Original Research Article

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A Comparative Study between Dexmedetomidine 1 µg/kg and and 25mg/kg of 50% Magnesium Sulphate as Adjuvants with 0.5% Lidocaine for Intravenous Regional Anaesthesia

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Abstract

Introduction: Intravenous regional anaesthesia (IVRA) also called as Bier's block is a commonly used anaesthetic technique for surgical procedures on the upper extremities. Many adjuvants have been used to improve the quality of intravenous regional anaesthesia (IVRA). *Aims and objectives*: The aim of this study was to compare the use of dexmedetomidine and magnesium sulphate as adjuvants lidocaine for IVRA as regards to onset and duration of sensory and motor blocks, hemodynamic variables. *Materials and Methods:* This prospective, randomized, double-blinded trial was conducted in 60 ASA I and II patients scheduled for upper hand and forearm surgeries who were randomly divided into two groups, comprising 30 patients each. Group D received dexmedetomidine 1mic/kg and 0.5% lidocaine to a total volume of 40 ml, whereas group M received 25mg/kg of 50% magnesium sulphate and 0.5% lidocaine to a total volume of 40 ml. Onset and duration of sensory and motor block, hemodynamic variables were recorded and compared between the two groups. *Results:* There was statistically significant difference between both the groups as group D achieved rapid onset and prolonged duration of sensory and motor block compared to group M ($p<0.0001$). Group D showed significant difference in heart rate and mean arterial pressure compared to group M after the tourniquet deflation. ($p<0.0001$). *Conclusion:* Our study shows that Dexmedetomidine provides rapid onset and prolonged duration of sensory and motor block in Intravenous regional anaesthesia compared to magnesium sulphate.

Keywords: Intravenous Regional Anaesthesia**;** Dexmedetomidine; Lidocaine; Magnesium Sulphate.

Introduction

Augustus Bier first described Intravenous regional anaesthesia (IRVA) [1] in1908 which was re-popularised by Holmes in 1963 [2]. The administration of intravenous local anaesthetic in an isolated limb by applying a tourniquet to the limb is a simple and effective technique, with a low incidence of failure and high degree of safety. IVRA or Bier's block is an ideal choice for short surgical procedures on extremities, performed on day care basis. The advantages of IVRA are rapid onset of analgesia and good muscular relaxation. The disadvantages are application of a pneumatic tourniquet throughout the procedure which may produce pain, limited duration of action. Over the years numerous adjuvants have been tried in an effort to overcome these problems, like opioids, ketamine, nonsteroidal anti-inflammatory drugs, alpha2 agonist, magnesium sulphate etc [3,4,5]. In our study we compared Dexmedetomidine and Magnesium sulphate as adjuvants to 0.5% lidocaine for IVRA.

Materials and Methods

This prospective, randomized, double-blinded study was conducted in Narayana Medical College, Nellore from April 2016 to January 2017 with

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institutional ethical committee approval. After obtaining written informed consent, 60 patients aged 20–60 years with American Society of Anesthesiologists (ASA) Physical Status class I–II who were scheduled for hand and forearm surgeries of duration less than 90 mins (i.e. facture both bones forearm, carpal tunnel release and tendon release) were divided into two groups Group D and Group M of 30 each. Exclusion criteria were history of allergy to study drugs, sickle cell anemia, Reynaud's disease, scleroderma, myasthenia gravis, cardiac disease, liver or renal insufficiency and history of convulsions were excluded from the study.

All patients were kept fasting for 6 hours before surgery. Lidocaine intradermal sensitivity testing was done for all patients. All patents were pre medicated with 1mg midazolam. In the Operation theatre, all the patients were monitored for non-invasive arterial blood pressure, electrocardiogram and oxygen saturation. A 22g i.v cannula was placed in a distal vein on the dorsum of the hand to be operated and a wide bore cannula in the opposite hand. A pneumatic double tourniquet was applied on the upper arm of the hand to be operated. Arm was exsanguinated for 2 mins with esmarch bandage. The esmarch bandage was removed after the proximal tourniquet was inflated to a pressure of 100 mmHg above the systolic blood pressure of the patient The anaesthetic solution was prepared by an observer unaware of the study and was given over a period of 90 seconds.

