ORIGINAL RESEARCH PAPER

Anaesthesiology

KEY WORDS:

COMPARARISON OF EFFECTS OF LIGNOCAINE VERSUS LIGNOCAINE WITH DEXMEDETOMIDINE IN BIER'S BLOCK: A PROSPECTIVE DOUBLE BLINDED STUDY

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Introduction

God gifted hands for better skillful work with arm and forearm as backbone. In this fast moving world, there is an increase in the number of road traffic accidents and so is the number of patients with upper limb trauma coming for various orthopaedic surgical procedures. General anaesthesia may be high risk because patient may be full stomach and may have associated co morbidity. The brachial plexus block can be used but it needs skilful and experience hands. There is risk of pneumothorax, nerve injury, inadvertent drug injection, delayed or incomplete analgesia and its success rate is only 75 - 80 %. Thus, a simple, safe and effective technique like intravenous regional anaesthesia can be a better alternative for upper limb surgeries, which has got 100 % success rate. Only limiting factor is tourniquet time and tourniquet pain. Intravenous regional anaesthesia is also called Bier's block. It is named after August Karl Gustav Bier, a German surgeon, who first introduced this technique into clinical practice. It is a simple technique in which analgesia and muscle relaxation are produced by the injection of adequate volume of a local anaesthetic solution or a mixture of solution containing local anaesthetic and other drugs like muscle relaxants, opioids, NSAIDs, alpha-2 agonist, into a vein of an extremity to be operated upon, while the inflow and outflow of blood is prevented by an arterial tourniquet.

It was Alms in 1886 (cited by Adams 1944), who first showed that an Intravascular injection of cocaine was associated with analgesia in the area supplied by that vessel. Based on this finding, in 1908 August Karl Gustav Bier presented a paper on venous anaesthesia for limb surgery, which was a natural outgrowth of his work with tourniquet and anaesthetic methodology. His method of intravenous anaesthesia consisted of isolation of a segment of arm with two tourniquets and injection of 0.5% procaine into a vein of the forearm, which was exposed by surgical cut down. The limb was rendered bloodless previously by an elastic rubber bandage extending from the fingers to the upper arm. The injected solution permeated the entire section of the limb very quickly producing what Bier called "Direct vein anaesthesia" in 5-15 minutes.

The anaesthesia lasted as long as the upper constricted band was kept in place. Once the band was removed, the sensation returned to normal in a few minutes. Bier's technique gained considerable popularity for some time as evidenced by the flooding of a number of articles on the technique of venous anaesthesia. But the technique was used on a limited scale in various parts of world over the next 50 years, because the technique was cumbersome, requiring wrapping and unwrapping of Esmarch's bandage in a precise manner and requirement of surgical cut down to expose vein. In fact till 1925, all the investigators of this technique used procaine. It might be assumed that adverse reaction to procaine played at least some role in its lack of acceptance. Morrison in 1931 improved the Bier's technique by introducing a single tourniquet and percutaneous cannulation of the desired vein. He did not exsanguinate the limb and used either 2% or 3% procaine. Holmes in 1963 modified the IVRA technique described by Bier. He used a fine needle for venepuncture and used lignocaine 0.5 % which was quite potent and safer than procaine. He used a sphygmomanometer cuff to occlude the arterial circulation instead of the rubber bandage and recommended a subcutaneous band of injection of local anaesthetic solution just above the tourniquet or the application of a second tourniquet distal to the first one, to reduce the incidence of tourniquet pain or discomfort. After Holmes published his paper, Bier's technique received wide spread attention as evidenced by a series of papers appearing on the facets of this technique.

Thereafter IVRA has got a virtually unanimous applause from the world over as a simple, safe and effective technique of anaesthesia for short surgical procedures of the limbs.

Harris et al in 1968 studied prilocaine for IVRA and found that a dose of 3 mg.kg-1 was safe and effective and minimal side effects.

