Original Research Article

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An Observational Study to Compare Dexmedetomidine and Clonidine as Adjuvant to Local Anaesthetic Ropivacaine (0.5%) in Supraclavicular Brachial Plexus Block for Upper Limb Surgery

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Abstract

Context: Various adjuvants have been used with Ropivacaine in supraclavicular blocks to enhance sensory and motor block along with prolongation of postoperative analgesia.

Aim: To compare the effect of dexmedetomidine and clonidine as adjuvant to 0.5% ropivacaine in supraclavicular brachial plexus block with respect to onset and duration of sensory and motor block and duration of analgesia.

Methods and Material: After ethical committee's approval, a prospective randomised study of 60 patients aged18-60 years were randomly divided into two groups (Group C and Group D) of 30 each. Group C received 50mcg clonidine with ropivacaine (29ml), Group D received 50mcg dexmedetomidine with ropivacaine (29ml), via supraclavicular approach. Onset and duration of sensory and motor block and duration of analgesia in both groups were evaluated. Intraoperative hemodynamics and adverse effects were observed.

Statistical Analysis: Numerical-variables were presented as mean & standard-deviation while categorical-variables were presented as frequency and percent. For analysis, unpaired student t-test and chi-square test were used.

Results: Early onset and prolonged duration of sensory and motor block and prolonged duration of analgesia was seen in group D, as compared to group C.

Conclusion: Dexmedetomidine produces rapid onset and prolonged duration of sensory and motor block and also prolonged duration of analgesia with good hemodynamic stability with no side effects as compared to clonidine.

Keywords: Dexmedetomidine; Clonidine; Ropivacaine; Brachial Plexus Block.

Introduction

Upper limb surgeries are mostly performed under peripheral nerve blocks such as the brachial plexus block which provide very good anaesthesia and analgesia intraoperatively along with reduced incidences of complications like delayed recovery from anaesthesia, unwanted effect of anaesthetic drugs used during general anaesthesia, hypotension, bradycardia stress of laryngoscopy and tracheal intubations and also provide very good postoperative analgesia. The brachial plexus block, via supraclavicular approach, provide safe, effective, low-cost complete anaesthesia/analgesia of the upper limb. It is done at the level of distal trunks where it is in its tightest formation which allows rapid analgesia/anaesthesia of the upper limb. Numerous methods were used by Schoenmakers et. al. (2012) and Scott DB et al (1989) to extend the duration of analgesia like using higher volume of local anaesthetics [8] but that increased the risk of LA systemic toxicity [9]. Continuous catheter-based nerve blocks, as studied by Ilefelid BM et al(2011) and

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Salinas FV et al(2006), provide very good postoperative analgesia [6] but it's time consuming and is costly and needs skills [7]. There have always been a search for an ideal adjuvant. Many adjuvants like tramadol, fentanyl, sodabicar-bonate, dexamethasone & various alpha 2 agonists like clonidine and dexmedetomidine have been used in 2012 with varying degrees of success [13].

This study is designed to compare the effect of dexmedetomidine and clonidine with ropivacaine. We have used 0.5% ropivacaine for supraclavicular brachial plexus block instead of bupivacaine owing to its more cardiostable and less lipophilic properties.

Methods

Study Type

Observational study

Duration of Study: One year and 6 months

Sample Size: 60 patients selected using randomised sampling allocated into two equal groups using chit-method.

Setting: Dhiraj hospital, piparia.

Patients belonging to ASA I and II of age group 18-60 years, normotensive posted for upper limb surgeries and those giving written and informed consent were included in the study whereas patients not giving consent, hypertensive, heart rate less than 50 beats per minute, systolic blood pressure less than 100mmHg, patients with heart block, hyperthyroid patients and patients on adrenoceptor agonist/ antagonist therapy were excluded from the study.

After approval of institutional ethical committee, 60 consenting patients fulfilling the inclusion criteria were considered for the study. A pre-anesthetic checkup was done for all patients, which included a detailed history, general physical and systemic examination.

Basic investigations in the form of complete haemogram, bleeding profile, random blood sugar, blood urea, serum creatinine and chest x ray were carried out.