- Group D received 1mic/kg of Dexmedetomidine and 0.5% Lidocaine to a total volume of 40 ml.
- Group M received 25mg/kg of 50% Magnesium sulphate and 0.5% Lidocaine to a total volume of 40 ml.

When patient complains of discomfort at the proximal tourniquet site, the distal tourniquet was inflated to the same pressure and proximal one was deflated. Sensory block onset time was noted as time elapsed from injection of drug to sensory block achieved in all dermatomes. Onset of motor block was assessed by asking the patient to flex and extend his/her wrist and fingers. Complete motor block was noted when no voluntary movement was possible. Sensory block duration was noted as the time elapsed from release of tourniquet to sensory block recovery in all dermatomes. Motor block duration was noted as the time elapsed from release of tourniquet to complete motor block recovery. The tourniquet was not deflated before 30 min and was not kept inflated for more than 90 mins. The tourniquet was deflated by a cyclic deflation technique at the end of surgery. Heart rate, mean arterial pressure were recorded during the procedure.

Statistical Analysis

All recorded data were entered using MS Excel software and analysed using SPSS 20 version software for determining the statistical significance. Results were presented as mean+standard deviation. Proportions were compared using Chi-square test. Statistical difference between both the study groups was determined by student 't' test. $p < 0.005$ was taken as statistically significant, p value of <0.001 has high statistical significance and p value of <0.0001 was considered as extremely statistically significant.

Results

Sixty patients scheduled for elective hand and forearm surgeries expected to last for no more than 90 min participated in this study. Age, sex, height & weight were similar in both the groups. The difference was not statistically significant ($p > 0.05$). (Table 1). There was no statistically significant difference in Tourniquet time and duration of surgery. Onset of sensory block was achieved earliest in group D (mean of 2.49 min) compared to Group M (mean of 3.22mins) which was statistically highly significant ($p < 0.0001$). Onset of motor block in group D (5.5mins) was also achieved earlier than in Group M (7.89) ($p<0.0001$). Duration of sensory block was also achieved earlier in Group D (7.37hrs) compared to group M (5.868hrs) ($p<0.0001$). Duration of Motor block was also significantly prolonged in Group D (3.47) compared to Group M (2.84) ($p<0.0001$) (Table 2 and Figure 1).

Table 1: Demographic data

Demographic Variables among the groups	Group D	Group M	P Value
Age in years (mean ± SD)	34.1812.13	34.87±10.12	0.964
Height in CMS (mean ± SD)	168.88±66	164.32±2.10	0.53
Weight in KGS (mean ± SD)	60.45±3.26	63.32±7.22	0.43
Gender (M/F)	16/14	17/13	0.34

Table 2: Average differences in Tourniquet time, sensory and motor block onset, Sensory and motor block Duration

S. No	Variables	Group D		Group M		T value	P value
		Mean	SD	Mean	SD		
1.	Tourniquet time	63	15.36	60.2	12.61	0.5457	0.58
2.	Sensory block onset (mins)	2.49	0.33	3.22	0.15	7.799	0.0001**
3.	Motor block onset(mins)	5.5	0.61	7.89	0.89	8.578	0.0001**
4.	Sensory block Duration(hrs)	7.37	0.49	5.868	0.354	9.623	0.0001**
5.	Motor block Duration(hrs)	3.47	0.32	2.84	0.41	4.6914	0.0001**

Table 3: Average differences in Heart rate after tourniquet release

S. No	Time	Group D		Group M		T value	P value	S/NS
		Mean	SD	Mean	SD			
1.	0 mins	72.3	9.16	86.8	7.7	4.69	0.0001**	Highly significant
2.	30 mins	73.9	7.7	90.2	7.7	5.79	0.001**	Highly significant
3.	60 mins	75.7	7.3	91.8	8.13	5.706	0.001**	Highly significant
4.	90 mins	77.8	6.78	93	7.5	5.827	0.001**	Highly significant