Wares in 1975 advocated bupivacaine 0.2 % for IVRA and found that if it is used in this concentration, it provide better analgesia even after release of tourniquet. If more conc. of bupivacaine used it leads to cardiac arrest after tourniquet removal.

Trevilla in Spain in 1981 first used mepivacaine for IVRA. He found it to act faster than lignocaine.

Chan VWS et al in 1999 used ropivacaine for IVRA as an alternative to lignocaine which provided longer duration of post-deflation analgesia and a good safety profile.

Further modification in the evolution of IVRA included the use of different additives along with local anaesthetic agents like opioids (fentany, pethidine, pentazocine, tramadol, buprenorphine, Morphine, sufentanil, alfentanil), non-steroidal anti-inflammatory drugs (ketorolac, tenoxicam,aspirin), skeletal muscle relaxants (atracurium, pancuronium,) and α-2 adrenergic agonists (clonidine, dexmedetomidine).

IVRA has been limited by tourniquet pain and the inability to provide postoperative analgesia. One of the problems with IVRA, as compared with peripheral nerve blocks, is that there is no prolonged analgesic effect after tourniquet release. To improve the quality of IVRA block, the addition of various opioids to local anaesthetics has been investigated with controversial results. A meta-analysis concluded that opioids lack significant effect.37 α -2- Adrenergic receptor (adrenoreceptor) agonists have been the focus of interest for their sedative, analgesic, and perioperative sympatholytic and cardiovascular stabilizing effects with reduced anaesthetic requirements.

Dexmedetomidine, a potent α -2-adrenoceptor agonist, is approximately 8 times more selective toward α-2 adrenoceptors than clonidine.

Dexmedetomidine has been shown to decrease anaesthetic requirements by up to 90% and to induce analgesia in rats, volunteers, and patients.

We designed this study to evaluate the effect of Dexmedetomidine when added to lignocaine in IVRA. We planned to investigate the sensory and motor block onset, the quality of anaesthesia, intraoperative and postoperative hemodynamic variables, intraoperative and postoperative pain, sedation, and the other effects of Dexmedetomidine.

MATERIALS AND METHODS

A study entitled "TO COMPARE THE EFFECTS OF LIGNOCAINE VERSUS LIGNOCAINE WITH DEXMEDETOMIDINE IN BIER'S BLOCK: A PROSPECTIVE DOUBLE BLINDED STUDY" was undertaken at our Medical College from April 2013 to September 2014.

Study design:
This prospective randomized, double blinded study was undertaken after obtaining ethical committee approval as well as informed, written consent from all the patients.

The study population consisted of sixty patients aged between 20-50 years belonging to ASA class 1 and 2 scheduled for elective upper limb surgeries requiring intravenous regional anaesthesia. These patients were randomly allocated into two groups with thirty patients in each group.

Inclusion criteria:
1. ASA grade I & II physical status.
2. Weight 50 to 70 kg.
3. Age from 20 to 50 years.

Exclusion criteria:
1. History of angina, palpitation, syncope and ECG abnormalities.
2. Treatment with beta blockers & calcium channel blockers and psychiatric medications.
3. Subjects with Raynaud's disease and Sickle cell anemia.
4. Subjects with h/o allergy to lignocaine

Group L (n =30): received 40 ml of 0.5% lignocaine with 1 ml of saline.

Group D (n =30): received combination 40 ml of 0.5% lignocaine with 1ml of 0.5mcg/kg Dexmedetomidine.

A thorough preoperative evaluation was done in all the patients on the day before surgery. Patient kept NBM for 6 hours. The patients were graded as per the ASA classification and they were explained about the procedure to ensure good co-operation. An informed written consent was obtained from each patient. As far as possible cases were chosen such that the surgery was expected to get over within the maximum tourniquet time of the upper limb (that is < 90 minutes).