Patients were kept nil per oral for 6 hours. On arrival of the patient in the operating room, an 18-gauge intravenous line was secured in the unaffected limb and Ringer's lactate was started. The patients were connected to multichannel monitor which records Heart rate (HR), non-invasive measurements of systolic and diastolic blood pressure and mean arterial pressure (SBP, DBP, MAP), continuous electrocardiography (ECG) monitoring and oxygen saturation. The total volume of the solution used was same in both the groups by adding saline when ever needed. The study drug was prepared by a senior anaesthesiologist who was not involved in the study. Under aseptic precautions, perivascular supraclavicular brachial plexus block was performed using paraesthesia technique. A negative aspiration for blood was performed before each incremental injection of 5ml to a total volume of 30ml of drug solution was given. A brief massage for one minute was performed to facilitate an even drug distribution.

Onset of sensory block was assessed by the pin prick response on the areas of all four nerves of the upper limb.

Assessment of motor block was carried out using the Bromage three point score [0= normal motor function with full flexion and extension of elbow, wrist and fingers, 1= decrease motor strength with ability to move fingers and/or wrist only, 2= complete motor blockade with inability to move fingers] by the same observer at each minute till complete motor blockade after drug injection. Onset Time of Motor Block (OTMB) was taken as the time interval in minutes from time-0 till motor block started appearing i.e BS score $\geq$ 2. Time for Complete Motor Block (TCMB) was taken as the duration of time in minutes from time-0 till complete motor block was achieved i.e. BS score=3. Thereafter effect of block was tested every 30 minutes. Total Duration of Motor Block (TDMB) was taken as the duration of time in minutes from the TCMB till the time when BS score < 3 in the postoperative period. Adequacy of block was evaluated by Allis clamp test before handing over the patient to surgeon. The test was done by asking the patient whether they felt any discomfort when pressure was applied with the Allis clamp at the area of the surgical field. The readings were recorded as follows:

a. Complete (Total comfort to patient)

b. Inadequate (Discomfort: Requiring supplementation)

The block was considered to be incomplete when any of the segments supplied by the median, ulnar, radial and musculocutaneous nerve did not have analgesia after 30 minutes of drug injection. Block was considered as a failure if complete sensory and motor block was not achieved even after 45 minutes. Failed blocks were converted to GA and recorded.

Sedation of patient was assessed by the Ramsay Sedation Score. Level of sedation was assessed at an interval of every 20 min from Time-0 till the end of surgery using the 5 point sedation scale. Blood loss assessment was done and fluid administered as per the loss was done. Duration of surgery was noted.

Ramsay Sedation Score

Score Response

1 Anxious or restless or both
2 Cooperative, orientated and tranquil
3 Responding to commands
4 Brisk response to stimulus
5 Sluggish response to stimulus
6 No response to stimulus

Postoperative Management

With stable haemodynamics, all the patients were shifted to the recovery room and were constantly monitored for pain as well as any associated complaints.

Postoperatively, sensory block, motor block and post-operative pain (by Visual Analogue Scale) were assessed. VAS was recorded at an interval of every 1 hour till the score ≥ 4. HR, SBP, DBP, MAP and RR were recorded at an interval of every 30 minutes.

Results

The demographic profile in terms of age, sex, weight, height and ASA physical status were comparable among the two groups of patients (Table 1). Duration of surgery was also comparable in two groups (Table 1). Group D produced statistically significant earlier onset with prolonged duration of sensory blockade as compared to group C ($p<0.0001$) (Table 2). Group D produced statistically significantly earlier onset and prolonged duration of motor blockade as compared to group C ($p<0.0001$) (Table 3). Group D produced significantly prolonged duration of analgesia as compared to group C ($p<0.0001$) (Table 4).

