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A COMPARATIVE STUDY OF 0.5% LIGNOCAINE VERSUS 0.5% LIGNOCAINE WITH DEXMEDETOMIDINE FOR BIERS BLOCK IN UPPER LIMB SURGERIES

Anesthesiology

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ABSTRACT

INTRODUCTION: Dexmedetomidine,a stereoisomer of medetomidine is a highlyselective 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, epidural and brachial blocks.The present study was designed to evaluate the quality,onset and recovery of IVRA with 0.5mcg/kg Dexmedetomidine added to 3mg/kg of 0.5% lignocaine.

METHODS: After institutional approval and informed consent, 60 ASA 1 &2volunteers, were taken into the study. In Group A 30 patients were randomly allocated to receive IVRA for upper limb with 3mg/kg for 0.5% lignocaine; in Group B 30 patients randomly received IVRA of upper limb with 3mg/kg of 0.5% lignocaine with 0.5mcg/kg Dexmedetomidine. The onset and recovery of sensory block were tested in six sites of the forearm and hand, determined by pin prick, touch and cold. The cuff was released after 45 minutes. The onset of complete motor block was also assessed and any symptoms after cuff deflation were recorded. Usual haemodynamic monitoring was used. Both groups were compared statistically and results wereanalysed using SPSS version 18. Independent T test and chi-square test were used to find significant difference of study parameters; p value of <0.05 was considered significant.

RESULTS: The speed of onset of sensory and motor block was higher in Group Bthan in Group A($p<0.05$). The recovery of sensory and motor block was prolonged in Group B than in Group A($p<0.05$). The tourniquet pain occurred significantly later in Group B as compared to Group A. There were few incidence of bradycardia in Group B.

CONCLUSION: Addition of 0.5mcg/kg of Dexmedetomidineas an adjuvant to IVRA effectively enhance the anaesthesia and post-operative analgesia obtained with lignocaine. The low dose of Dexmedetomidine was effective and did not cause any major side-effects .

KEYWORDS

IVRA: Intravenous Regional Anaesthesia, Local Anesthetic: Lignocaine Hydrochloride, α-2 agonist: Dexmedetomidine.

BACKGROUND

Intravenous regional anaesthesia (IVRA) was introduced into clinical practice by August Bier in 1908 but was forgotten for nearly half a century until it was reintroduced by Holmes in Great Britian in 1963. Since then it became widely popular and numerous reports from all over the world have appeared testifying to its efficacy in properly selected cases. The factors to be considered while performing this technique are possible reaction to the agents used and the anticipated length of procedure. Since the analgesia is dependent upon the uninterrupted presence of the tourniquet, it provides satisfactory analgesia for most surgical procedures on distalparts of the limbs[1].

This form of analgesia is ideally suited for emergencies, where patient is with full stomach or suffering from other diseases that contraindicates general anaesthesia, moreover the feasibility and simplicity of execution of this method, its effectiveness and its lack of any side effects have been gratifying. The equipment needed is minimal. IVRA is particularly suitable for day care surgeries as it requires minimalpreparation and premedication[3].

IVRA is suitable for distal limb surgeries like ganglion excision, carpal tunnel release, decompression of dequervain'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.

In recent years, alpha-2adrenergic receptor agonists[4] have been focus of interest for their sedative, anxiolysis, analgesic and perioperative sympatholytic and cardiovascular stabilizing effects with reduced anaesthetic requirements.

Dexmedetomidine[4],a stereoisomer of medetomidine is a highly 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 usedsuccessfully in combination with local anaesthetics for procedures like brachial blocks[5], spinal[6] and epidural[7]where it has been found to enhance /potentiate the action of local anaesthetics.

The present study was designed to evaluate the quality, onset and recovery of IVRA with 0.5mcg/kg dexmedetomidine added to 3mg/kg of 0.5% lignocaine.

REVIEW OF LITERATURE

In1908 "AUGUST BIER" first described a satisfactory technique of intravenous anaesthesia using procaine hydrochloride and methylene blue. He produced anaesthesia of the extremity by injecting procaine intravenously between two tourniquets which were inflated above systolic pressure to isolate the circulation. The resulting analgesia was adequate to perform all surgical procedures distal to tourniquet. But this technique didn't achieve popularity due to certain technical issues:

a) the technique was cumbersome
b) require wrapping and unwrapping of esmarch bandage
c) adverse reactions of procaine also played role in lack of acceptance[3].

