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A CLINICAL STUDY ON COMPARISON OF DEXMEDETOMIDINE VERSUS FENTANYL AS AN ADJUVANT TO 0.5% BUPIVACAINE IN SUPRACLAVICULAR NERVE BLOCK

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Abstract

Background: Supraclavicular approach of brachial plexus block has been popular technique in delivery of anesthesia in patients undergoing upper limb surgeries. Of various local anesthetics, bupivacaine is used most frequently for brachial plexus block. Any adjuvant to the local anesthetics for brachial plexus block prolongs its analgesic effect. Hence the present study was undertaken to compare the effect of dexmedetomidine and fentanyl as adjuvant to bupivacaine in supraclavicular nerve block for upper limb surgeries. **Methods:** A total 100 patients of ASA grade I and II were enrolled and randomly divided into two equal groups. Group A received 25-30mL of 0.5% Bupivacaine + 50µg Fentanyl and group B received 25-30mL of 0.5% Bupivacaine + 50µg Dexmedetomidine. The onset time and duration of sensory and motor blockade were recorded. Hemodynamic variables and duration of analgesia were recorded for 24 hours postoperatively. **Results:** The onset of sensory and motor block was significantly faster, and duration of sensory and motor block was significantly prolonged in group B as compared to group A ($p<0.05$). Rescue analgesic requirements were significantly less in group B compared to group A ($p<0.05$). Hemodynamic variables did not differ between groups in the post-operative period, except the pulse rate which was found to be on the higher side for fentanyl group. **Conclusion:** Addition of 50µg dexmedetomidine to 25-30ml bupivacaine 0.5% in supraclavicular brachial plexus block was more effective in prolongation of sensory and motor duration as well as providing adequate intra-operative analgesia when compared to 50µg fentanyl with 25-30ml bupivacaine 0.5%, without producing any adverse events.

Keywords: Supraclavicular nerve block; Analgesia; Bupivacaine; Dexmedetomidine; Fentanyl; Sensory; Motor block

Introduction

Brachial plexus refers to the network of nerves in the shoulder that controls movements and carries sensory signals from spinal cord to the arms and hands. Blockade of brachial plexus is an effective method, recommended for upper limb surgeries, where anesthesia is provided from the shoulder to the fingertips [1]. There are several approaches/ techniques available to anesthetize the brachial plexus and their requirement varies given patient anatomy and indications. Supraclavicular brachial plexus block is among the popular regional nerve block performed during surgeries and/ or postoperative pain control to the distal two-thirds of the upper extremity, or from the mid- humerus to the fingertips [2].

Of various local anesthetics used for brachial plexus block, bupivacaine is used most frequently. It has unique characteristics from the amino group of local anesthetics and has a long duration of action varying from three to eight hours [3, 4]. But it has some limitations of longer latency and increased potential for systemic toxicity. The various studies have investigated several adjuncts, including opioids, clonidine, neostigmine, hyaluronidase etc to overcome these limitations by local anesthesia [5-7].

Dexmedetomidine, is a selective, short- acting, agonist of the α2-adrenergic receptors. Many researchers in the past have studied the dose dependent effect of dexmedetomidine on the onset and regression of sensory and motor blockade when used as an adjuvant to bupivacaine in spinal anesthesia [8, 9]. On the other hand, opiates are widely known to have an analgesic effect at the central and spinal cord level. Fentanyl is a short- acting, synthetic opioid analgesic that is similar to morphine, but is more potent. The use of fentanyl as an adjuvant to local anesthetic improved the status of intraoperative and postoperative analgesia [10]. Therefore, the present study was intended to compare the effect of dexmedetomidine and fentanyl as adjuvant to bupivacaine on onset and duration of block and length of analgesia during supraclavicular nerve block for upper limb surgeries.

Materials and Methods

After obtaining Institutional Ethical Committee approval and written informed consent from all the patients, this prospective, randomized, single- blinded study was conducted in the Department of Anaesthesia, at Owaisi Hospital and Research Centre during a period from May 2020 to November 2021. A total 100 patients of either sex, ASA grade I & II, age ranged from 18-60 years, weight between 30-70 Kgs, posted for upper limb surgeries under supraclavicular brachial plexus block were selected for the study. All these patients were randomly divided into two of 50 patients in each group. Group A patients received 25ml to 30ml of 0.5% bupivacaine with 50 mcg of fentanyl. Group B patients received 25ml to 30ml of 0.5% bupivacaine with 50mcg of dexmedetomidine. Patients who refused to give consent, patients with coagulopathy or on anticoagulants, peripheral neuropathy, peripheral vascular diseases, local cutaneous infection, allergic to local anesthetics, pregnant patients and patients undergoing emergency surgery of upper limb were excluded from the study.