The patients were placed in supine position with due comforts on a tiltable operative table. The intravenous line was secured on the non-operating upper limb with 20 gauge intravenous cannula for infusion of intravenous fluids. The patients were connected to standard monitors that included continuous E.C.G, pulse oximetry, non-invasive blood pressure monitor. The baseline values were recorded. All the necessary equipment's and emergency drugs were kept ready for resuscitation, in order to cope with any toxic and untoward reactions occurring during the procedure.

Drugs and equipment's used in IVRA:
Inj. Lignocaine 2% without preservative. (Xylocard 2%)
Inj. Dexmedetomidine 50mcg. (Dextomid 0.5ml (50mcg) ampoule)

Intravenous cannulas - 2 sizes. (20 G and 22 G)
1 Esmarch's rubber bandage.
Pneumatic tourniquet.
20 ml, 5 ml and 2 ml syringes.
Roller bandage.
Cotton rolls.

Venepuncture and selection of vein:
As far as possible distal veins were selected for venepuncture. The venepuncture was done with 22 gauge intravenous cannula in the operative limb. The cannula was fixed with strips of adhesive plaster to the skin.

Pre-medication:
Every patient given premedication through 20 G cannula, 10 min before start of surgery.

inj. Ondensetron 0.08 mg/kg as antiemetic inj. Midazolam 1mg as anxiolytic

DISCUSSION
IVRA isolates the arm from the rest of the circulation and is therefore a useful model for studying the peripheral actions of a drug in the absence of central effects. Local anaesthetic agents are known to block impulse conduction by inhibiting voltage gated sodium channels.

The advantages of IVRA are high indices of reliability, rapid onset of analgesia within 5-10 minutes and good muscular relaxation. The disadvantage of IVRA is the application of a tourniquet, which must remain inflated continuously throughout the procedure. The duration of surgery is limited by the time during which the arterial tourniquet could be kept safely inflated. Tourniquet pain, which is described as a dull and aching pain sensation, is a well-known limitation of IVRA. Skin compression, tourniquet size, and inflation pressure have been implicated as factors involved in tourniquet pain. Another drawback with this technique is the absence of postoperative analgesia.

In several studies it was tried to find a local anaesthesia mixture that allows relief from tourniquet pain and prolong the duration of analgesia after tourniquet release. Non-steroidal anti-inflammatory drugs, opioids, and combination of opioid and muscle relaxant have been used without demonstrating clear advantage.

In this age of increasing mechanization and accidents, a technique of anaesthesia which is simple, cheap, easily applicable, safe and time saving has to be employed to cope with the increasing work load and to effect rapid turnover.

Dexmedetomidine is a potent alpha 2-adrenoceptor agonist with eight time's higher affinity for the alpha 2- adrenoceptor than clonidine.

Dexmedetomidine induces analgesia mainly through stimulation of alpha 2- adrenegic receptors in the dorsal horn of the spinal cord. It also depresses nerve fibre action potentials especially in the alpha 2A-adrenoceptor subtype is responsible for relaying the sedative and analgesic properties of dexmedetomidine. The use of an alpha 2- agonist as an adjunct in pain management is attractive because of the potentiation that occurs through their action at the central and peripheral sites.

Since it has been introduced in India only in 2009 not many studies have been done in our country regarding its use in IVRA, there is a need to study the effectiveness of Dexmedetomidine in improving the quality of anaesthesia in IVRA and for perioperative analgesia in forearm and hand surgeries.

The technique of IVRA was first described by August Bier in 1908 using procaine as the local anaesthetic agent. Holmes subsequently repopularised the method in 1963 using lignocaine. Since then many workers have proved the effectiveness of IVRA and the technique has become a useful addition to the anaesthesiologist's armamentarium, which meets the above mentioned requirements. Many local anaesthetic agents like procaine, bupivacaine, prilocaine, mepivacaine, ropivacaine etc. have been used for this technique. Because of many complications associated with their use, only lignocaine has been employed popularly.