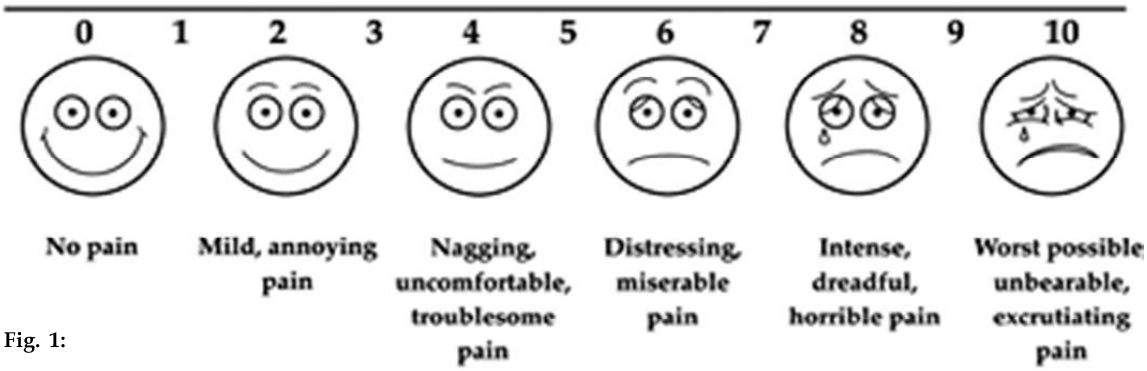

Fig. 1:

Table 1: Patient Characteristics

Patient Characteristics	Group C (N = 30) (Mean ± SD)	Group D (N = 30) (Mean ± SD)	P value
Age (Years)	38.56±7.77	40.1±14.14	0.6031
Gender (M/F)	18/12	17/13	N.A.
Weight (Kg)	60.4±7.77	61.56±16.26	0.7257
ASA Physical Status (I/II)	14/16	17/13	N.A.
Duration of Surgery (min)	87±21.21	97±7.07	0.0173

Abbreviations: [ASA= American society of Anaesthesiologists; M/F=Male/Female; Kg=kilogram; min=minutes; N=number of patients; SD= standard deviation; N.A.= not applicable]

Table 2: Sensory Characteristics of Brachial Plexus Blockade

Sensory Characteristics (Minutes)	Group C (N = 30) (Mean ±SD)	Group D (N = 30) (Mean ±SD)	P value
Onset	14.9±0.7	8.1±1.4	<0.0001
Duration	435.63±3.53	729.53±17.67	<0.0001

Abbreviations: [N=number of patients; SD= standard deviation]

Table 3: Motor Characteristics of Brachial Plexus Blockade

Motor Characteristics (Minutes)	Group C (N = 30) (Mean ± SD)	Group D (N = 30) (Mean ± SD)	P value
Onset	24.16±0.70	11.63±0.70	<0.0001
Duration	473.46±14.84	692.53±28.99	<0.0001

Abbreviations: [N=number of patients; SD= standard deviation]

Table 4: Duration of Effective Analgesia

Variable	Group C (N = 30) (Mean ±SD)	Group D (N = 30) (Mean ±SD)	P value
Effective Analgesia (minutes)	475.06±9.89	811.66±21.21	<0.0001

Abbreviations: [N=number of patients; SD= standard deviation]

Table 5: Comparison of VAS In Both Groups

VAS>3	Group C (N=30) Mean ± SD	Group D (N=30) Mean ± SD	P value
Time (in min)	505±0.0	847±42.42	<0.0001

Abbreviations: [N=number of patients; SD= standard deviation; min=minutes]

Group D produced statistically significant reduction in the pulse rate intraoperatively at 15, 45, 90 and 120 minutes and postoperatively at 8 hours as compared to group C ($p<0.0001$). The changes in systolic blood pressure during both the intraoperative and postoperative period in both the groups was comparable with no statistically significant changes ($p>0.05$).

The changes in diastolic blood pressure during the intraoperative period in both the groups was comparable with no statistically significant changes ($p>0.05$). The changes in diastolic blood pressure during the postoperative period in both the groups was comparable with only statistically significant change occurring at 1, 10 & 12 hours ($p<0.0001$).