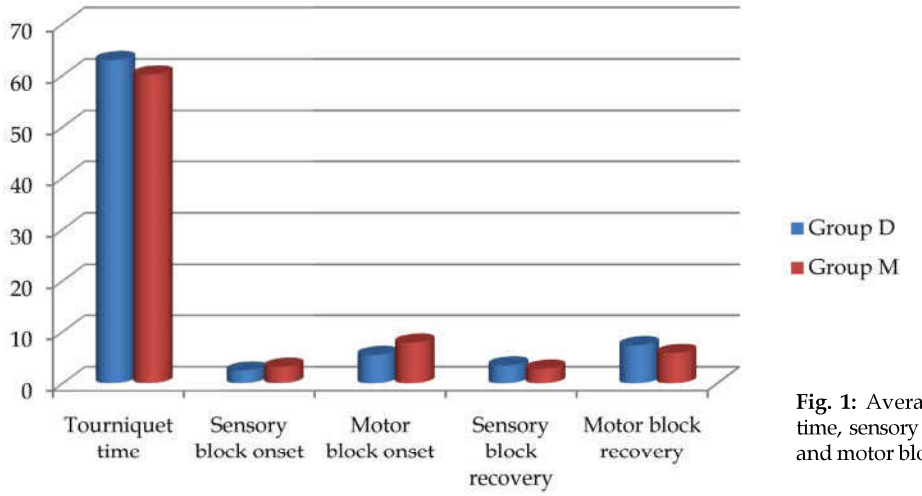

Fig. 1: Average differences in Tourniquet time, sensory and motor block onset, Sensory and motor block recovery

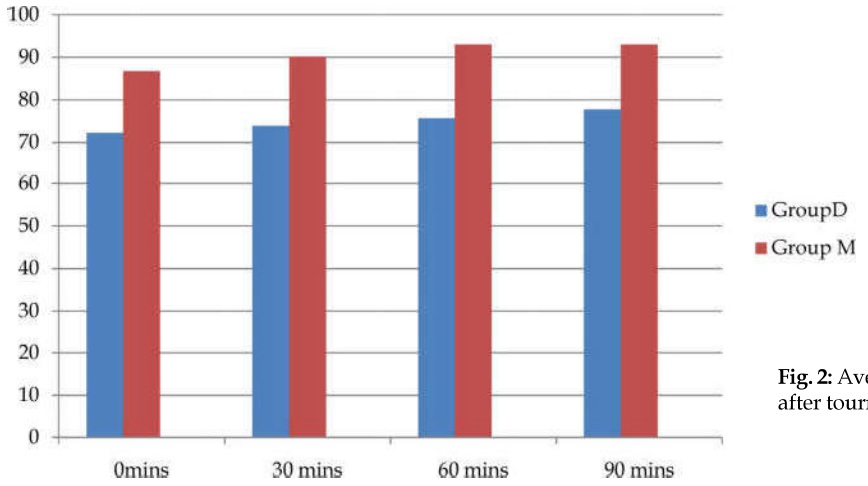

Fig. 2: Average differences in Heart rate after tourniquet release

Table 4: Average differences in MAP after tourniquet release

S. No	Time	Group D		Group M		t value	p value	S/NS
		Mean	SD	Mean	SD			
1.	0 mins	78.06	5.9	85.6	9.17	2.67	0.01**	Highly significant
2.	30 mins	75.2	6.3	86.06	8.55	3.96	0.0005**	Highly significant
3.	60 mins	74.3	5.5	90.4	9.03	5.897	0.0001**	Highly significant
4.	90 mins	74.4	5.74	93.4	8.166	7.371	0.0001**	Highly significant