This present study is to compare the effects of 0.5mcg/kg Dexmedetomidine plus 0.5% lignocaine with 0.5% lignocaine plus 1ml saline in intravenous regional anaesthesia for upper limb surgeries. The study population consisted of 60 patients of either sex randomly allocated to two groups, with 30 patients in each group, who received intravenous regional anaesthesia for upper limb surgeries.

- Group L - received 40 ml of 0.5% lignocaine with 1ml saline.
- Group D - received 40 ml of 0.5% lignocaine and 1ml of 0.5 mcg/kg Dexmedetomidine.

Age:
Reviewing the available literature, it is evident that IVRA is most commonly used in patients aged between 18-60 years. Elhakim M and Sadek RA carried out IVRA on patients aged between 25-55 years. Sanjay Kherde et al carried out IVRA on patients aged between 15-55 years. Kumar A. et al carried out IVRA on patient aged between 20-50 years.

In this study patients selected were between the ages 20-50 years. The above age group was selected to ensure better co-operation and also this age group patients commonly present with upper limb surgeries.

Premedication:
In this study all the patients were premedicated with
Inj. ondensetron 0.08mg/kg as antiemetic.
Inj. midazolam 1mg as anxiolysis.

Exsanguination:
The success of IVRA is dependent to a great extent on the degree of exsanguination of the limb involved and application of tourniquet. Exsanguination can be achieved either by simple gravity drainage alone or by the combined use of Esmarch's bandage and gravity drainage as advised by Holmes, .

In the present study the exsanguination was obtained by the combined use of Esmarch's bandage and gravity drainage.

Tourniquet:
Tourniquet was applied in IVRA with the intention of restricting analgesia to the part of the limb distal to the tourniquet, which forms the basis for the success of intravenous regional anaesthesia and to prevent the incidence of side effects. Holmes, Charles Sorbie and Chacha, Janardha have advocated the use of double tourniquet method, with the second tourniquet on the anaesthetized portion of the extremity, distal to the proximal one to prevent tourniquet pain and discomfort.

In the present study two tourniquets were used. One proximal latex rubber bandage (Esmarch tourniquet) and one distal Pneumatic tourniquet, was used as tourniquet.

Drugs and Dosage:
Reviewing available literature, it is evident that various combinations of local anaesthetics and alpha 2 agonists have been used in IVRA.

Memis D. et al carried out study using Dexmedetomidine with lignocaine in Bier's block. Thirty patients undergoing hand surgery were randomly assigned to two groups to receive IVRA. They received
- Group L (n=15) - 40 mL of 0.5% lignocaine and 1 mL of isotonic saline.
- Group LD (n=15) - 40 mL of 0.5% lignocaine and 0.5 mcg/kg Dexmedetomidine.

Esmaoglu A. et al carried out study using Dexmedetomodine with lignocaine in Bier's block in forty patients undergoing hand surgery. They received
- Group L (n=20) – 3mg/kg lignocaine diluted up to 40ml with saline.
- Group D (n=20) – 3mg/kg lignocaine diluted up to 40ml with saline and 1mcg/kg Dexmedetomidine.

In this study we used two groups randomly allocated with thirty patients in each group. They received
- Group L (n=30) – 0.5% 40ml lignocaine and 1ml of saline.
- Group D (n=30) – 0.5% 40ml lignocaine and 1ml of 0.5mcg/kg Dexmedetomidine.

Sensory Characteristics:
In the present study, the mean time of onset of sensory loss was 4.73 ± 0.38 minutes in group D and 6.93 ± 0.86 minutes in group L. The difference between the two groups regarding the mean time of onset of sensory loss was statistically significant (P< 0.05).

According to Memis D. et al the mean time of achieving onset of sensory block was 5 ± 2 minutes in patients who received 40 ml of 0.5% lignocaine with 0.5mcg/kg Dexmedetomidine and was 7 ± 2 minutes in patients who received 40 ml of 0.5% lignocaine with 1ml saline. The difference between the two groups with respect to the mean time of onset of sensory block was statistically significant (P< 0.05).

