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Research Article

Comparative Study of Dexmedetomidine and Fentanyl as an Adjuvant in Supraclavicular Block in Upper Limb Surgery

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Abstract

Background: Regional anaesthesia, particularly the brachial plexus block via the supraclavicular approach, provides excellent anaesthesia and postoperative analgesia for upper limb surgeries. The addition of adjuvants to local anaesthetic agents enhances block quality, prolongs analgesia, and provides hemodynamic stability. Among various adjuvants, dexmedetomidine and fentanyl are commonly used for their sedative and analgesic properties.

Aim: This study aimed to compare the efficacy of dexmedetomidine and fentanyl as adjuvants to 0.5% bupivacaine in supraclavicular brachial plexus block with respect to onset and duration of sensory and motor blockade, duration of analgesia, and hemodynamic changes.

Methods: Sixty adult patients (ASAI–II) scheduled for elective upper limb surgery under supraclavicular brachial plexus block were randomly allocated into two equal groups: Group D (bupivacaine + dexmedetomidine 1 µg/kg) and Group F (bupivacaine + fentanyl 1 µg/kg). Onset and duration of sensory and motor block, duration of analgesia, and hemodynamic parameters were recorded and compared.

Results: The onset of sensory and motor block was significantly faster in Group D compared to Group F ($p<0.05$). The duration of sensory and motor block and total analgesia were significantly longer in Group D. Hemodynamic parameters remainedwithin acceptable limits in both groups, though mild bradycardia was observed in Group D.

Conclusion: Dexmedetomidine as an adjuvant to bupivacaine in supraclavicular brachial plexus block provides earlier onset and longer duration of anaesthesia and postoperative analgesia than fentanyl, with stablehemodynamic and minimal adverse effects.

Keywords: Dexmedetomidine, Fentanyl, Supraclavicular block, Brachialplexus, regional anaesthesia

INTRODUCTION

Brachial plexus block isa reliable and popular regional anaesthetic technique for upper limb

surgeries, providing dense anaesthesia, muscle relaxation, and prolonged postoperative analgesia. Among various approaches, the supraclavicular approach is often termed the "spinal ofthe upperlimb" because itprovides a rapid, dense, and uniform block ofthe entire upperextremitydistal to the shoulder joint [1, 2].

However, the duration of analgesia achieved by local anaesthetics alone is often limited. To enhance the duration and quality of block, adjuvants such as opioids, α2-adrenergic agonists, and corticosteroids have been used. Dexmedetomidine, a highly selective α2-adrenergic receptor agonist, provides sedation, anxiolysis, and analgesia without respiratory depression [3]. Fentanyl, a potentμ-opioid receptor agonist, is also widely used asan adjuvant dueto its analgesic efficacy andsynergistic action with local anaesthetics [4].

This study compares dexmedetomidine and fentanyl as adjuvants to 0.5% bupivacaine in supraclavicular brachial plexus block, focusing on the onset and duration of sensory and motor block, postoperative analgesia, and hemodynamic stability.

Aim and Objectives

Aim:
To compare the efficacy of dexmedetomidine and fentanyl as adjuvants to bupivacaine in supraclavicular brachial plexus block.

Objectives:

1. To compare the onset time of sensory and motor block.
2. To compare the duration of sensory and motor block.
3. To assess the duration of post operative analgesia.
4. To evaluate intraoperative and post operative hemodynamic parameters and side effects.

Materials and Methods

A prospective, randomized, double-blind comparative study was conducted on 60 patients undergoing elective upper limb surgeries under supraclavicular brachial plexus block.

Inclusion Criteria

- ASA physical status I or II
- Age 18–60 years
- Scheduled for upper limb surgeries (fore arm, hand, wrist)
- Duration of surgery <2 hours

Exclusion Criteria

- Patient refusal
- Infection at block site
- Known allergy to study drugs
- Coagulopathy, severe cardiac or respiratory disease

- Pregnant or lactating women

Study Groups

Group	Drug Composition	Total Volume
Group D	30mlof0.5%bupivacaine+Dexmedetomidine(1µg/kg)	31 ml
Group F	30mlof0.5%bupivacaine+Fentanyl(1µg/kg)	31 ml

Procedure

All patients were premedicated with midazolam 0.02 mg/kg IV. Standard monitoring included ECG, NIBP, and SpO2. The supraclavicular block was performed under ultrasound guidance using a 22G stimulating needle. Following negative aspiration, the study drug was injected incrementally.

Sensory block was assessed by pinprick method every 2 minutes in dermatomal distribution of median, radial, ulnar, and musculocutaneous nerves.

Motor block was evaluated using the modified Bromage scale for upper limbs. Duration of analgesia was recorded as the time from completion of injection to first request for rescue analgesic (VAS ≥ 4).

Results

Both groups were comparable in demographic variables such as age, sex, and weight ($p>0.05$).

