Original Article

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Comparative Study of Lignocaine, Lignocaine with Dexmedetomidine and Lignocaine with Fentanyl for Biers Block in Upper Extremity Surgeries

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Abstract

Background: Dexmedetomidine and Fentanyl have been used effectively along with local anaesthetics to shorten the onset, prolong the duration of the block, and to increase postoperative analgesia. We compared fentanyl and dexmedetomidine as adjuvants to lignocaine for Biers Block for upper extremity surgeries.

Materials and Methods: After Institutional approval and informed consent, 90 ASA 1 and 2 volunteers were taken into the study. 30 patients were randomly allocated each in Group A to receive Biers block for upper extremity with 3 mg/kg of 0.5% lignocaine; in Group B, with 3 mg/kg of 0.5 % lignocaine with 0.5 mcg/kg dexmedetomidine and Group C received Biers block of upper extremity with 3 mg/kg of 0.5% lignocaine with 1mcg/kg Fentanyl. The onset of sensory, complete motor block and tourniquet pain were observed and any symptoms after cuff deflation were recorded. Usual haemodynamic monitoring used.

Statistical Analysis: ANOVA (Analysis of Variance) and Chi-square tests were used for data analyses; p value of <0.05 considered significant.

Results: Groups A, B and C were comparable in demographic and surgical parameters. The speed of onset of sensory and motor block was higher in Group C (Fentanyl) ($p < 0.0001$). The tourniquet pain occurred significantly later in Group B (Dexmedetomidine) ($p<0.0001$). There were few incidences of bradycardia in Group B.

Conclusion: In conclusion, present study suggested that dexmedetomidine and fentanyl will enhance the quality of anaesthesia, providing a shorter onset time of sensory and motor block, delayed first analgesia requirement.

Keywords: Biers block; Local Anesthetic: Lignocaine Hydrochloride; α-2 Agonist: Dexmedetomidine; Fentanyl.

Introduction

Biers block which came into clinical practice by August Bier in 1908, was forgotten for nearly half a century and it was reintroduced by Holmes in Great Britain in 1963. Since then it has become popular and numerous reports from all over have appeared affirming to its efficacy in properly selected patients. The factors to be considered while performing this block are allergic reaction to the agents used and the anticipated length of procedure. Since the analgesia is dependent upon the continuous presence of the tourniquet, it provides satisfactory analgesia for most surgical procedures on distal parts of the extremities.[1]

This form of analgesia is preferably appropriate for emergencies, where patient is high risk pf gastric aspiration. Moreover the feasibility and easiness of execution of this method, its effectiveness and

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Indian Journal of Anesthesia and Analgesia

its lack of any side effects have been gratifying. The equipment needed is negligible. Biers block is mainly suitable for outpatient surgeries, as it requires negligible preparation and premedication.[2]

Biers block is apt for distal extremity surgeries like ganglion excision, decompression of de Quervain's disease, manipulative reduction and dislocations of bones of forearm, amputations, wound debridement, tendon repair, foreign body removal, open reductions of fracture of forearm bones etc.

Currently, alpha-2 adrenergic receptor agonists[3] have been the focus of interest for their beneficiary effects like sedation, anxiolysis, analgesia and perioperative sympatholytic and cardiovascular alleviating effects with decreased anaesthetic requirements.

Dexmedetomidine[4], a stereoisomer of medetomidine is a highly selective alpha-2 adrenergic agonist which decrease anaesthetic necessities by upto 90% and to induce analgesia in rats, and patients. It has been used successfully in combination with local anaesthetics for procedures like spinal[5] epidural[6] and brachial blocks[7] where it has been found to enhance/potentiate the action of local anaesthetics.

Fentanyl is a piperidine derivative that can be added to a LA during to increase the rate of success of the blockade and extend postoperative analgesia.

The present study was designed to evaluate the quality, onset of sensory, onset of motor blockade and beginning of tourniquet pain in Biers block with 0.5 mcg/kg dexmedetomidine added to 3 mg/kg of 0.5% lignocaine and 1mcg/kg Fentanyl added to 3 mg/kg of 0.5% lignocaine.

Materials And Methods

This prospective, randomised, double-blinded study conducted in Mahadevappa Rampure medical college, Kalaburagi between January 2017 to February 2018 after obtaining clearance from Institutional Ethical Committee of the Institute and written informed consent from all patients.