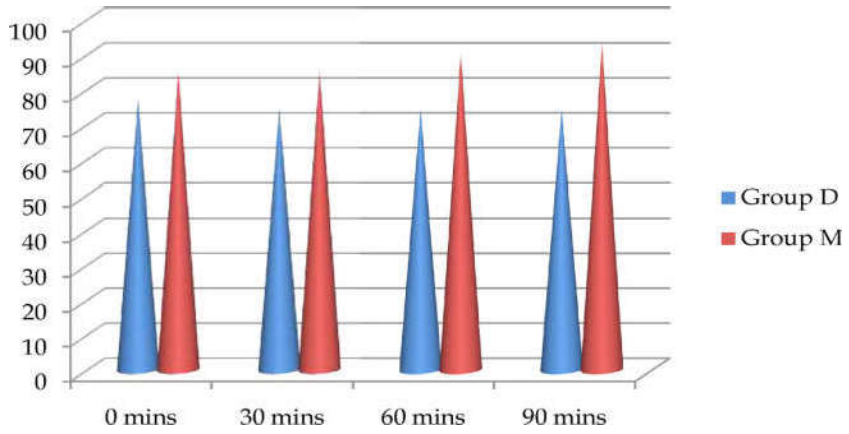

Fig. 3: Average differences in MAP after tourniquet release

Heart rate and Mean arterial pressure were comparable in both the groups after the tourniquet is inflated. The mean differences in heart rate and mean arterial blood pressure were found to be statistically highly significant after deflation of tourniquet which were measured up to 90mins (Table 3,4 and Figure 2,3). None of the patients had significant side effects such as Bradycardia, hypotension, intraoperative bleeding, nausea, or vomiting.

Discussion

Intravenous regional anaesthesia involves the intravenous administration of a local anaesthetic into the limb occluded by a tourniquet (i.e., Bier block) [6].

The local anaesthetic diffuses from the peripheral vascular bed to nonvascular tissue such as axons and nerve endings. Both the safety and the efficacy of this regional anaesthetic procedure depend on interruption of blood flow to the involved limb and gradual release of the tourniquet to prevent the sudden release of local anaesthetic into the circulation which may cause complications. Intravenous regional anaesthesia has been used primarily for surgical procedures on the upper limbs. Shorter procedures on the foot can also be successfully performed under intravenous regional anaesthesia [7].

Though various local anaesthetics have been used, Lidocaine has remained the main stay for intravenous regional anaesthesia in view of its short duration of action and less cardiovascular effects. Use of Bupivacaine has been discouraged due to sudden cardiovascular collapse which may occur after the release of tourniquet [8]. Preservative –free Lidocaine can be used up to a dose of 3 mg/kg diluted to 0.5% solution to a volume of 40ml for upper extremity procedures. For surgical procedures on the lower limbs, 50 to 100 mL of a 0.5% lidocaine solution has been used.

Over the years various adjuvants were used as additives to lidocaine for IVRA, including ketamine, diclofenac, opioids, neostigmine, alpha2 agonists and magnesium sulphate [9,10].

In our study, we compared the efficacy of two adjuvants to lidocaine in IVRA, dexmedetomidine and magnesium sulphate. alpha2 agonists provide sedation, analgesia, anxiolysis, sympatholysis, cardiovascular stabilising effects, reduced anaesthetic requirements and preservation of respiratory function.

These properties have been extensively studied and clinically employed in regional anaesthesia [11,12]. Dexmedetomidine has side effects such as Bradycardia, hypotension, and sedation. Dexmedetomidine is 8–10 times more selective toward alpha2 adrenergic receptors and is 3.5 times more lipophilic than clonidine. It thus prolongs the duration of both sensory and motor blockade induced by local anaesthetics, irrespective of the route of administration [13-15].

Very few authors have studied the role of Magnesium sulphate as an adjuvant for IVRA who showed it as a suitable adjuvant to lidocaine for IVRA. This could be attributed to the antagonistic properties of magnesium on the NMDA receptor and its inhibitory properties for calcium channels. NMDA receptor antagonists can inhibit the induction of central sensitization owing to peripheral nociceptive stimulation and can eliminate hypersensitivity [16].

Kol et al [17] conducted a prospective, randomized, double-blinded study on 75 patients scheduled for hand and forearm surgery found that addition of dexmedetomidine (0.5 μg/kg) to prilocaine improved the quality of anesthesia, decreased tourniquet pain, and decreased analgesic requirements as determined by hemodynamic variables and pain scores. Tramer and Glynn [14] used magnesium for the treatment of chronic limb pain in IVRA and showed that the addition of magnesium to lidocaine increases the quality of the block and decreases overall failure rate.

Our study showed that Dexmedetomidine provides rapid onset of sensory and motor block and also prolonged duration of sensory and motor block. Tourniquet pain was not experienced in both the groups. Hemodynamic changes were significant in Dexmedetomidine group after deflation of tourniquet which did not require any intervention.

Conclusion

We conclude that Dexmedetomidine is superior to Magnesium sulphate in providing rapid onset and prolonged duration of sensory and motor block.

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