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Comparative study of nitroglycerine and dexamethasone as adjuncts to lignocaine in intravenous regional anaesthesia

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Abstract
The study evaluated 120 adult patients of either sex belonging to ASA grade 1 and 2, aged 20 to 60 years were randomly allocated into 3 groups of 40 each. Group 1 – lignocaine (L), Group 2 – lignocaine and nitoglycerine (LN), Group 3 – lignocaine and dexamethasone (LD). Patients were premedicated with 0.07 mg/kg midazolam and 0.01 mg/kg atropine which were administered intramuscularly 45 min prior to surgical procedure. They were monitored for mean arterial blood pressure (MAP), oxygen saturation (SPO2) and heart rate (HR) in the operating room. Two venous cannulae were placed, one in dorsum of the operative hand and the other in the opposite hand for crystalloid infusion. Operative hand was exsanguinated with an esmarch bandage, a double cuffed pneumatic tourniquet was placed around the upper arm and proximal cuff was inflated to 250 mm Hg. Regional anaesthesia was in group 1 (LN) 200 microgram nitroglycerine plus 3mg/kg lignocaine 2% diluted with saline to a total of 40 ml and in group 2 (LD) 8mg of dexamethasone plus 3mg/kg lignocaine 2% in 40 ml volume of normal saline and in group 3 (L) 3 mg/kg lignocaine 2% diluted in normal saline to a total of 40ml. The solution was injected over 90 seconds. Sensory block was assessed by pin prick every 30 seconds. Motor function was assessed by asking the subject to flex and extend his/her wrist and fingers. After sensory and motor block onset, the operative tourniquet (distal cuff) was inflated to 250 mmHg and the proximal tourinquet was released and surgery was started. MAP, HR and SPO2 were monitored before and after tourniquet application and in every 5 minute interval intra-operatively and after tourniquet. Assessment of tourniquet pain scores was made on the basis of the Visual Analogue Scale (VAS) {0= no pain and 10= worst pain imaginable} measured before and after tourniquet application. The demographic data of all the groups was comparable. The percentage of males and females patients was in group 1, 80% and 20% in group 2 and 77% and 23% in group 3. The mean duration of surgery in group 1 was 44.0± 10.5 minutes, in group 2 was 41.2± 9.7 minutes and group 3 was 43.3± 9 minutes. The addition of 200microgram nitroglycerine improved the speed of onset, quality of anaesthesia, prolonged the sensory and motor block recovery time, increased the duration of post-operative analgesia. The addition of 8 mg dexamethasone improved the quality of anaesthesia but did not cause significant difference in time to first request. Based on the study, it may be said that the addition of nitroglycerine and dexamethsone to lignocaine in Intra venous regional analgesia definitely improved the quality of anaesthesia.

Keywords: Intra Venous Regional Analgesia, Double Cuff Pneumatic Tourniquet, Esmarch Bandage, Lignocaine, Nitroglycerine, Dexamethasone.

1. Introduction
Anaesthesia is not only limited to general anaesthesia but advances were made in the fields of regional anaesthesia and analgesia also. Harvey Cushing coined the term “Regional Anaesthesia” in 1902. In older days cocaine was the first effective local anaesthetic. Corning (1885) recommended the use of esmarch’s bandage to arrest local circulation prolonging the cocaine induced block and decreasing the uptake of local anaesthetic from the tissues. Intra Venous Regional Anaesthesia (IVRA) was first discovered by August Gustav Bier in 1908 and now this block is popular by his name i.e. Bier block for anaesthesia in hand and forearm. In this method circulation is occluded in a segment of arm with two tourniquets and then injecting a diluted local anaesthetic through an Intra venous canula. This resulted in prompt analgesia between the two tourniquets and slower onset of anaesthesia in distal part of the limb. He quoted “I have therefore used a new avenue, the blood vessel, to get the anaesthetic agent to the end apparatus of the nerves as well to the nerve trunks.”