The study included of 90 patients belonging to either sex and age between 18 and 60 years. All the patients fitted to ASA (American Society of Anesthesiologists) grade 1 or 2. Patients were randomly separated into three groups:

Randomisation of the patients is allocated into defined groups according to computer generated random numbers-

Group A- received Biers block for upper extremity with 3 mg/kg of 0.5% lignocaine.

Group B- received Biers block of upper extremity with 3 mg/kg of 0.5% lignocaine with 0.5 mcg/kg dexmedetomidine.

Group C- received Biers block of upper extremity with 3 mg/kg of 0.5% lignocaine with 1 mcg/kg Fentanyl.

No sedatives and opioids were administered to the patients in the preoperative period. Standard monitoring applied to the patients to measure blood pressure, and pulse rate every 5 min for the 30 min then every 15 min till 2 h after deflation of tourniquet.

22 gauge intravenous cannula inserted in the most distal veinon the dorsum of the hand to be operated, it was used for injecting lidocaine mixture, and another 20 gauge cannula was inserted in theother hand for fluids, antibiotics, and analgesics.

The arm to be operated upon was evacuated from blood by Esmarch bandage, then double tourniquet was put on the upper arm with proximalTinflated to 300 mm Hg. Complete termination of arterial blood supply and venous return in limb was confirmed by pallor ofthe hand absence of radial pulse, and absence of the plethysmography of pulse oximetry.

Injection of 40 ml of the lidocaine solution with the adjuvant wasdone over next 1 min and the time of complete injection of the solution was considered 0 time.

Sensation was examined by pin prick every 30 s in the 1st 10 min oruntil complete sensory loss to define the sensory onset, and every 1 min after deflation of the tourniquet to determine sensory recovery time.

Motor block was examined every 30 s in the 1st 10 min to determine the onset of motor block, then every 30 s after deflation of tourniquet to conclude motor recovery time. It was studied by the ability of the patient to move his wrist or fingers in flexion, extension, supination, or pronation.

Once patient felt discomfort, distal tourniquet was inflated with 250 mmHg or 100 mm Hg above the systolic blood pressure of the patient, and the proximal one was deflated. At the end of the operation, the anesthesiologist deflated tourniquet by repeated inflation, deflation technique in which 10 s ofdeflation followed by 1 min of reinflation, and this was repeated 3 consecutive times.

Time to 1st analgesic request was calculated from time of deflation of the tourniquet was recorded.

Side effects such as hypotension (20% decrease

of baseline bloodpressure), bradycardia (heart rate below 60 beat per minute), tinnitus, numbness, dizziness, hallucinations, excessive sedation and pain on injection were treated and recorded.

Statistical Analysis

One-Way ANOVA (Analysis of Variance) used for the comparison between the groups and Chi-square test applied for age, sex and ASA grades. P value of <0.05 considered significant.

Results

The present study demonstrated that patients were between the 18-60 years of age with mean age of 38.6 in Group A, 33.2 in Group B and 40.3 in Group C.(table 1)

Table 1: Age Distribution.

	Group A	Group B	Group C
Mean	38.6	33.2	40.3
S.D	15.3	TT9.6	14.5

P value < 0.05.

In our study there were seventeen male patients and thirteen female patients in Group A, thirteen male patients and seventeen female patients in Group B and sixteen male patients and fourteen female patients in Group C.(table 2)

Table 2: Sex Distribution.

	Group A	Group B	Group C
Male	17	13	16
Female	13	17	14

p value < 0.05

The present study revealed that sensory blockade occurred at mean time of 6.6 mins in Group A, 2.4 mins in Group B and 4.3 mins in Group C. (table 3)

Table 3: Statistical Analysis of onset of Sensory Blockade.

	Group A	Group B	Group C
Mean	6.6	2.4	TT 4.3
S. D	1.4	0.7	0.9

p value < 0.05

The present study revealed that onset of motor block occurred at mean time of 16.6 mins, 7.8 mins and 13.9 mins with standard deviation of 2.1, 1.4 and 1.9 mins in Group A, Group B and Group C respectively. (table 4)

Table 4: Statistical Analysis of onset of Motor Block.

	Group A	Group B	Group C
Mean	16.6	7.8	13.9
S.D	2.1	1.4	1.9

p value < 0.05

The present study revealed that onset of tourniquet pain occurred at mean time of 11.3 mins, 13.2 mins and 16.9 mins with standard deviation of 3.5, 2.1 and 2.8 mins in Group A, Group B and Group C respectively.(table 5)

Table 5: Statistical Analysis of onset of Tourniquet Pain.

