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Comparision of Fentanyl and Dexmedetomidine as Adjuvants to Ropivacaine for Potentiation of Post Operative Analgesia in Femoral Nerve Block for Knee Surgeries

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Abstract

Aims: To compare the effect of addition of Dexmedetomidine (1 ug/kg) and Fentanyl (1 ug/kg) to Ropivacaine (0.2%) in femoral block for potentiation of postoperative analgesia in knee surgeries. *Material and methods:* After ethical committee approval study was conducted on 50 patients posted for planned knee surgeries. At the end of surgery patients were divided randomly into two groups of 25 each and PNS guided femoral nerve block was given. Group–F received 0.2% Ropivacaine (20 ml) +Inj. Dexmedetomidine 1 µg/kg+ Normal Saline. Total volume 22 ml. Group–Freceived 0.2% Ropivacaine (20 ml)+Inj. Fentanyl 1 µg/kg+ Normal saline. Total volume 22 ml. Hemodynamic monitoring, duration of postoperative analgesia, motor and sensory blockade and sedation were assessed for 24 hours. Results: Duration of sensory and motor block was significantly higher in group D compared to group F; p value <0.001. Duration of analgesic action was found to be significantly higher in patients of group D; p value <0.001. There was significantly lower mean pain score on the VAS among patients in the group D as compared to those in group F; p value < 0.001. *Conclusion:* The onset and duration of motor and sensory blockade among patients in the group D was significantly quicker and longer as compared to those in the group F. Analgesic duration was also more in the patients of group D and pain scores as measured by VAS were less. Thus from this study we concluded that Dexmedetomidine with Ropivacaine provided better postoperative pain relief as compared to fentanyl with Ropivacaine.

Keywords: Fentanyl; Dexmedetomidine; Ropivacaine; Postoperative analgesia; femoral nerve block; knee surgeries.

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Introduction

Postoperative pain relief helps in good patient outcome. Peripheral nerve blockade offers an excellent alternative for patients who are hemodynamically compromised or too ill to tolerate general anesthesia. Also very good postoperative analgesia can also be provided [1,2]. Femoral nerve block is well-suited for knee surgery. Post operative pain may worsen the functional outcome [3]. Femoral analgesia is an important arm of multimodal analgesia for knee surgery, which has been proved to be superior to epidural analgesia in terms of fewer side effects [4]. It also decreases the need for other intravenous analgesics. Ropivacaine is a long-acting amide local anaesthetic agent. Ropivacaine causes reversible

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inhibition of sodium ion influx, and thereby blocks impulse conduction in nerve fibres [5]. Ropivacaine is less lipophilic than bupivacaine so penetrates large myelinated motor fibres less, resulting in a relatively reduced motor blockade and also has decreased potential for central nervous system toxicity and cardiotoxicity. Dexmedetomidine is a α_2-agonist having an eight-fold greater affinity for α_2-adrenergic receptors than clonidine and much less α_1-effects [6,7]. Fentanyl-a potent, synthetic lipophillic opioid analgesic (μ receotor), intrathecally exerts its effect by combination with opioid receptors in dorsal horn of spinal cord and may have a supraspinal spread and action [8]. Hence this study is undertaken to evaluate the efficacy of fentanyl and dexmedetomidine to ropivacaine in potentiation of postoperative analgesia in femoral block for knee surgery.

Material and Methods

- This prospective study was conducted on 50 patients posted for planned knee surgeries in the department of anaesthesiology of Dhiraj Hospital, S.B.K.S. & M.I.R.C. Piparia after ethical committee's approval. Patients were divided randomly into two groups of 25 each using "slips in a box technique". *Group–D* (n=25) received 0.2% Ropivacaine (20 ml)+Inj. Dexmedetomidine (1 μg/kg) + Normal Saline. Total volume 22 ml. *Group – F* (n=25) received 0.2% Ropivacaine (20 ml) +Inj. Fentanyl (1 μg/kg) +Normal saline. Total volume 22 ml.

Inclusion criteria

1. ASA grade I and II patients
2. Age between 18-60 years of both gender
3. Patients willing to sign informed consent

Exclusion criteria

1. Patient refusal for procedure
2. Pregnant woman
3. Heart rate less than 50 bpm
4. SBP < 100 mmHg
5. Coagulation disorder or on anticoagulant therapy
6. Local infection
7. ASA grade III or more
8. H/O drug allergy to study drugs

A pre-anestheticcheck up was done for all patients. All routine investigations were done. Patients were kept fasting overnight. On the morning of surgery, written informed consent was taken, vital parameters of pulse (P), blood pressure (BP), oxygen saturation (SpO_2) and electrocardiogram (ECG) were recorded. Intravenous (IV) line was secured and inj. Ringer lactate was started at the rate of 8 ml/kg/hr.