Harrisons used 0.3gm cocaine as 2%solution intravenously over a period of 30 minutes. At the end of injection,a deep skin incision produced only moderate discomfort but the amount of cocaine used was considered to be extremely toxic dose, and produced only imperfect and short duration analgesia.

Mizraket al[16] in the year 2010 a double blinded study was done in which he randomly divided 45 patients who were scheduled to undergo carpal tunnel release into three groups. IVRA was performed with 40 ml of 0.5% lignocaine in the operating room. A single dose of dexmedetomidine 0.5mcg/kg and placebo (saline) solution in a total volume of 20 ml were administered intravenously to Group P and Group S, respectively, before IVRA.0.5mcg/kg of dexmedetomidine was added to lignocaine in Group A during IVRA. Significantly shortened sensory block onset and recovery time in Group P and A, shortened motor block onset time in Group P, and decreased post operative VAS scores and analgesic requirement in Groups P and A were found. Intraoperative Ramsay sedation scores(RSS) in Group P and postoperative RSS in Groups P and A were higher than in Group S. Intraoperative and postoperative heart rate and postoperative mean arterial blood pressure (MAP) of Group P were significantly lower than Groups A and S respectively.

Usha et al[17] found that adding dexmedetomidine as an adjuvant in intravenous regional anaesthesia improved block quality, prolong post deflation analgesia and decreased tourniquet pain.

Alok Kumar et al[18] in a prospective randomized study involving seventy two patients undergoing hand surgery were randomly assigned to three groups to receive IVRA. They received 20 ml of 1% lignocaine

and either 1 ml of isotonic saline (Group L, n = 24); or 0.5 mg/kg body weight ketamine (GroupLK, n = 24) or 1 mcg/kg body weight dexmedetomidine (Group LD, n = 24). Shortened sensory and motor block onset times (69.17 min and 7.83 min respectively, *P*< 0.0001) and improved quality of anaesthesia (satisfaction score = 3, *P*< 0.05) were found in ketamine group. Visual analog scale scores (3.21 ±0.41) were comparable while time to first analgesic requirement (166.25 ± 25.89 min, *P*< 0.0001) was significantly longer in dexmedetomidine group after tourniquet release.

Yasser M. Nasr et al[19] in a prospective randomized double blinded study involving 60 patients were randomly assigned into Group C, Group T, and Group D. All patients received 3mg/kg 0.5% lignocaine (+100mg tramadol in Group T, or 1mcg/kg dexmedetomidine in Group D). Significantly shorter onset times and longer recovery times of sensory and motor block were recorded in Groups T and D compared to Group C (*P*< 0.05); while, with no significant differences between Groups T and D. Delayed onset of tourniquet pain occurred in Groups T and D compared to Group C (*P*< 0.05) with no significant differences between Groups T and D. Significantly lower Postoperative VAS score, longer time to first dose and lower consumption of Paracetamol were recorded in Groups T and D than in Group C; with no significant differences between Groups T and D. Complications were skin rash in 30% of patients in Group T, bradycardia and sedation in 35% and 65% of patients in Group D respectively.

Abhishek Gupta et al[20] in a randomized controlled study included 60 patients of ASA class I and II of either sex aged between 17-70 years scheduled for various upper limb surgeries. Patients were randomly divided into two groups 30 each. They received 40 ml 0.5% lignocaine and either dexmedetomidine 0.5 µgm/kg (Group A) or dexmedetomidine 1 µgm/kg (Group B). The onset of sensory and motor block in Group B was significantly shorter than Group A. Both the groups showed comparable low level of sedation. VAS score of Group B was statistically lower than VAS score of Group A. Quality of blockade among both groups was excellent.

SuhasJewlikar et al[21] in 2017 studied 60 patients undergoing elective hand and forearm surgeries were randomly assigned to Group L (0.5% Lignocaine 200 mg) and Group LD (0.5% Lignocaine 200 mg and 0.5 ug/kg of Dexmedetomidine) and concluded that addition of Dexmedetomidine to lignocaine provides IVRA with quicker onset of sensory and motor block, better quality of anaesthesia, prolonged duration of sensory, motor blockade and postoperative analgesia, delays the onset and severity of tourniquet pain, better hemodynamic stability without any adverse effects.