	Group A	Group B	Group C
Mean	11.3	13.2	16.9
S.D.	3.5	2.1	2.8

p value < 0.05

The present study demonstrated that duration of surgery took a mean time of 49 mins, 45 mins and 48 mins with standard deviation of 19.5, 11.6 and 16.8 mins in Group A, Group B and Group C respectively. (table 6)

Table 6: Statistical Analysis of duration of Surgery.

	Group A	Group B	Group C
Mean	49	45	48
S.D	19.5	11.6	16.8

p value of 0.05

Whole 90 patients were distributed into 3 groups of 30 each. Age, sex and time duration of surgery were comparable in between groups (p >0.05). The time of onset of sensory and motor block was faster in Group B as compared to Group C (p <0.0001), while duration of onset of tourniquet pain was longer in Group C compared to Group B (p <0.0001).(table 7)

Whole 90 patients were distributed into 3 groups of 30 each. Age, sex and time duration of surgery were comparable in between groups (p >0.05). The time of onset of sensory and motor block was faster in Group B as compared to Group C (p <0.0001), while duration of onset of tourniquet pain was longer in Group C compared to Group B (p <0.0001).(table 7)

		Group A	Group B	Group C
Age (Years)		38.6 +/- 15.3	33.2 +/- 9.6	40.3 +/- 14.5
Sex	**Male**	17	13	16
	Female	13	17	14
Onset of Sensory Block (minutes)		6.6 +/- 1.4	2.4 +/- 0.7	4.3 +/- 0.9

Table continued ...

Indian Journal of Anesthesia and Analgesia

Onset of motor Block (Minutes)	16.6 +/- 2.1	7.8 +/- 1.4	13.9 +/- 1.9
Onset of Tourniquet Pain (Minutes)	11.3 +/- 3.5	13.2 +/- 2.1	16.9 +/- 2.8
Duration of Surgery (Minutes)	49 +/- 19.5	45 +/- 11.6	48 +/- 16.8

p value < 0.05

Discussion

Intravenous regional anesthesia is a simple, cost-effective and safe procedure for surgery. It is a proven, time tested technique for surgeries of upper and lower extremity. It provides rapid onset of analgesia in 5–10 minutes with good muscle relaxation. Biers block is principally appropriate for out patient surgeries, as it requires very lessl preparation and premedication.[1]

Drawback of biers block is pain due to tourniquet , as tourniquet has to be kept inflated constantly throughout procedure and limited duration of the surgery can be allowed.

In view to enhance quality of block, duration of analgesia and sedation, several trials have been done with dexmedetomidine and fentanyl.

Memis et al[4] in 2004 performed Biers block using 0.5% lignocaine 3 mg/kg with saline in control group and 0.5% lignocaine 3 mg/kg with 0.5 mcg/ kg dexmedetomidine in study group.

Grounded on this study, we used 0.5 mcg/kg dexmedetomidine with lignocaine in the present study.

The current study was performed on 90 patients undergoing various upper extremity procedures. The patients were randomly chosen to three groups:- Group (A) Group (B) and Group (C). Group A patients underwent biers block with 0.5% lignocaine alone. Group B patients underwent Biers block with combination of dexmedetomidine 0.5 mcg/kg and 0.5% lignocaine. Group C patients underwent Biers block with 1 mcg/kg Fentanyl and 0.5% lignocaine.

Ninety patients were randomly assigned for upper extremity surgeries for short procedures after adequate nil by mouth, physical status and basic investigations.

The present study demonstrated that patients were between the 18-60 years of age with mean age of 38.6 in Group A, 40.3 in Group B and 33.2 in Group C.

In our study there were seventeen male patients and thirteen female patients in Group A, thirteen male patients and seventeen female patients in Group B and sixteen male patients and fourteen female patients in Group C.

Exsanguination

John Mabeeet al[2] studied that while Esmarch was the most active exsanguination method, arm elevation or arterial compression also were effective.

Hence, in this study first gravitational drainage was done followed by Esmarch bandage application.

Dose Selection

In this study Group A received 0.5% of lignocaine 3 mg/kg, Group B received 0.5% of lignocaine 3 mg/kg with dexmedetomidine 0.5 mcg/kg and Group C received 0.5%of lignocaine 3 mg/kg with fentanyl 1 mcg/kg.