- On arrival in the operating room, monitoring of the vital parameters was continued, and patients were pre medicated with Inj. Glycopyrolate 0.2 mg and Inj. Ondensetron 4 mg.
- Under aseptic precautions lumbar puncture at L_3-L_4 intervertebral space using a 25G spinal needle patient in sitting or left lateral position using Injection Bupivacaine (0.5%) 3 ml was performed for all the patients. All patients were closely monitored intraoperatively.

At first complaint of pain, or when spinal anaesthesia segment receded to L1, femoral nerve block was given and the patients received adjuvants according to the randomization.

Preparation of the part was done with antiseptic solution and by standing on the side of the patient the needle was introduced at the lateral border of the artery and advanced in sagittal, cephalad plane. After initial stimulation of the femoral nerve is obtained by peripheral nerve stimulator (PNS), the stimulating current will be gradually decreased until twitches are still seen or felt at 0.5 mA, which typically occurs at a depth of 2 to 3 cm. After obtaining negative results from an aspiration test for blood, 22 mL of prepared solution was injected slowly. A visible or palpable twitch of the quadriceps muscle (a patellar twitch) at 0.5 mA was considered the most reliable response.At the end of the procedure all patients were observed for analgesia using Visual Analogue Scale (VAS) for 24 hrs and with the patients first complaint of pain (VAS>/3) rescue analgesia with 75 mg inj. diclofenac sodium iv was given and duration of analgesia was considered from the time of injection till the patient's first complaint of pain. Sensory blockade was assessed using 3 point scale for first 24 hours. Duration of sensory blockade was considered from time of injection of drug to complete return of sensation (Grade 0). Motor Blockade was assessed using 3 point Modified Bromage Scale for first 24 hours. Duration of motor blockade was considered from time of injection of drug to complete motor functions (Grade 0). Also, hemodynamic parameters including Heart rate,

BP and SpO_2 were recorded and side effects or complications if any were also seen.

Results

Hemodynamic parameters: HR, SBP, DBP and SpO2 were taken every hour for 6 hours and 2 hourly for next 18 hours Pulse in the patients from the Fentanyl group were higher as compared to Dexmedetomidine group, the difference was not statistically significant. For systolic blood pressure reading at the end of the first hour, systolic blood pressure was found to be significantly higher in patients in the Dexmedetomidine group (129.88 ± 4.4 mm Hg) as compared to the Fentanyl group (126.44 ± 3.5 mm Hg), p value = 0.04. During the subsequent follow up points, the systolic blood pressures were not significantly different in patients in the Fentanyl or Dexmedetomidine group. Also for Diastolic blood pressure readings the differences between the two groups were not significant.

Table 1: Age distribution of patients included in the study

	Group F (n=25)	Group D (n=25)	P
Age in years 21 to 60	41.12 ± 17.4	43.56 ± 18.7	P>0.001

Table 2: Comparing the onset and duration of sensory and motor block in the two study groups

	Group F N=25	Group D N=25	p value
Onset of sensory block (in minutes)	13.00 ± 1.958	9.28 ± 1.542	<0.001
Onset of motor block (in minutes)	20.48 ± 1.610	12.72 ± 2.558	<0.001
Duration of sensory block (in minutes)	432.92 ± 11.601	451.76 ± 29.081	<0.001
Duration of motor block (in minutes)	453.84 ± 22.007	538.12 ± 25.689	<0.001

Table 3: Comparing duration of analgesic action between the two study groups

	Group F N=25	Group D N=25	p value
Duration of analgesic action (in minutes)	94.28 ± 14.155	216 ± 14.434	<0.001

