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A Study of Effectiveness of Dexmedetomidine in Intravenous Regional Anesthesia as an Adjuvant to Lignocaine

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Abstract

Context: Dexmedetomidine has been a prime matter of subject studies in research over it with its comparison with various other agents as it possesses properties like sedation and analgesia. *Aims:* To study the effectiveness of dexmedetomidine in intravenous regional anesthesia. *Settings and Design:* This is a prospective, randomized, double blind control study conducted at SVS Hospital and Medical College, Mahabubnagar. *Methods and Material:* In this study totally 60 patients were divided into two groups. We gave 40 ml of Lignocaine with 0.5 microgram/kg Dexmedetomidine in Group LD patients. 40 ml of 0.5% Lignocaine was given for Group L patients. *Statistical Analysis:* Mean and standard deviation were calculated. Student's t test was used for statistical analysis. P value of less than 0.05 was taken as statistically significant. *Results:* Both the groups were comparable in terms of pulse rate, age, duration of surgery, weight, and mean arterial blood pressure. Sensory onset time, motor onset time was significantly lesser in LD group compared to L group. At the same time, motor recovery time and sensory recovery time were significantly more in LD group compared to L group ($p<0.05$). Duration of post operative analgesia when VAS was more than 3 was significantly more in LD group compared to L group ($p<0.05$). *Conclusion:* Dexmedetomidine was found to be very effective in terms of less occurrence of pain of tourniquet, quick onset of motor and sensory blockade, hemodynamic stability, persistence of analgesia post operatively.

Keywords: Dexmedetomidine; Lignocaine; Benefits; Anesthesia; Analgesia; Intravenous.

Introduction

In 1902, August Bier was the first one who described the intravenous regional anesthesia (IVRA). It is the reliable technique and at the same time very simple. By this method, we can produce analgesia in the distal part of the leg or hand. This can be achieved by giving local anesthetic agent locally. This is given in the vein of the same limb. Tourniquet is applied simultaneously to occlude the circulation. Various agents like opioids, non steroidal anti inflammatory agents, muscle relaxants and phencyclidines can be used for intravenous injection. Ketamine has been found as an effective agent. Similarly dexmedetomidine decreases the requirement of an anesthetic agent by 90%. When dexmedetomidine is added to lignocaine in this method, it leads to increased effectiveness of anesthesia without any side effects [1].

IVRA has many advantages like it can be performed on day care basis. It is suitable for operations which are of short duration and specifically performed over limbs. The procedure is highly reliable, there is very good relaxation of muscles and onset of analgesia is very rapid. But it also carries some disadvantages like application of tourniquet which leads to occurrence of pain. The surgery must be finished before the tourniquet is deflated. IVRA method does not have residual analgesia and anesthesia. Means

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there is no analgesia after surgery. Ongoing research in this direction is concentrated towards improvement in tourniquet techniques, to enhance the overall effectiveness of the analgesia intra operatively as well as post operatively. It also aims at reduction in the occurrence of the side effects of the drugs. The attempts in these direction include use of agents like narcotics etc. but they were not found to be very effective. Hence there is a trend in the use of dexmedetomidine which is being increasingly reported as highly effective, safe agent [2].

Dexmedetomidine has been a prime matter of subject studies in research over it with its comparison with various other agents as it possesses properties like sedation and analgesia. It is α2-adrenoreceptor agonist. It is better than clonidine as it is eight times more selective toward the α2-AR. It decreases anesthetic requirements by up to 90% and induces analgesia in patients. Therefore, it is considered as a full agonist of the receptor (with more potent neurological and less cardiovascular effects). Its highly lipophilic nature allows rapid absorption into cerebrospinal fluid and binding to α2-AR of the spinal cord and α2A-AR of peripheral nerves. Dexmedetomidine has been successfully used in IVRA. Ketorolac is the only NSAID that is approved for intravenous use and it acts by interference with the synthesis of inflammatory mediators [3].

Hence present study has been carried out to study the effectiveness of dexmedetomidine as an adjuvant to lignocaine in intravenous regional anesthesia.

Material and Methods

This is a prospective, randomized, double blind control study conducted at SVS Hospital and Medical College, Mahabubnagar. Institutional Ethics Committee of SVS Medical College permission was taken before the start of the study. A total of 60 patients were studied.

Inclusion Criteria

1. Patients willing to participate in the study and giving informed consent.
2. Aged 20-60 years
3. ASA grade I & II
4. Upper limb surgeries of < 90 minute duration

Exclusion Criteria

Patients having history of

1. Allergy to Local Anesthetics
2. Sickle Cell Disease,
3. Reynaud's Disease
4. Scleroderma
5. Local Infection
6. Paget's disease
7. Patients who had contraindication to Dexmedetomidine

Pre-anesthetic evaluation was done and informed, written consent was obtained.

All patients were pre-medicated with Inj. Midazolam 0.15 mg/kg intramuscularly 45 minutes before surgery. Sedation of the patients was assessed by using Ramsay Sedation Scale.

Drugs and equipments required for resuscitation were ready. The baseline parameters like blood pressure, pulse rate and oxygen saturation was recorded and noted. The patients were continuously kept under monitor during the procedure.