Also, Dilek Memis et al[4] used 0.5% of lignocaine 3mg/kg diluted to 40 mL in lignocaine group and 0.5% of lignocaine 3 mg/kg with dexmedetomidine 0.5 mcg/kg diluted to 40 mL in dexmedetomidine group.

Abhishek Gupta et al[3] performed 40 mL 0.5% of lignocaine and either dexmedetomidine 0.5 mcg/ kg in Group A or dexmedetomidine 1 mcg/kg in Group B.

Esmaoglu et al[9] used 3 mg/kg lignocaine diluted with saline in control group and 1 mcg/ kg of dexmedetomidine +3 mg/kg lignocaine in dexmedetomidine group.

Gobeaux et al.[10] added 100 µg of fentanyl to adrenalized lignocaine for brachial plexus block and reported increasing levels of sensory and motor blockade.

The present study showed significant reduction of onset of sensory and motor block in Group B and Group C. Sensory and motor block recovery times were also statistically prolonged in these groups (p <0.001).

In a study conducted by Dilek Memis et al[4] also found substantial reduction in onset times of sensory and motor block in Group LD as related to Group L. Sensory and motor block recovery times were also statistically extended in this group.

Toxicity Reaction

The problems of Biers block usually are caused by the systemic toxicity of the adjuvents used.

Brown and colleagues in their twenty years' experience explained Biers block without mortality and morbidity. In one series of 1400 patients, only 8 patients had CNS stimulation and only three had frank convulsions.[12]

Dunbar and Mazze found zero arrhythmias and small drop in blood pressure or bradycardia on release of the tourniquet.[13]

Kennedy and co-workers noticed a 15% incidence of ECG changes and documented one cardiac arrest that was preceded by bradycardia.[14]

They explained that lower the dose and higher the injection release interval, the probability of toxic reactions were rare. In this study, there were no significant changes in heart rate or ECG.

Blood Levels

Mazze and colleagues reported a blood level of 1.5 mcg/mL following 3 mg/kg of 0.5% lignocaine.[15]

Hargrove and colleagues found that maximum level of local anaesthetic in venous blood from other arm did not exceed 2 mcg/mL.[16]

In our study, we could not calculate blood levels due to lack of facilities.

Complications Related to the use of Tourniquet

One study reviewed an predictable 6,30,000 tourniquet applications found an incidence of peripheral nerve damage of 1 in 80,000. The incidence was high in procedures involving the upper extremity than in those involving lower extremity. The tourniquet time was in range 20 minutes to 2-½ hours.[17]

DilekMemis et a[l4] found that addition of dexmedetomidine found significant decrease in tourniquet and post-operative pain during Biers block.

In this study there were no complications related to the application of tourniquet and also it was found that adding up of dexmedetomidine and fentanyl reduce tourniquet pain during Biers block.

In recent years, alpha-2 adrenergic receptor agonists4have been the focus of interest for their beneficiary effects such as sedation, anxiolysis analgesia and perioperative sympatholytic and cardiovascular stabilizing effects with reduced anaesthetic requirements. Dexmedetomidine, centrally acting α2- adrenergic agonist exerts strong analgesic action. It increases the local anaesthetic action of lignocaine via α 2A adrenoceptor. Dexmedetomidine[4], a stereoisomer of medetomidine is a extremely selective alpha 2 adrenergic agonist and has been shown to decrease anaesthetic requirements by upto 90% and to induce analgesia in rats, volunteers and patients. It has been used successfully in combination with local anaesthetics for procedures like spinal[5], epidural[6] and brachial blocks[7], where it has been found to enhance/potentiate the action of local anaesthetics.

Perioperative dexmedetomidine usage decreases the necessities for opioid or non-opioid analgesics, both intra and post-operatively.[19] Intravenousdexmedetomidine can be used as a premedication as it decreases patient's anxiety, sympatho-adrenal responses and opioid analgesic requirements, but it did not reduce tourniquet pain.[20,21] Dexmedetomidine causes hypertension and bradycardia until the central sympatholytic effect dominates, resulting in moderate decrease in both mean arterial pressure and heart rate from baseline.[22]

In this study, dexmedetomidine produced early onset of block, whereas fentanyl when added in Biers block provided delayed onset of tourniquet pain and better postoperative analgesia.

Conclusion

Present study suggested that dexmedetomidine and fentanyl will enhance the quality of anaesthesia, providing a shorter onset time of sensory and motor block, delayed first analgesia requirement.

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