Discussion

The present study was conducted to compare the effects of adding Fentanyl or Dexmedetomidine to Ropivacaine in femoral nerve block (FNB) in patients undergoing knee surgeries and we observed that, FNB with 22 ml of ropivacaine with adjuvant dexmedetomidine compared to the fentanyl provided better postoperative analgesia. For infra-umbilical and lower abdominal surgeries, spinal anesthesia is a safe and reliable method of anesthesia. Spinal anesthesia as compared to general anesthesia has been associated with rapid onset of action, economical and ease of administration and a shorter post-anesthesia care unit stay [9]. However, if the duration of action is limited, or the recovery of motor power is delayed, which in turn can delay the ambulation and prolong hospital stay, spinal anesthesia can be less useful practically [10]. For these reasons, adjuvants like alpha-2 blockers (dexmedetomidine, clonidine), opioids (fentanyl, tramadol), dexamethasone etc widely are used with regional anesthesia in order to improve the quality of blockage and prolong the duration of analgesia, and reduce the required dose of local anesthetics [11]. FNBs, both continuous and single-injection techniques, are effective strategies for providing postoperative analgesia, opiate-sparing effect, and fewer associated adverse effects after TKA [12-15]. In addition, femoral nerve blocks can reduce the reflex quadriceps muscle, thus reducing pain and muscle spasms [16], which may provide a positive contribution in facilitating physical therapy and early ambulation, as well as reduce the length of hospitalization [15,17]. The mechanism by which dexmedetomidine acts perineurally is not understood very well and is mainly extrapolated from studies on clonidine, both being α2-adrenoreceptor blockers. α2-adrenoreceptor blockers directly increase hyperpolarisation of action potential that follows a single compound action potential of the peripheral nerve [18]. Like clonidine, dexmedetomidine too enhances the degree of hyperpolarisation by blocking the Ih current (generated by low-grade stimulation and activation of Na+/K+ pump) [18]. Other indirect actions of dexmedetomidine include central analgesia, vasodilatation and anti-inflammation properties. So far, dexmedetomidine has been used in various peripheral nerve blocks at different sites, mainly of upper limb (axillary, supraclavicular brachial plexus, greater palatine nerve block, etc.). Further, there is no homogeneity in dexmedetomidine dose and type of local anaesthetic used. Doses have ranged from 1 µg/kg

to 2 μg/kg, [19] up to 100 μg in conjunction with bupivacaine, levobupivacaine or ropivacaine in variable concentrations [20]. We decided to use a dose of 1 μg/kg. We found that perineural dexmedetomidine significantly improved the quality and duration of post-operative analgesia.

The patients in our study had similar baseline demographic parameters. Post-operative vital parameters were also found similar and statistically insignificant in both the study groups. Bradycardia is a known clinical effect of opioids but in the present study heart rate remained stable in the range of 67 to 86 per minute and systolic and diastolic pressure remained between 121 to 137 mm Hg and 74 to 94 mm Hg in both the groups. Similar to our findings, Bajwa et al. demonstrated that the requirement of vasopressors for maintaining stable hemodynamic parameters were not significantly different between patients receiving dexmedetomidine or fentanyl for regional analgesia in lower limb orthopedic surgeries [21]. Kaur et al. had similar observation when dexmedetomidine and fentanyl were used in combination with 0.75% ropivacaine. This, however, changes when bupivacaine was used by some authors instead of ropivacaine. Gupta et al. found that dexmedetomidine offered a better hemodynamic stability as compared to fentanyl when used with bupivacaine [22].

We observed in our study that onset of sensory (9.28 ± 1.542) and motor blockade (12.72 ± 2.558) was significantly quicker among patients in the dexmedetomidine group as compared to fentanyl (sensory: 130 ± 1.958 & motor: 20.48 ± 1.610).Dexmedetomidine also augments the local anesthetic effects peripherally by reducing norepinephrine release and increasing the potassium conduction in C and A-delta neurons responsible for passage of pain stimulus, whereas it produces analgesia and sedation centrally by inhibition of substance P release in the nociceptive pathway at the level of the dorsal root ganglia and locus coeruleus [24]. Duration of sensory (451.76 ± 29.081) and motor block (538.12 ± 68.9) was significantly higher among patients in the dexmedetomidine group. Also the duration of analgesia was longer in Group D (216 ± 14.434) compared to Group F (94.28 ± 14.155) Similar results were seen in study of Bajwa et al. who also found the duration of motor block and duration of analgesia to be longer in group dexmedetomidine as compared to group fentanyl, and the difference was also statistically highly significant ($p<0.0001$). Furthermore, Cham et al. found that adding fentanyl prolonged both surgical anaesthesia and time to request for first analgesia by 30 minutes, whereas dexmedetomidine as an adjunct prolonged anaesthetic duration by an hour and total analgesic duration by two hours compared to the patient receiving only ropivacaine for achievement of block [25]. Post-operative pain as measured by VAS was less in the dexmedetomidine as compared to fentanyl group in our study. This is similar to the findings by Park et al. who compared dexmedetomidine and fentanyl as adjuvant to ropivacaine in pediatric orthopedic surgeries [26]. The authors found that the pain score at postoperative 6 hours was significantly lower for patients who received dexmedetomidine than for those receiving fentanyl.

Conclusion

Based on these results of our studies we concluded that dexmedetomidine seems to be a better alternative to fentanyl as an adjuvant for femoral block as it provides comparable stable hemodynamics, early onset and establishment of sensory anesthesia, prolonged post-operative analgesia, and lower pain scores. This would translate into lower adjuvant dose and less need of rescue analgesia. So that vulnerable populations that are more susceptible to local anesthetic toxicity and side effects of opioids may benefit from the use of dexmedetomidine as an adjuvant for femoral block. Patients with hemodynamic compromise can also achieve stable block and analgesia with dexmedetomidine.

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