Table1: Demographic distribution

Parameter	Group D (Mean±SD)	Group F (Mean±SD)	p-value
Age(years)	38.4 ±8.2	39.1 ±7.9	0.74
Weight(kg)	63.2 ±6.1	64.5 ±5.8	0.52
Gender(M/F)	18/12	17/13	0.80

Table 2: Onset and Duration of Block

Parameter	Group D (Mean± SD)	Group F (Mean± SD)	p-value
Onset of Sensory Block (min)	8.5 ±2.1	11.2±2.4	0.001*
Onset of Motor Block (min)	12.1 ±2.3	15.3 ±2.8	0.001*
Duration of Sensory Block (min)	520.4 ±35.6	360.2 ±28.1	0.001*
Duration of Motor Block (min)	460.3 ±33.5	320.8 ±26.7	0.001*
Duration of Analgesia (min)	610.5 ±42.2	430.1 ±38.6	0.001*

*$p<0.05$ indicates statistical significance.

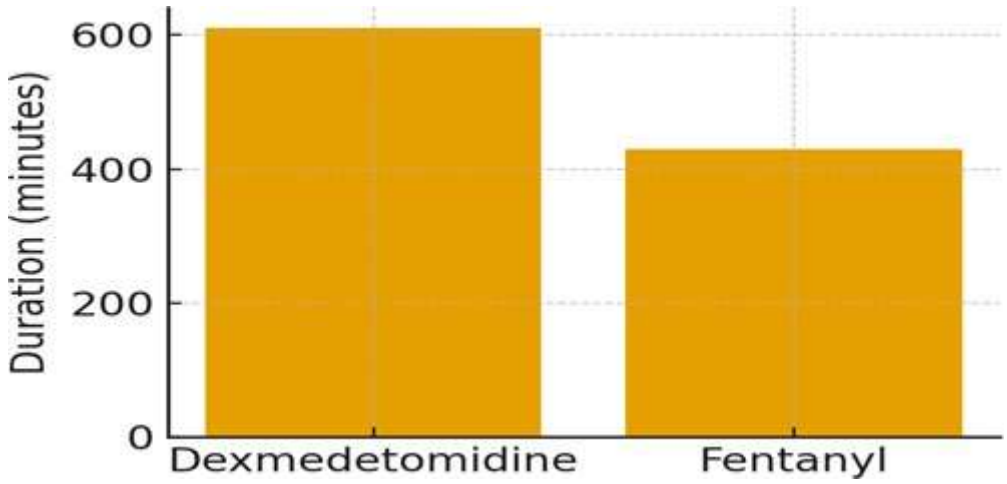

Figure 1: Comparison of Duration of Analgesia between Groups

Hemodynamic Parameters

Mean heart rate and blood pressure were lower in Group D throughout surgery but within 20% of baseline values. Mild bradycardia (HR < 60 bpm) occurred in 2 patients in Group D, managed with atropine. No respiratory depression or hypotension requiring intervention occurred.

DISCUSSION

This study demonstrated that the addition of dexmedetomidine to 0.5% bupivacaine in supraclavicular block results in faster onset and longer duration of sensory and motor blockade compared to fentanyl. Similar findings were reported by Gupta et al.(2014)[5]and Kaur et al. (2015) [6], where dexmedetomidine prolonged the duration of analgesia and improved block quality.

The mechanism of action of dexmedetomidine involves hyperpolarization of nerve tissues due to inhibition of norepinephrine release, resulting in decreased neuronal excitability and potentiation of local anaesthetic effects[7]. Fentanyl, on the other hand, acts through μ-opioid receptors producing analgesia but less prolongation of motor block [8].

Hemodynamic stability is a crucial aspect of regional anaesthesia. In our study, Group D showed slightly lower heart rates and mean arterial pressures, consistent with the sympatholytic action of dexmedetomidine, as also noted by Agarwal et al. (2017) [9]. These changes were clinically insignificant.

The duration of analgesia was approximately 610 minutes in the dexmedetomidine group compared to 430 minutes in the fentanyl group, indicating a substantial benefit in post operative pain management. Similar prolongation was documented by Swami et al. (2012) [10] and Kathuria et al. (2016) [11].

Adverse effects were minimal and comparable between groups. Sedation wasmild (Ramsay score 2–3) in both, with no respiratorydepression.

Overall, dexmedetomidine proved to be a superior adjuvant to fentanyl in supraclavicular brachial plexus block.

CONCLUSION

Dexmedetomidine (1 μg/kg) as an adjuvant to 0.5% bupivacaine in supraclavicular brachial plexus block provides:

- Faster onset of sensory and motor block,
- Longer duration of anaesthesia and postoperative analgesia, and
- Stable intraoperative hemodynamics,

Compared to fentanyl (1μg/kg), with minimal side effects. Hence, dexmedetomidine can be considered a more effective and safer adjuvant for upper limb surgeries under regional anaesthesia.

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