The changes in respiratory rate during the intraoperative period in both the groups was comparable with no statistically significant changes ($p>0.05$). The changes in respiratory rate during the postoperative period in both the groups was comparable with only statistically significant change occurring at 1& 6 hours ($p<0.0001$). There was a statistically significant difference in VAS score on comparing both the groups (Table 5). No complications were observed in any of the two groups throughout our study period.

Discussion

Brachial plexus block is one of the most commonly performed peripheral nerve blocks in routine practice. It can be used as the sole anaesthetic technique or in combination with general anaesthesia for intraoperative and postoperative anaesthesia & analgesia. Brachial plexus roots, present between the scalenus anterior and medius muscle, combines to form the trunks which carry the entire sensory, motor and sympathetic innervations of the upper extremity in a very small surface area. It is at this level supraclavicular blocks are performed. As a result, the block is rapid in onset, predictable and dense anaesthesia is achieved with high successful rate. Search for longer acting local anesthetic is great and wide spread.

Supremacy of lignocaine remains unchallenged despite the introduction of various local anesthetics. The only drawbacks of it are shorter duration of action and increased risk of overdose and toxicity. The limiting factor in the more widespread use of this agent for block is the duration of action of the local anesthetics available which means either use of perineural catheters for longer surgeries or addition of adjuvants which prolong the duration of motor and sensory block and analgesia. A few groups, in 2014, had compared the effects of the alpha 2 agonists clonidine and dexmedetomidine with bupivacaine and with 0.75% Ropivacaine [4].

In our study, the drugs selected for supraclavicular block were ropivacaine (0.5%), and dexmedetomidine and clonidine as adjuvants. Simpson D et. al. (2005) found that ropivacaine had structural similarity to bupivacaine but with low lipid solubility and without cardiotoxic effects of bupivacaine [12].

Dexmedetomidine and clonidine has been previously studied by various authors as an adjuvant to local anaesthetic in supraclavicular block. Dexmedetomidine and clonidine are both α_2 selective agonists. There is a possibility that they work in a similar manner and may indicate a class effect. Very few studies have compared ropivacaine with dexmedetomidine and clonidine as adjuvants for supraclavicular block in India. Hence, ropivacaine (0.5%) with dexmedetomidine and clonidine combination was selected for our study.

The rationale for choosing this concentration of ropivacaine (0.5%) is supported by the study done by Klein et. al. in 1998, who found that for interscalene brachial plexus block, increasing the concentration of ropivacaine from 0.5% to 0.75% failed to improve onset or duration of block, suggesting that the risk of increased total dose of local anesthetic may be avoided. Hickey and co-workers, in 1992, had shown that 0.25% ropivacaine when used for subclavian perivascular brachial plexus block for upper limb surgery required frequent analgesia supplementation due to the low concentration of local anesthetic used [5].

We have used Dexmedetomidine 1µg/kg and clonidine 1µg/kg in our study, but in 2010 Shivinder Singh et al used various doses of Dexmedetomidine and clonidine 0.5µg/kg for brachial plexus block [11].

But Singelyn et. al. in 1996 had found that a minimum dose of clonidine (0.5µg/kg) added to mepivacaine prolonged the duration of analgesia & anaesthesia after brachial plexus block and no added benefit of exceeding the dose of clonidine more than 1.5µg/kg [10]. Dexmedetomidine has $\alpha_2/\ \alpha_1$ selectivity ratio eight time higher than clonidine but, an equipotent dose of both was unknown so dose selection was done according to previous studies by Gandhi R et. al. (2012) where dexmedeto-midine and clonidine were used in 1µg/kg [3].

Karthik G et. al., in 2015, had compared dexmedetomidine and clonidine with levobupivacaine and Don Sebastian et. al. [1] in 2015 had used dexmedetomidine and clonidine with ropivacaine in brachial plexus block. Erlacher W et. al. in 2000 found that ropivacaine did not provide higher level of motor block and the clinical advantage of levobupivacaine was not substantial [2].

The demographic profile between the two groups was quite similar and provided us the uniform platform to evenly compare the results obtained.