Intravenous access with a 20-gauge IV cannula on the contralateral upper limb under aseptic techniques. Investigations included Hb%, TC, DC, BT and CT, routine urine analysis, RBS, blood urea and serum creatinine, Chest X- ray, ECG, HIV, HBs Ag were done. 32ml

solution for "single shot" supraclavicular brachial plexus blockade were administered. Pre-anaesthetic check-up was done. Patients were fasted overnight. IV line secured and patients were connected to monitors to record pulse, O2saturation, NIBP and ECG. Premedication done with inj. Midazolam 0.05mg/kg body weight before the procedure. Drug solutions were prepared. Patient lies supine, arms by the side and head turned to other side. After aseptic preparation of the area, at a point 1.5 to 2.0 cm posterior and cephalad to midpoint of clavicle, subclavian artery pulsations were felt. A skin wheel was raised with local anaesthetic cephalo posterior to the pulsations. Next, a 22 guage,1.5 inches short, beveled needle introduced through the same point, parallel to head and neck, in a caudal, slightly medial and posterior direction, until either paraesthesia was elicited, or first rib was encountered. If the rib was encountered, the needle was moved over the first rib until paraesthesia was elicited in the arm or hand. After eliciting paraesthesia and negative aspiration of blood, keeping the needle in the same position the study medication was injected slowly ruling out intravascular injection intermittently.

The onset time and duration of sensory and motor blockade were recorded. Sensory block was evaluated by pin prick method with a 23-gauge needle. The onset time was defined as the time between injection and complete loss of pin prick sensation in C2 and T2 dermatome and temperature testing using spirit-soaked cotton on skin dermatomes C2 to T2. Motor block was assessed by Bromage three-point score. Hemodynamic variables and duration of analgesia were recorded for 24 hours postoperatively. Post-operative assessment every hourly for next 6 hours for intensity of pain, motor, and sensory recovery.

Statistical analysis

Statistical analysis was performed using the statistical software IBM SPSS Version 22.0. To analyse the data, descriptive statistics was used to draw the graphs and frequencies and percentages, and quantitative data was analysed using student's t test. Then qualitative data was analysed using qualitative chi square test. If p value <0.05 was considered statistically significant.

Observations and Results

Total 100 patients who were undergoing upper limb surgery were enrolled and randomly divided into two groups of 50 patients in each group. In both the groups, the majority of patients were in the age group of 31-40 years with male predominance as shown in table 1. The mean age of patients in dexmedetomidine group was 34.84±7.1 years and in fentanyl group it was 36.72±10.2 years.

Table 1: Demographic profile of the patients

Demographic data		Dexmedetomidine group	Fentanyl group
Age group (Years)	18-30	16 (32%)	16 (32%)
	31-40	28 (56%)	17 (34%)
	41-50	04 (8.0%)	13 (26%)
	≥51	02 (4.0%)	04 (8.0%)
Sex	Male	35 (70%)	32 (64%)
	Female	15 (30%)	18 (36%)

The onset of sensory and motor block was significantly faster, as well as duration of sensory and motor block and duration of analgesia was significantly prolonged in group B (Dexmedetomidine group) as compared to group A (Fentanyl group), ($p<0.05$) as shown in table 2.

Table 2: Supraclavicular nerve block characteristics

Block Characteristics	Dexmedetomidine group	Fentanyl group	P value
Onset of Sensory block	6.02±0.93	11.92±0.72	0.001*
Onset of motor block	4.98±1.31	8.70±1.28	0.002*
Duration of Sensory block	615.90±46.29	431.68±29.00	0.003*
Duration of motor block	437.64±32.91	344.20±46.12	0.002*
Duration of analgesia	12.01±2.05	10.17±1.13	0.003*

Both the groups were comparable with regard to systolic blood pressure (SBP), diastolic blood pressure (DBP), O2 saturation (SPO2) and respiratory rate (RR), except the pulse rate (PR) which was found to be on the higher side for fentanyl group as depicted in figure 1 and 2.

