On comparing the mean SpO2 in subjects of all the two groups, baseline was comparable during the postoperative period, we found no significant difference among the two groups (p value >0.05).

Majority of patients in the two study groups showed no side effects to either drug or to block technique. 3.4% of patients in Group A had nausea. 3.2% patients in Group B had vomiting. Bradycardia was noted in 3.4% in Group A, 5.9% in Group B. 2.9% patients had hypotension in Group B. The results were statistically insignificant (P value >0.05).Similar results were observed by Sahi P *et al*. in [36], who also reported statistically insignificant adverse effects like nausea, vomiting, sedation, bradycardia and hypotension in the post- operative period in their study. Our study also correlates with that of Sun Q [37], who reported that addition of Fentanyl did not affect the incidence of postoperative nausea, vomiting, hypotension, bradycardia, and somnolence and pruritus.

CONCLUSION

The addition of Fentanyl to ropivacaine for adductor canal block increases postoperative analgesia time and reduces total amount of rescue analgesic consumed postoperatively. This study also showed that addition of 1mcg/kg Fentanyl to ropivacaine showed significantly better duration of postoperative analgesia without causing any significant side effects.

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