The onset of sensory and motor block in both group C and group D and the difference between two groups is statistically significant ($p<0.0001$) . Both sensory and motor onset is early with dexmedetomidine compare to clonidine. Sensory onset in group C was 14.9±0.7 mins whereas in group D it was 8.1±1.4 mins, whereas motor onset in group C was 24.16±0.7 mins and in group D it was 11.63±0.7 mins. Karthik G et. al. (2015) and Don Sebastian et al (2015) [1] also found significantly faster sensory and motor onset with dexmedeto-midine than clonidine.

Sarita Swami et. al. (2012) also found faster sensory block with dexmedetomidine compare to clonidine but motor onset in their study was more rapid in clonidine group.

The total duration of sensory and motor block in group D were 729.53±17.67 mins and 692.53±28.99 mins whereas, in group C, duration of sensory and motor blocks were 435.63±3.53 mins and 473.46±14.84 mins respectively. The difference between two groups were statistically significant ($p<0.0001$).

Similar to our study, Karthik G et. al. (2015), Don Sebastian et. al. (2015) [1] and Sarita Swami et. al. (2012) found longer sensory and motor block with dexmedetomidine compare to clonidine when they were combined, as an adjuvant, with local anaesthetic in brachial plexus block. Many studied have shown the addition of clonidine extending the duration of brachial plexus block but Erlacher et. al. (2000) did not find much advantage of clonidine as an adjuvant.

Average total duration of analgesia in group D was 811.66±21.21 min whereas in group C it was 475.06±9.89 min which was significantly longer in dexmedetomidine group and difference between two was statistically significant ($p<0.0001$). In Don Sebastian et. al. (2015) [1] study duration of analgesia with 50µg of clonidine and 50µg dexmedetomidine was 510min and 720 min respectively which were similar to our result. Karthik G et. al. (2015) and Sarita Swami et al (2012) also reported significantly longer duration of analgesia with dexmedetomidine than clonidine.

None of the patients from any of the two groups required any sedation during intraoperative period. Dexmedetomidine also produce better arousable sedation than clonidine. Similar to our study, Karthik G et. al. (2015), Sarita Swami et. al. (2012) and Don Sebastian et. al. (2015) also recorded better sedation with dexmedetomidine than clonidine.

On comparison of haemodynamic parameters between the two groups, the baseline pulse and blood pressure between group D and group C were comparable ($P>0.05$). But, 15, 45, 90 & 120 mins after the block, pulse rate in group D was significantly lower than group C ($p<0.05$). The difference in mean SBP, DBP & RR between the two groups was

statistically insignificant (p>0.05). No significant side effects of clonidine or dexmedetomidine were noted in our study.

Singelyn et. al. in 1996 reported that a minimum dose of clonidine (0.5 μg/kg) added to mepivacaine prolonged the duration of anaesthesia and analgesia after brachial plexus block. No added benefits were found with the doses exceeding 1.5 μg/kg. The enhancing effect of a small dose of clonidine on lignocaine was because of the evoked inhibition of C-fiber action potential. Similar effects were found in our study too.

Anjan Das et. al. (2014) concluded that the addition of 100 mcg of dexmedetomidine to ropivacaine 0.50% solution for supraclavicular brachial plexus block prolonged the duration of sensory and motor blockade thus reducing the requirement of rescue analgesia in the post-operative period, but had no appreciable effect on the time of onset of sensory & motor blockade.

Conclusion

From our study, with the use of α-2 agonists, Dexmedetomidine (50mcg) and Clonidine (50mcg) as adjuvants to local anaesthetic solution (0.5% ropivacaine) in supraclavicular brachial plexus block for upper limb surgeries, we conclude that there was faster onset and prolonged duration of sensory and motor block with prolonged duration of postoperative analgesia with dexmedetomidine as compared to clonidine. Haemodynamic parameters, side effects and sedation scores were comparable between the two drugs.

Key Message

Dexmedetomidine, when added to Ropivacaine, in supraclavicular brachial plexus-block, produced faster onset longer duration of sensory and motor block and longer analgesia duration with reduced complications and stable hemodynamics compared to Clonidine.

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Nil

Conflict of Interest

Nil

Source of Support

Nil

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