The technique gained popularity in 1960 when Holmes used Lidocaine in place of Procaine. Lidocaine remains the standard local anaesthetic agent. The principle applied is that of isolating the vascular supply to the distal extremity by proximally placed tourniquet. The limb is first exsanguinated prior to inflating the tourniquet and the isolated vascular segment is injected with a weak local anaesthetic solution that produces rapid onset of analgesia. This technique is limited to procedures lasting less than an hour because of increasing discomfort from the tourniquet. Intra Venous Regional Anaesthesia is easy to administer, reliable and cost effective. It is an effective method of producing anaesthesia for extremity surgery with success rates from 94% - 98%. Normal sensation and motor power returns almost immediately after cuff release. The ideal IVRA solution should have rapid onset, reduced dose of local anaesthetic, reduced tourniquet pain and prolonged post deflation analgesia. At present this is achieved by addition of adjuncts like opioids, NSAIDs, dexmedetomidine, muscle relaxant, potassium and alkalinization with sodium bicarbonate. Drugs selected as adjuncts to local anaesthetic agents potentiate a block by either altering nerve conduction or via peripheral nociceptor binding.

Lidocaine is one of the least toxic local anaesthetics used in IVRA with dose of 3 mg/kg administered as 0.5% solution. The lower concentration (0.5%) acts on the sensory nerve endings and the small nerves whereas the higher concentration (2%) acts on both nerve trunks and the nerve endings.

Nitroglycerine has similar effect like magnesium sulphate when added with lidocaine for IVRA. End products of nitroglycerine produces pain modulation in the central and peripheral nervous system.

Dexamethasone has a potent anti-inflamatory effect. The addition of dexamethasone to lidocaine for IVRA in patients undergoing hand surgery improves post operatives analgesia during the first post-operative day.

There are two theories how IVRA produces block. One is the anaesthetic agent entering the venous system produces block by blocking the peripheral nerves running with the venous structures. Other theory is that local anaesthetic leaves the vein and blocks small distal branches of peripheral nerves.

2. Aims of Study- The present clinical study was undertaken to evaluate the effects of combinations of lignocaine and nitroglycerine and lignocaine and dexamethasone for Intra Venous Regional Anaesthesia to access motor block, sensory block, tourniquet pain and post-operative analgesia and compare results with lignocaine administered alone.

3. Material and Method- A randomized prospective study was done on 120 patients of ASA grade I and II of age 20 – 60 years of either sex posted for hand or forearm surgery likely to get completed within 1 hour at VCSGGMS&RI Srinagar (Garhwal).

4. Exclusion Criteria

- Reynaud's disease
- Sickle cell anaemia
- Peripheral or central neurological diseases
- Cardiac conduction block
- Scleroderma
- Skeletal muscle disorders
- Severe hyptotension
- Paget's disease

5. Group Allocation

The patients were allocated into 4 groups of 30 each

1. Group LN- lignocaine and nitroglycerine
2. Group LD- lignocaine and dexamethasone
3. Group L- lignocaine alone

6. Observations- The present study was conducted on 120 patients of ASA grade I and II of age 20 – 60 years of either sex posted for hand or forearm surgery likely to get completed within 1 hour. These patients were randomly allocated into 3 groups of 40 patients each.

Group LN, Group LD and Group L.

Patients Characterstics

S. NO.	Group LN	Group LD	Group L	P
Age (Years)	43.0±11.0	40.6±12.1	35.4±11.3	0.088
Weight (kgs)	58.5±9.3	60.3±8.5	58. 6±8.1	0.705
Duration of surgery (min)	44.0±10.5	41.2±9.7	43.3±9.0	0.175
Onset of sensory block (min)	3.5±0.8	5.0±1.7	7.0±1.7	0.000
Onset of motor block (min)	4.1±0.5	5.2±2.1	7.5±1.8	0.000
VAS score at 5 min Before tourniquet deflation	1.1±0.8	1.3±0.9	1.6±1.2	0.052
VAS score at 10 min Before tourniquet Deflation	1.6±0.8	1.2±1.1	1.5±1.1	0.106
VAS score at 20 min Before tourniquet Deflation	0.9±1.1	1.5±1.4	2.0±0.9	0.002
VAS score at 40 min Before tourniquet Deflation	1.9±1.1	2.3±1.1	3.0±0.7	0.001
VAS score at 60 min Before tourniquet Deflation	2.2±1.1	1.5±1.3	2.2±0.9	0.000
VAS score at 2 Hrs After tourniquet Deflation	2.5±1.2	2.8±0.9	3.3±0.7	0.0046
VAS score at 4 Hrs After tourniquet Deflation	2.9±1.0	2.9±1.1	3.6±1.6	0.033
VAS score at 6 Hrs After tourniquet Deflation	3.1±1.0	2.6±0.9	3.2±0.8	0.007
VAS score at 12 Hrs After tourniquet Deflation	0.9±0.8	1.0±1.1	1.3±1.2	0.491
VAS score at 24 Hrs After tourniquet Deflation	1.1±0.9	1.0±0.9	1.0±0.8	0.782
Sensory block Recovery time (min)	6.8±1.8	12.2±4.4	3.3±1.1	0.000
Motor block recovery Time (min)	7.6±1.9	13.0±3.8	3.9±1.4	0.000
Time of injection of First dose of analgesic (in min)	195.7±112.9	55.0±36.5	48.2±31.3	0.000
Total no. of doses of Analgesic required	1.3±0.5	1.4±0.6	2.0±0.6	0.000