Motor Characteristics:
In the present study, the mean time of onset of motor block was 4.87 ± 0.79minutes in group D and 8.27 ± 1.07 minutes in group L. The difference between the two groups regarding the mean time of onset of motor block was statistically significant (P< 0.05).

According to Memis D. et al the mean time of achieving onset of motor block was 10 ± 4 minutes in patients who received 40 ml of 0.5% lignocaine with 0.5mcg/kg Dexmedetomidine and was 15 ± 3 minutes in patients who received 40 ml of 0.5% lignocaine with 1ml saline. The difference between the two groups with respect to the mean time of onset of motor block was statistically significant (P< 0.05).

Tourniquet pain and Analgesia:
In this study there was a statistically significant difference between groups when compared for tourniquet pain. It was seen that mean tourniquet pain in D group was 45.47 ± 3.35 min compared to L group which was 34.63 ± 2.76 min with p <0.001 and mean difference of 13.67 which was highly statistically significant. The onset of tourniquet pain is significantly delayed in group D compared to group L. Only 5 patients required Tramadol 100mg as rescue analgesic intraoperative in group D compared to 24 patients required Tramadol 100mg in group L. Requirement of intra-operative analgesia is significantly less in group D compared to group L.

According to Memis D. et al the mean tourniquet pain in LD group was 52 ± 10 min and 32 ± 10 min in group L. There was a highly statistical difference between groups when compared for VAS scores for tourniquet pain. There was a statistically highly significant lower VAS in group LD (P< 0.001).onset of tourniquet pain was delayed in group LD compared to group L. Intra-operative fentanyl requirement is significantly lesser in group LD compared to group L.

Esmaoglu A. et al did not comment on tourniquet pain. Intraoperative requirement of fentanyl as analgesia was significantly lower in Dexmedetomidine group (0 mcg) compared to Lignocaine group (20±25 mcg) (p<0.001).There was a significant difference between Dexmedetomidine and lignocaine group regarding consumption of intra-operative analgesic.

Quality of Anaesthesia:
Intra-operatively quality of anaesthesia was noted with opinion of same surgeon and resident after completion of operation. It was found that Surgeon rated the quality of anaesthesia as perfect in 84% and acceptable in 16%in D group compared to L group in which he rated 60% acceptable and 40% poor. And resident rated the quality of anaesthesia as 70% excellent, 14%good and 16% moderate in D group compared to L group in which he rated 20% good and 80% moderate. There was statistically very highly significant (p<0.001) difference of quality of anaesthesia rated by surgeon and residents for D and L group.

Haemodynamic parameters:
In this study the hemodynamic parameters such as pulse rate, systolic, diastolic and mean arterial blood pressure was compared pre operatively, Intra -operatively and post -operatively. There was no significant difference in mean blood pressure and mean pulse rate pre operatively between the group D and group L (p >0.005)

Side effect:

In this study there was none of the patients had any side effect of perioral numbness, nausea, vomiting, dryness of mouth, headache, bradycardia and bradypnoea in patients of the two groups.

CONCLUSION

From this study we concluded that

- The onset time of sensory block was significantly earlier in Dexmedetomidine group than lignocaine group.
- The onset time of motor block was significantly earlier in Dexmedetomidine group than lignocaine group.
- Intra-operatively onset of tourniquet pain was delayed in Dexmedetomidine group than lignocaine group.
- Intra-operative requirement of analgesia was minimum in Dexmedetomidine group than lignocaine group.
- Post-operative analgesia time was significantly prolonged and analgesic requirement was reduced in Dexmedetomidine group than lignocaine group.
- Quality of anaesthesia was better in Dexmedetomidine group than lignocaine group.
- There was no significant difference between group Dexmedetomidine and group Lignocaine with respect to changes in cardiovascular and respiratory parameters during intra-operative and post-operative period.
- There were no side-effects in the intra-operative period in both groups.