Figure 1: Hemodynamic variables

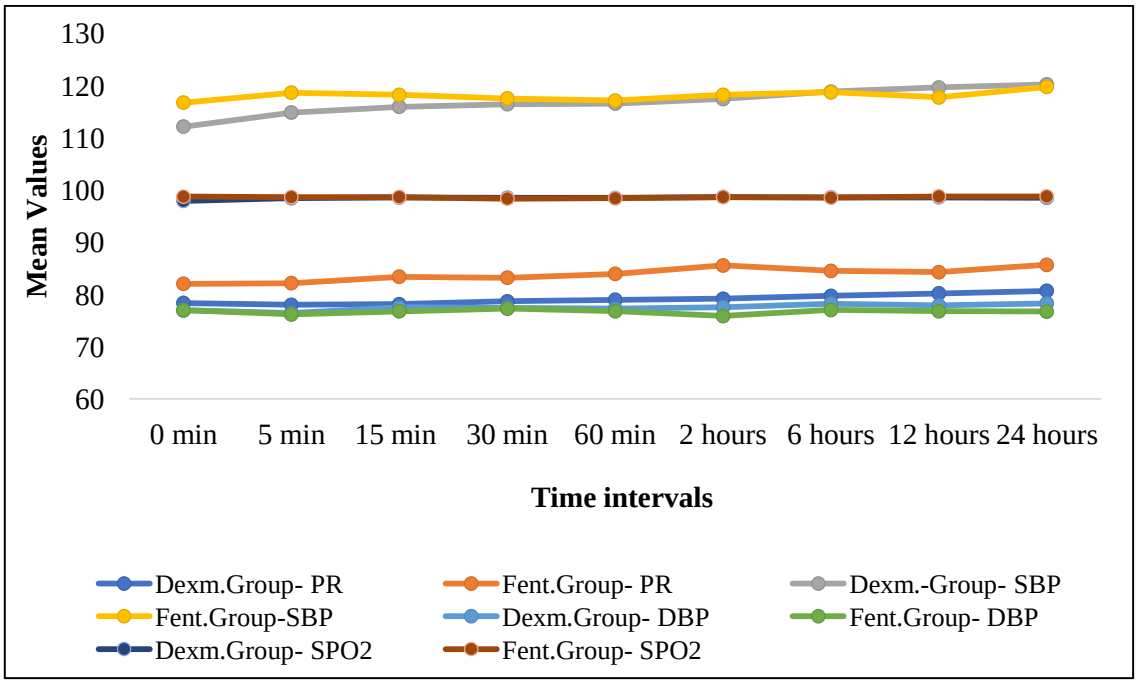
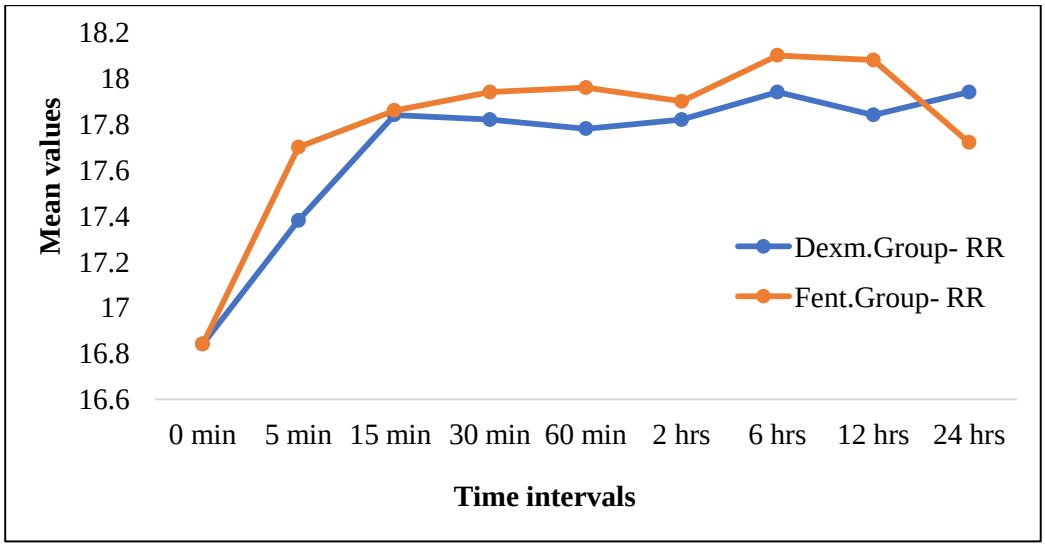
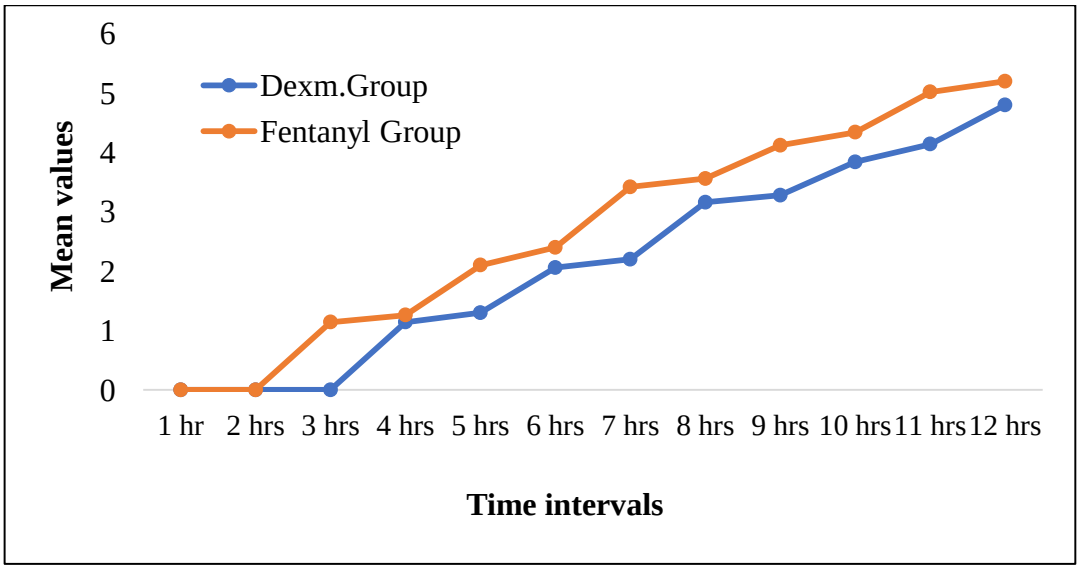