Two groups of patients were created who were similar in baseline parameters. LD group of patients were those who were given 0.5% lignocaine (40 ml) with addition of 0.5 mcg/kg of dexmedetomidine. The patients who received only lignocaine in the same doses were labeled as group L.

Once the required anesthesia was reached for patient, the tourniquet was inflated which was present on the distal part of the limb and at the same the tourniquet which was there on the proximal part was deflated.

During the surgery, in the beginning at 1 minute and then every 5 minutes till 30 minutes the patient was monitored in terms of his blood pressure, pulse rate, SpO_2 concentration, respiratory rate and any signs of toxicity of the drug. In case the patient complained of any pain due to tourniquet, then that patient was given fentanyl in the dose of 1 mcg/kg intravenously. Also inter-costo-brachial nerve block was carried out for that patient by infiltrating locally nearby the cuff. Since the time local anesthetic injection was given, the cuff was not allowed to deflate for 30 more minutes. This was followed for all cases even when the operative procedure was over within 30 minutes. The care was taken not to keep the cuff inflated for more than 60 minutes.

Cuff was deflated as per the standard operative guidelines. Each patient was kept under special observation for half an hour after the operative procedure was completed.

During the surgery, the parameters like time of onset of action with motor and sensory and motor block, total time taken for surgery, score of sedation, requirement of the rescue analgesia, any occurrence of side effects, were noted. After the surgery was over, the time required for giving the first dose of analgesic drug was recorded.

Data Analysis

Mean, standard deviation was calculated and t test was used to study the statistical difference between the parameters of the two groups. In case of proportions, chi square test was calculated. P value of less than 0.05 was taken as significant difference between the two groups.

Results

Table 1 shows distribution of study subjects as per their age. The representation in both the groups was almost similar, making them comparable to each other. Mean age of group LD was 37.8 years and that of group L was 36.8 years. There was no significant difference ($p = 0.6148$).

Table 2 shows the sex wise distribution of the study subjects. 56.7 % of Group LD and 63.3% of Group L were males. The sex distribution did not have any statistically significant difference ($p > 0.05$). Thus both the groups were comparable to each other.

Table 3 shows the distribution of study subjects as per the type of surgery done. Ganglion excision and k wire fixation for fracture of phalanx were the most common surgeries performed in both the groups.

Table 4 shows the distribution of the study subjects as per the rescue analgesia required. 21 cases in Group L required rescue analgesia whereas not even a single patient in Group LD required it. This was statistically significant ($p = 0.0001$).

Table 5 shows the comparison of parameters in both the groups. The parameters like age, weight of the patients, average duration of the surgery, mean arterial blood pressure at 1 and 5 minutes, pulse rate at 1 and 5 minutes were comparable among both the groups. The difference in the values of the above parameters was statistically not significant ($p > 0.05$).

Table 6 shows the comparison of parameters in both the groups. Sensory onset time, motor onset time were significantly lesser in LD group compared to L groups and this difference was found to be statistically significant ($p < 0.05$). At the same time, the motor recovery time and the sensory recovery time were significantly more in LD group compared to L group and this difference was statistically significant ($p < 0.05$). Time required for giving first analgesic drug was significantly more in LD group compared to L group ($p < 0.05$).

Table 1: Distribution of study subjects as per their age

Age groups (years)	Group LD		Group L	
	Number	Percentage	Number	Percentage
20-29	07	23.3	09	30
30-39	09	30	09	30
40-49	10	33.3	07	23.3
50 and above	04	13.3	05	16.7

Table 2: Sex wise distribution of study subjects

Sex	Group LD		Group L	
	Number	Percentage	Number	Percentage
Male	17	56.7	19	63.3
Female	13	43.3	11	36.7
Total	30	100	30	100

Table 3: Distribution of study subjects as per the type of surgery done

Type of Surgery	Group LD		Group L	
	Number	Percentage	Number	Percentage
Ganglion excision	12	40	10	33.3
K Fix for fracture of phalanx	11	36.7	09	30
Tendon repair	03	10	04	13.3
Total	30	100	30	100

Table 4: Distribution of the study subjects as per the rescue analgesia required

Rescue Analgesia Required	Group LD		Group L	
	Number	Percentage	Number	Percentage
Yes	00	00	21	70
No	30	100	09	30
Total	30	100	30	100

Table 5: Comparison of parameters in both the groups (values are mean±SD)

Parameter	Group LD	Group L	P value	Interpretation
Age (years)	37.8±8.4	36.8±10.8	0.6148	Not significant
Weight (kg)	52.5±5	52.9±5.5	0.8471	Not significant
Duration of surgery (min)	46.83±5.07	47.43±4.79	0.6354	Not significant
Mean arterial blood pressure at 1 min	94.9±4.9	95±5.7	0.8581	Not significant
Mean arterial blood pressure at 5 min	95.5±3.3	94.8±3.6	0.623	Not significant
Pulse rate at 1 min	82.7±5.8	81.6±6	0.3926	Not significant
Pulse rate at 5 min	82±4.7	82.1±4.9	0.9465	Not significant