Bharti Gupta et al[22] in 2017 studied sixty patients of either sex belonging to the American Society of Anesthesiologists Class I and II, in the age range of 18–65 years, scheduled for upper limb orthopedic surgery, either elective or emergency, were included in the study. All patients were administered IVRA in this prospective, double-blind, randomized study. Patients enrolled in the study were randomly divided into two groups of thirty each. Group M-received 40 ml of 0.5% lignocaine with midazolam 50 µg/kg and Group D-received 40 ml of 0.5% lignocaine with dexmedetomidine 1 µg/kg and concluded Dexmedetomidine and midazolam, when used as adjuvants to lignocaine for IVRA, significantly improve the intraoperative conditions by providing superior quality of block.

Mona Mohamed Mogahed et al[23] in 2017 concluded that adding lornoxicam-dexmedetomidine to 0.25% lidocaine in comparison with 0.5% lidocaine for IVRA alone causes a short delay in the onset and the attainment of complete sensory and motor blocks; however this safe and effective combination can be used in IVRA for upper limb surgeries with better analgesic effect and lesser probability of local anesthetic toxicity

M Balamurugan et al[24] in 2016 concluded the addition of 0.5 µg/kg dexmedetomidine to lignocaine for IVRA reduced the time for onset of block, delayed the onset of tourniquet pain, improves quality of anesthesia prolonged post-operative analgesia and reduced post-operative analgesic requirement.

DiptanuBhaumik et al[25] in 2016 concluded that addition of 0.5 mcg/kg dexmedetomidine to (0.5%) lidocaine for IVRA improves quality of anaesthesia, tourniquet pain and postoperative analgesia without causing side effects.

EshaNilekanet al[26] in 2016 concluded that the addition of 0.5µg/kg of dexmedetomidine as an adjuvant to IVRA effectively enhances the anaesthesia and post-operative analgesia obtained with lignocaine. The low dose of dexmedetomidine was effective and did not cause any major side effects.

Ghali et al[27] in 2016 concluded that Dexmedetomidine significantly facilitates onset, prolongs recovery of sensory and motor block as well as duration of post-operative analgesia as compared to clonidine. Patient satisfaction was better in Dexmedetomidine group; however, patients of both groups have comparable intra-operative fentanyl requirement and both decrease tourniquet pain satisfactorily.

Nitin Purohit et al[28] in 2015 studied with sixty patients randomly allocated in two groups L and D, receiving 40ml of 0.5 % lignocaine alone and 40 ml 0.5 % lignocaine with 1 ml of 0.5 mcg/kg Dexmedetomidine respectively. During study hemodynamic changes, onset of sensory and motor block, time of tourniquet pain, post-operative analgesic duration and sedation were noted and concluded that addition of 0.5 mcg/kg Dexmedetomidine to 40 ml of 0.5% lignocaine in Bier's block improve quality of anaesthesia and peri-operative analgesia without any side effects.

PROCEDURE

The present study was designed to compare and evaluate the quality and onset of intravenous regional anaesthesia in the upper limb with dexmedetomidine added to lignocaine..

Based on the findings of previous studies by M.BalaMurugan et al[24], Esha et al[26] and Nitin Purohit et al[28], sample size of 60 patients was taken belonging to either sex and age between 18 and 65 years. All the patients belonged to ASA(AMERICAN SOCIETY OF ANESTHESIOLOGIST) grade1 or 2. Computer based Randomisation was done and divided into two groups:

Group A-0.5%lignocaine3mg/kg(without preservatives)
Group B-0.5%lignocaine3mg/kg(without preservatives) + dexmedetomidine 0.5mcg/kg

Detailed history was taken and complete clinical examination was done to exclude patients with history of epilepsy, hypersensitivity to local anesthetics, neurological, cardiac and hemolytic diseases. Routine investigations like blood grouping, haemoglobin, blood urea and blood sugar were done. ECG whenever indicated was undertaken to rule out the presence of any cardiac disease. Pre-operative temperature, pulse rate, respiratory rate, blood pressure and condition of heart and lungs noted. Patients weight was recorded.

Written and informed consent was taken prior to scheduled operation. Patients were explained about the procedure of intravenous regional anaesthesia.