Figure 2: Respiratory rate (RR)



It was seen that the mean VAS score in the dexmedetomidine group ranged between 0.00 and 4.8, while in fentanyl group it was ranged between 0.00 and 5.2. Statistically significant difference ($p<0.05$) in the mean VAS scores between the studied groups at different times of assessment was seen as depicted in figure 3.

Figure 3: Visual analogue scale (Pain)



There was no significant association found between the groups with respect to side effects (p value=0.360) as shown in table 3.

Table 3: Comparison of side effects

Side effects	Dexmedetomidine group	Fentanyl group	P value
None	48 (96%)	46 (92%)	0.360
Nausea	02 (4.0%)	02 (4.0%)	
Itching	00 (0.0%)	02 (4.0%)	

Discussion

In the present study, both the groups were comparable and found no significant difference in regard to demographic profile of the patients. While study found a statistically significant differences between the groups regards to sensory and motor block onset. It was clearly shown that the addition of dexmedetomidine to bupivacaine has significantly shortened the onset of sensory and motor blocks when compared to the fentanyl group which is similar to other studies [11-13]. We also have observed that the onset of motor block was found to be faster than the onset of sensory block in both the groups. The possible explanation for this is the somatotrophic arrangement of fibres in a nerve bundle at the level of the trunks in which motor fibres are located more peripherally than sensory fibres. Hence, a local anaesthetic injected perineurally will begin to block motor fibres before it arrives at the centrally located sensory fibres.