Table 6: Comparison of parameters in both the groups (values are mean±SD)

Parameter	Group LD	Group L	P value	Interpretation
Sensory onset time (min)	1.8±0.76	5.27±0.58	0.0001	Significant
Motor onset time (min)	13.63±1.54	18.07±1.26	0.0001	Significant
Sensory recovery time (min)	18.87±3.27	4.8±0.71	0.0001	Significant
Motor recovery time (min)	25.6±3.83	2.53±0.51	0.0001	Significant
Duration of post operative analgesia in minutes (VAS > 3)	416.2±45.73	11.33±0.96	0.0001	Significant

Discussion

Intravenous regional anesthesia is a method to give conduction block. A local anesthetic agent is used for this. This is usually done for one of the limbs. This is achieved by proximally occluding the limb. IVRA should be safe for the patients at the same time it should not be unpleasant and the surgeon should also be comfortable with it. It should not be harmful to internal homeostatic mechanisms [1].

Nowadays IVRA is commonly used technique especially for upper limbs. Studies have shown that it is safe with minimum problems. It is highly reliable. It gives quick onset of analgesia taking a maximum of 5-10 minutes. It provides good relaxation of smooth muscles. But it also carried certain drawbacks like a tourniquet must be applied which can lead to certain degree of pain or discomfort for the patient. Till the surgery is over, the cuff must be properly kept inflated. Hence it is not useful for long time taking surgeries but useful in short duration operative procedures [2].

Tourniquet application causes a dull and aching pain. This is due to compression of the skin, the pressure of the inflation and the size of the tourniquet [3].

The very important disadvantage of IVRA is the lack of analgesia after the surgery is over. Many authors tried to use several agents like muscle relaxants, NSAIDs etc but could not get satisfactory results [4].

Dexmedetomidine was found to be effective as after administration of dexmedetomidine, there is no need of opioid drugs even during or after surgery. It is also useful in reducing the anxiety of the patient. But some studies indicate that it is less likely to reduce the pain [5].

There are several advantages when dexmedetomidine was added to lignocaine in the IVRA procedure. It leads to decreased pain, increased quality of anesthesia, reduced requirement for the analgesics, reduces the onset time for sensory block and also prolongs the recovery time of sensory block. Quality of anesthesia is also improved a lot [5].

In this study, an attempt was made to assess the effect of adding Dexmedetomidine to Lignocaine for IVRA and comparing its efficacy to plain Lignocaine in IVRA.

The parameters like age, weight of the patients, average duration of the surgery, mean arterial blood pressure at 1 and 5 minutes, pulse rate at 1 and 5 minutes were comparable among both the groups. The difference in the values of the above parameters was statistically not significant.

We found that group LD patients in comparison to group L patients had rapid onset of sensory and motor blockade. These results are similar to the findings of Memis et al [4], Alok Kumar et al [1], Sardesai et al [2] and Kavlas et al [5].

In group LD, the duration of blockade after cuff deflation, both sensory and motor has similar recovery profile. Esmaoglu A et al [6] reported similar findings in their study.

No patient in group LD complained of having tourniquet pain whereas 70% of patients in group L complained of having tourniquet pain. This difference was found to be statistically significant. Similar findings were reported by Memis et al [4], Esmaoglu et al [6], Alok Kumar et al [1], Sardesai et al [2], and Kavlas et al [5].

Group LD patients took 416±45.73 minutes on an average for requirement of first analgesic drug in comparison to 19.4±11 minutes for patients in group L. This difference was found to be statistically significant. The p value is 0.0001, which is highly significant. This result was similar to the findings of Memis et al [4], Esmaoglu et al [6], Mizrak et al [7], Kavlas et al [5] and Gupta et al [8].

Abosedira MA [9] in his study found that Dexmedetomidine caused sudden increase in blood pressure and reduced heart rate. This was present till the domination of central sympatholytic effect. This led to some degree of decrease in heart rate and mean arterial blood pressure. But we did not observe such hemodynamic changes with the use of Dexmedetomidine in IVRA. This is because we did regular cyclical deflation of the tourniquet in the present study. This led to slow release of drug into the systemic circulation and made the patient stable.

The sedation score in Group LD was 1.77±0.43 and in Group L was 1.00. The p value is 0.0001 which is statistically significant. This finding is similar to that of Memis et al [4], Esmaoglu et al [6], Alok Kumar et al [1], Sardesai et al [2], and Kavlas et al [5].

How the tourniquet causes the pain is not clear. Though we know that unmyelinated C fibres and A fibres play a role in it. Nerve action potential is depressed by dexmedetomidine specifically in C fibres. This mechanism is independent of α-2-adrenergic receptor stimulation. This leads to strong anesthetic block. This effect was observed in the present study.

Conclusion

Using Dexmedetomidine for intravenous regional anesthesia has significant benefits when compared to using plain Lignocaine alone as not even a single patient in Group LD required rescue analgesia, sensory onset time, motor onset time were significantly lesser in LD group the motor recovery time and the sensory recovery time were significantly more in LD group. Time required for giving first analgesic drug was significantly more in LD group.

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