Patients with Raynauds disease, sickle cell anemia were excluded from the study.

TECHNIQUE:

An 18 G intravenous cannula was inserted into a vein of the non-operated limb for the purpose of administering fluids or drugs.

Another 22 G cannula was inserted into suitable vein on dorsum of hand that was to be operated as distally as possible and firmly secured.

Tourniquet:

Cotton padding was placed on the proximal part of the limb to beoperated. Double tourniquets were set up and connected to pneumatic pressure gauge.

The occlusion pressure i.e the pressure at which pulse disappears was noted for each tourniquet.

Exsanguinating the extremity: The arm to be operated is elevated to 90 angle from the body above the level of heart for 5 minutes to drain the blood from the limb . Esmarch bandage was wrapped tightly around the arm from the most distal part to near the pneumatic tourniquet to further exsanguinate. The proximal cuff was inflated to 100mmHg higher than the occlusion pressure and esmarch bandage removed.

Injecting the anesthetic solution: The limb was placed horizontally and local anesthetic was injected steadily.

Group A patients received solution containing 0.5% lignocaine 3mg/kg

Group B patients received solution containing 0.5% lignocaine 3mg/kg and dexmedetomidine 0.5mcg/kg.

After injection IV cannula was removed and pressure was applied to venepuncture site for some time till bleeding stops

Monitoring:

The following parameters were observed and recorded continuously throughout the surgical procedure.

1. Pulse rate
2. Blood pressure
3. Respiratory rate
4. Level of consciousness

The following parameters were noted

1. Tourniquet time
2. Grade of analgesia
3. Complications arising intraoperatively and postoperatively

Assessment of block: Six areas supplied by radial, median and ulnar nerves were tested in sequence with the patient unable to observe testing. At 90 second intervals after administration, the sensory block was assessed by using a 24 G needle. The patient reported verbally the sensation as pin prick, touch or absent.

Cold sensation was assessed using a cube of ice placed in sterile test tubes. Motor function was assessed by asking the patient to flex and extend his wrist and fingers.

Complete motor block was considered when no voluntary movement was possible.

Tourniquet pain:

Proximal tourniquet deflated after inflating distal tourniquet once patient complains of discomfort. Then distal cuff was inflated to 250 mmHg and proximal cuff was deflated.

Tourniquet release:

At the end of case/after 45mins the tourniquet was deflated using deflation and inflation technique before the cuff was let down permanently.

Monitoring after tourniquet release:

The patients were monitored for any change in pulse rate, blood pressure, loss of consciousness and for any signs of systemic toxicity like twitching, convulsions and ECG abnormalities.

Sensory assessment was continued until full recovery occurred at all six sites.

GRADING OF ANALGESIA: Method adopted was one given by R.J.WARE

Grading of analgesia and muscle relaxation.

GRADE	DESCRIPTION
1(Excellent)	Complete analgesia and motor loss as evidenced by inabilityto move fingers.
2(Good)	Complete analgesia but no motor paralysis
3.(Fair)	Loss of pain sensation but discomfort to deep pressure stillpresent.
4.(Partial)	Only partial and patchy analgesia ,requiring supplementation
5(Poor)	No analgesia at all,requiring general anaesthesia

RESULTS

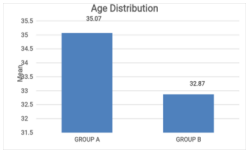
Descriptive and inferential statistical analysis has been carried out in the present study. The results were analysed by using SPSS version 18 (IBM Corporation, SPSS Inc., Chicago, IL, USA). Results on continuous measurements were presented on Mean±SD (Min-Max). Significance was assessed at 5% level of significance. Normality of the data was assessed using Shapiro Wilk test. Independent t test and Chi-square test were used to find the significant difference of study parameters between the groups.