7. Discussion- Intra Venous Regional Anaesthesia is technically simple and reliable. It is executed by applying pressure to the proximal extremity with the use of a pneumatic tourniquet isolating the limb from systemic circulation and then injecting local anaesthetic solution in the isolated limb. Lidocaine is the local anaesthetic most

commonly chosen for this technique. This technique has been limited by tourniquet pain and the inability to provide post-operative analgesia. One of the problems with IVRA, as compared with peripheral nerve blocks, is that there is no prolonged analgesic effect after tourniquet release. Numerous attempts to reduce the severity of tourniquet discomfort improve the quality of block and prolong post-operative analgesia have been made by adding a wide range of agents to the local anaesthetic for the Bier's block.

According to this study, the sensory and motor block onset times were statistically shorter in nitroglycerine group as compared to control group. The mean time of onset of sensory and motor block in dexamethasone group, results were statistically not significant when compared with control group. While doing the intergroup comparison, we found that although all the results were statistically significant, the mean time of onset of sensory and motor block was earliest in nitroglycerine group.

Tourniquet pain (VAS scores before tourniquet deflation)-

- VAS scores were lower in nitroglycerine and dexamethasone group as compared to control group.

Sensory and Motor Block Recovery Time-

Our finding is comparable with finding of Turan *et al*. (2005) who observed that the mean time of recovery from sensory and motor block is prolonged in nitroglycerine group as compared to control group.

Post-Operative Analgesia (VAS scores after tourniquet deflation)-

After 2, 4 and 6 hours of tourniquet deflation, the difference in VAS was statistically significant but after 12 and 24 hours, the difference in VAS was statistically insignificant in all the 3 groups as compared to the control group.

Time of Injection of First Dose of Analgesic (minutes)-

There was statistically significant difference in time of injection of first dose of analgesic in all the two groups compared to the control group but in intergroup comparison, it was longest in nitroglycerine group and shortest in dexamethasone group. Our results are consistent with the study by Sen *et al.* (2006) [12], the time to first Post-operative analgesic request in nitroglycerine group was statistically significant. In study by Bigat *et al.* (2006) [13], time to first analgesic requirements was shorter in dexamethasone group and statistically significantly different from control group.

Our study demonstrated that the addition of 200microgram nitroglycerine to lignocaine for IVRA improves the speed of onset and the quality of anaesthesia, prolong the sensory and motor block recovery time, increase the duration of post-operative analgesia and do not cause significant side-effects.

In our study, the tourniquet was not deflated before 30 minutes and the tourniquet deflation was performed by the cyclic deflation technique at the end of surgery. These techniques, combined with the short half-life of NTG, may reduce the frequency and severity of unwanted side-effects.

The addition of 8mg dexamethasone to IVRA improves the quality of anaesthesia, increases the duration of post-operative analgesia, decreases the onset of sensory and motor block and prolongs the sensory and motor block recovery time. Many studies have shown that local steroid application can have an analgesic effect.

In our study, according to the intergroup comparison we concluded that the onset of sensory and motor block was earliest and the duration of post-operative analgesia was also prolonged in nitroglycerine group.

8. Conclusion

In this study it is concluded that the addition of nitroglycerine and dexamethasone to lignocaine in intra venous regional anaesthesia definitely improves the quality of anaesthesia to a variable extent.

Onset of sensory and motor block was earliest and duration of post-operative analgesia was also prolonged in Nitroglycerine group. The sensory and motor block recovery times were prolonged in Dexamethasone group.

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