Considering the duration of sensory and motor blocks, there was a statistically significant differences between the study groups was seen. The duration of the sensory and motor block was significantly longer in dexmedetomidine group than the fentanyl group which is comparable with the previous studies in the literature [11-14]. However, among the groups', significantly prolonged duration was observed for sensory blocks than motor blocks in dexmedetomidine group than fentanyl group. The possible explanation for the prolonged sensory and motor blocks in the dexmedetomidine group is due to the inhibitory action of α2 receptor agonist could ex- plain this prolongation via the hyperpolarization effect leading to decrease firing of the central nervous system excitable cells. Another mechanism could be the reduction of calcium conductance into the cells which leads to inhibition of neurotransmitter release and prevention of nerve firing and propagation of signals to the neighbour's cells [13].

Management of postoperative pain is crucial in surgical and anesthetic practice. Poorly managed postoperative pain can lead to complications and prolonged rehabilitation. Failure to provide good postoperative analgesia could be due to multiple reasons such as insufficient expertise, fear of complications associated with analgesic drugs, poor pain assessment etc. The findings of current study showed that the duration of the analgesia was significantly longer in dexmedetomidine group (12.01±2.05 hours) than the fentanyl group (10.17±11.3 hours) which is comparable with the study done by Hashim RM et al [13], Swaro S et al [14] and Hamed MA et al [15]. Fentanyl is an opioid and it bind to receptors in the central nervous system and peripheral tissues and modulate the effect of the nociceptors. Fentanyl is a synthetic derivative of morphine and is more potent, have a shorter onset of action, and shorter half-lives compared with morphine. This could explain the reason for the shorter duration of analgesia with respect to fentanyl group compared to dexmedetomidine [16].

Both the groups were comparable with regard to pulse rate, SBP, DBP, SPO2 and respiratory rate. There was a statistically significant differences in the pulse rate between both groups at different times of assessment. However, not much of statistically significant differences were seen between the groups with respect to other variables and respiratory rate ($p>0.05$). No episode of respiratory depression or hypoxemia was observed in any of the

patients from both groups intraoperatively and 24 hours postoperatively. Similar findings are reported in the study conducted by Hashim et al [13] and Hamed et al [15].

Postoperative assessment included analgesia which was assessed at every 1 hr till 12hrs postoperatively using visual analogue scale (VAS). In VAS scale, 0 is no pain at all and 10cm is maximum imaginable pain, which was explained to all patients in their preoperative visit. Total duration of analgesia was taken from the time of complete sensory block to the request of rescue analgesic VAS ≥4cm. Both groups had an average VAS Score below 3 cm at all measured intervals except at the time of reception of Injection Diclofenac (1mg/kg, Intramuscular), when highest Scores of >4cm were observed. We have observed that in patients who were administered with dexmedetomidine the mean VAS has 4 and above at 11th hour postoperatively. However, in the patients who were administered with fentanyl, mean VAS scores of above 4 was seen from 9th hours. Moreover, statistically significant differences in mean VAS scores were observed between both groups was seen at different hourly intervals postoperatively indicating that dexmedetomidine has provided prolonged post-operative analgesia than fentanyl which is comparable with the study done by Hamed MA et al [15].

No adverse side effects were observed in the patients from both groups of the present study, only 4% patients from dexmedetomidine group complained nauseated feeling. On the other hand, in the fentanyl group, 4% of patients complained about nausea, while another 4% complained about itching sensation.

Limitations

Several limitations of this study could potentially contribute to the observed heterogeneity.

- First, in the present study there were no measurement of dexmedetomidine serum dose during surgery that would make the evaluation of this drug's systemic effect unpredictable after local absorption.
- Second, varied brachial plexus block types, nerve localization techniques, dexmedetomidine dosages, and local anesthetic types, as well as varied definitions of onset and duration of sensory and motor block, and unclear adverse events all could contribute to the methodological heterogeneity.
- Another limitation of our study is low sample size. A large sample size would have given more precision to the result.
- Dynamic pain score was not assessed in the postoperative period.
- Patients in the paediatric and geriatric age groups as well as patients with comorbid conditions were not included in the study.

Conclusion

From the results of present study, it can be concluded that the addition of 50μg dexmedetomidine to 25 to 30ml bupivacaine 0.5% in supraclavicular brachial plexus block was more effective in prolongation of the sensory and motor duration of the block, as well as providing adequate intra-operative analgesia when compared to 50 μg fentanyl with 25 to 30ml bupivacaine 0.5%. Dexmedetomidine is effective and safe in post-operative analgesia.

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