Table 1: Age Distribution

Age	GROUP A	GROUP B	P value
MEAN±SD	35.07±13.89	32.87±10.69	0.495

Inference:

There is no significant difference in age distribution between the groupsi.e both the groups are homogeneous



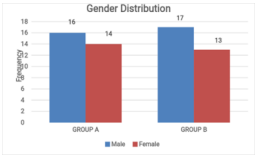
Graph 1: Age Distribution

Table 2: Gender Distribution

Gender	GROUP A	GROUP B	P value
Male	16	17	0.79
Female	14	13	

Inference:

There is no significant difference in gender distribution between the groupsi.e both the groups are homogeneous



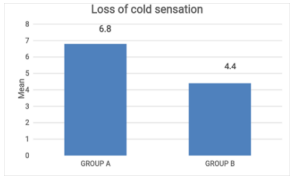
Graph 2: Gender Distribution

Table 3: Loss of cold sensation

Loss of cold Sensation	GROUP A	GROUP B	P value
MEAN±SD	6.80±1.35	4.40±1.07	0.001

Inference:

There is statistically significant difference between the groups with Group A having higher values.



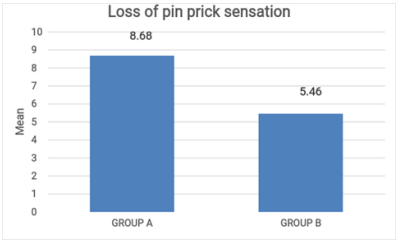
Graph 3: Loss of cold sensation

Table 4: Loss of pin prick sensation

Loss of pin prick sensation	GROUP A	GROUP B	P value
MEAN±SD	8.68±1.68	5.46±1.67	0.001

Inference:

There is statistically significant difference between the groups with Group A having higher values.



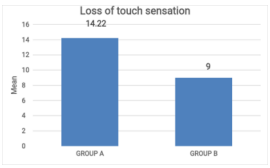
Graph 4: Loss of pin prick sensation

Table 5: Loss of touch sensation

Loss of touch sensation	GROUP A	GROUP B	P value
MEAN±SD	14.22±3.39	9.00±1.47	0.001

Inference:

There is statistically significant difference between the groups with Group A having higher values.

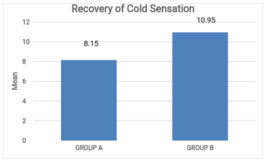


Graph 5: Loss of touch sensatio

Table 6: Recovery of cold sensation

Recovery of cold Sensation	GROUP A	GROUP B	P value
MEAN±SD	8.15±1.92	10.95±2.13	0.001

Inference:
There is statistically significant difference between the groups with Group B having higher values.

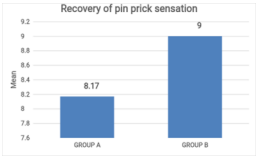


Graph 6: Recovery of cold sensation

Table 7: Recovery of pin prick sensation

Recovery of pin prick sensation	GROUP A	GROUP B	P value
MEAN±SD	8.17±1.33	9.0±2.06	0.041

Inference:
There is statistically significant difference between the groups with Group B having higher values.

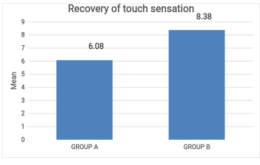


Graph 7: Recovery of pin prick sensation

Table 8: Recovery of touch sensation

Recovery of touch sensation	GROUP A	GROUP B	P value
MEAN±SD	6.08±1.50	8.38±1.02	0.001

Inference:
There is statistically significant difference between the groups with Group B having higher values.

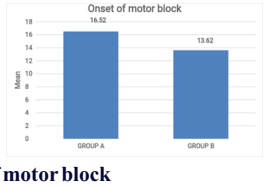


Graph 8: Recovery of touch sensation

Table 9: Onset of motor block

Motor block onset	GROUP A	GROUP B	P value
MEAN±SD	16.52±2.63	13.62±2.21	0.001

Inference:
There is statistically significant difference between the groups with Group A having higher values.

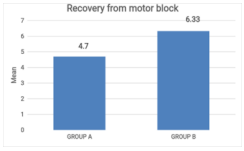


Graph 9: Onset of motor block

Table 10: Recovery from motor block

Motor block recovery	GROUP A	GROUP B	P value
MEAN±SD	4.70±1.29	6.33±1.40	0.001

Inference:
There is statistically significant difference between the groups with Group B having higher values.

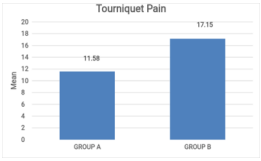


Graph 10: Recovery from motor block

Table 11: Onset of tourniquet pain

Tourniquet pain	GROUP A	GROUP B	P value
MEAN±SD	11.58±2.95	17.15±2.43	0.001

Inference:
There is statistically significant difference between the groups with Group B having higher values.



Graph 11: Onset of tourniquet pain

DISCUSSION

Intravenous regional anaesthesia is a simple, cost effective and safe technique for surgery .

IVRA is a proven,time tested technique for surgeries of upper /lower limb .

In order to improve quality of block,duration of analgesia and sedation several trials have been conducted with dexmedetomidine.

Memis et al[4] in the year 2004 achieved IVRA using 0.5% lignocaine 3mg/kg with saline in control group and 0.5% lignocaine 3mg/kg with 0.5mcg/kg dexmedetomidine in study group.

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

The present study was conducted on 60 patients undergoing various upper limb procedures. The patients were randomly allotted to two groups ,Group A and Group B. Group A patients underwent IVRA with 0.5% lignocaine alone. Group B patients underwent IVRA with combination of dexmedetomidine 0.5mcg/kg and 0.5% lignocaine.

60 patients were randomly assigned for short procedures of upper limb surgeries after adequate starvation, physical status and basic investigations.

The present study demonstrated that patients were between the age 18-60 years with mean age of 35.07 in Group A and 32.87 in Group B.

In our study there were 16 male patients and 14 female patients in Group A and 17 male patients and 13 female patients in Group B.

EXSANGUINATION:

John Mabee et al[34] showed that while esmarch was most effective exsanguination method, arm elevation or arterial compression also were effective .

Hence in our study, first gravitational drainage was done followed by esmarch bandage application.

DOSE SELECTION:

In our study Group A received 0.5% lignocaine 3mg/kg and Group B received 0.5%lignocaine 3mg/kg with dexmedetomidine 0.5mcg/kg.

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

Abhishek Gupta et al[20] used 40ml 0.5% lignocaine and either dexmedetomidine 0.5mcg/kg in Group A or dexmedetomidine 1mcg/kg in Group B.

Esmouglu et al[11] used 3mg/kg lignocaine diluted with saline in control group and 1mcg/kg of dexmedetomidine +3mg/kg lignocaine in dexmedetomidine group.

The present study showed significant reduction of onset of sensory and motor block in Group B. Sensory and motor block recovery times were also statistically prolonged in this group.($p<0.05$).

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

	Dilek Memis et al[4]	This study
Sensory block onset time (min)	5± 2	5.46
Sensory block recovery time(min)	7±3	9.0
Motor block onset time(min)	10±4	13.62
Motor block recovery time(min)	8±3	6.33
Initial time of tourniquet pain	53±10	17.15

TOXICITY REACTION:

The complications of IVRA usually are caused by the systemic toxicity of the agent used.

Brown and coworkers[35] in their 20 years experience described IVRA without mortality and morbidity.

Dunbar and Mazze found no arrhythmias and only a slight drop in blood pressure or slight bradycardia on release of the tourniquet[36].

Kennedy and co workers in their patients found a 15% incidence of ECGchanges and recorded one cardiac arrest that was preceded by bradycardia[37].

They felt that smaller the dose and greater the injection release interval, the chances of toxic reactions were rare.

In our study there were no significant changes in heart rate or ECG. Mild transient giddiness occurred in 2 patients of either Group.

BLOOD LEVELS:

Mazze and co-workers reported a blood level of 1.5mcg/ml following 3mg/kgof 0.5%lignocaine[38].

Hargrove and co-workers found that maximum levels of local anesthetic invenous blood from other arm did not exceed 2mcg/ml[39].

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

COMPLICATIONS RELATED TO THE USE OF TOURNIQUET:

A study reviewed an estimated 6,30,000 tourniquet application found an incidence of peripheral nerve damage of 1 in 80,000. The incidence was higher in procedures involving the upper limb than in those involving lower limb. Thetourniquet time varied from 20 minutes to 2 ½ hours[40].

Dilek Memis et al[4] found that addition of dexmedetomidine found significant reduction in tourniquet and post-operative pain during IVRA.

In our study there were no complications related to the use of tourniquet and also it was found that addition of dexmedetomidine reduced tourniquet pain during IVRA.

CONCLUSION

Addition of 0.5mcg/kg of Dexmedetomidine as an adjuvant to IVRA effectively enhances the anaesthesia and post-operative analgesia obtained with lignocaine. The low dose of Dexmedetomidine was effective and did not cause any major side-effects.

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