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Original Article

A Comparative Study of Lignocaine and Two Different Doses of Dexmedetomidine as an Adjunct to Lignocaine in Intravenous Regional Anesthesia for Upper Limb Orthopedic Surgeries – An Observational Study

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Abstract

Introduction: Intravenous regional anesthesia is a simple and cost reliable technique for providing anesthesia for extremity surgery. Dexmedetomidine which is about 8 times more potent than clonidine has been used in bier's block and was shown to improve the quality of anesthesia, tourniquet pain, and post-operative analgesic requirement.

Material and Methods: This study included 90 patients of ASA Class I and II of either sex aged between 20 and 60 years scheduled for various upper limb surgeries. Patients were divided into three groups 30 each. Group A received 40 ml of 0.5% lignocaine (preservative free). Group B received 0.5% lignocaine with 0.5 mcg/kg of dexmedetomidine to make a total volume of 40 ml. Group C received 0.5% lignocaine with 1 mcg/kg of dexmedetomidine to make a total volume of 40 ml.

Results: Sensory and motor block onset times were significantly shorter in Group B as compared to Group A and significantly shorter in Group C as compared to Group B. Recovery time of sensory and motor block was significantly prolonged in Groups B and C compared to Group A. Both the Groups B and C showed comparable low level of sedation. VAS score of Group C was statistically lower than VAS score of Group B and VAS score of Group B was statistically lower than Group A. Total amount of analgesic required was significantly lower in Group B than Group A and least in Group C. Quality of blockade in majority of cases of Groups B and C was excellent.

Conclusion: Addition of dexmedetomidine to lidocaine for IVRA shortens the onset times for both sensory and motor blockade, improves the quality of the anesthesia, and extends post-operative analgesia time. This study also demonstrated that addition of 1 μg/kg dexmedetomidine to lignocaine for IVRA showed significantly better improvement in the quality of anesthesia and post-operative analgesia in comparison to 0.5 μg/kg dexmedetomidine, without causing any significant side effects.

Key words: Biers block, Dexmedetomidine, Lignocaine

INTRODUCTION

Regional anesthesia was first used for surgical procedures at the turn of the 20th century. These central blocks were widely used worldwide until reports of permanent neurological injury appeared, most prominently in the United Kingdom. However, a large scale epidemiological study conducted in 1950s indicated that complications were rare when these blocks were performed skillfully, with attention to asepsis and newer, safer local anesthetics were used. Today, neuraxial blocks are widely used for labor analgesia, caesarian section, orthopedic procedures perioperative analgesia, and chronic pain management.[1] The earliest agent injected into the isolated vascular space was procaine. Lidocaine remains the standard local anesthetic agent for surgical procedures in North America[2]

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and prilocaine is used widely in Europe.[3] Intravenous regional anesthesia is an effective method of providing anesthesia for procedures expected to last <1 h and is widely used for minor operations in the extremities.[4] The technique includes applying a pneumatic tourniquet and injecting a local anesthetic distal to the tourniquet for delivering the local anesthetic directly to the core of the major nerves through the vasa nervosa. Intravenous regional anesthesia is easy to administer, reliable, and cost effective. Major nerve blocks such as brachial plexus block and femoral-sciatic block require technical expertise. Conversely, the administration of intravenous regional anesthesia requires only the skill necessary to perform a venipuncture.[5] It is quite safe for operations on the limbs especially in poor risk patient, in emergency situations such as full stomach, multiple facial injuries, and uninvestigated systemic problems or when general anesthesia might be hazardous. There is very little anesthetic hangover so that patient can go home and avoid hospitalization. The major disadvantages of this technique are occurrence of tourniquet pain, potential for local anesthetic toxicity, and minimal residual post-operative analgesia.[6] Different additives have been combined with local anesthetics[4] such as opioids, tramadol, NSAIDS, muscle relaxant, ketamine, and clonidine, to prolong post-deflation analgesia and reduce tourniquet pain, but there use is limited because of their side effects (e.g., mivacurium, which showed signs of local anesthetic toxicity,[7] and opioid) or limited efficacy (e.g., acetylsalicylate).[8]

The addition of clonidine to lignocaine during the Bier's block has shown to improve tourniquet pain tolerance but did not influence the speed and quality of bier's block. Its effect on prolonging post-operative analgesia is controversial. Reported side effects were post-deflation sedation and hypotension.[9,10] Dexmedetomidine, a potent alpha-2 adrenoceptor agonist, is about 8 times more potent than clonidine toward the alpha-2 adrenoceptors.[11] In addition to sympatholytic effects, dexmedetomidine has antihypertensive, anxiolytic, sedative/hypnotic, and analgesic effects.[12,13] It has been used clinically as an adjunct to anesthesia, as an analgesic agent, and is useful in painful surgical procedures and intensive care unit sedation.[14,15]

The present study was done to compare lignocaine and two different doses of dexmedetomidine (0.5 μg/kg and 1 μg/kg) as an adjunct to lignocaine in intravenous regional anesthesia for upper limb surgeries.

MATERIALS AND METHODS

The present study was undertaken on 90 patients in the Bone and Joints Hospital, Barzulla, an associated hospital of Government Medical College, Srinagar, during routine and emergency hours for various orthopedic surgical procedures involving upper extremities. An informed written consent was taken from all the patients in all the three groups after the approval of the Institutional and Ethics Committee in patients of ASA Class I and Class II of either gender aged between 20 and 60 years scheduled for various orthopedic procedures involving upper extremities. A detailed history, thorough physical examination, routine investigation, and any special investigation if required were done for the study.

All the patients observed were divided into three groups (30 patients each). Group A – received 40 ml of 0.5% lignocaine (preservative free). Group B – received 0.5% lignocaine with 0.5 μg/kg of dexmedetomidine to make a total volume of 40 ml. Group C – received 0.5% lignocaine with 1 μg/kg of dexmedetomidine to make a total volume of 40 ml.

A padded double cuff tourniquet was tested and positioned around the arm. A 20/22G intravenous cannula was placed for injecting drug in a peripheral vein distal to the operative site, preferably over the dorsum of the hand and secured in position. Now, the limb was elevated for exsanguination to 90° for 3 min along with an application of sterile bandage and it was followed by inflation of proximal tourniquet cuff to 250 mmHg. This criterion was fixed for all cases of the study. Then, a dose of 40 ml drug was given in each group slowly, Group A received 40 ml of 0.5% lignocaine, Group B received dexmedetomidine 0.5 μg/kg as adjuvant to 0.5% lignocaine, and Group C received 1 μg/kg dexmedetomidine as adjuvant to 0.5% lignocaine. The patients were asked frequently and were monitored continuously for any discomfort during the surgery. Throughout the procedure, tourniquet pressure was monitored. The hemodynamic parameters (HR, NIBP, RR, and SpO_2), visual analog scale (VAS), and Ramsay sedation scale were recorded every 10 min throughout the procedure. Vital parameters (heart rate, non-invasive blood pressure, and respiratory rate), sedation score, and visual analog scale (VAS) were recorded at 30 min after deflation of tourniquet and at 2 h, 4 h, 6 h, and 24 h after tourniquet deflation. Postoperatively, the pain score was recorded using visual analog pain scale (VAS), between 0 and 10 (0 – no pain and 10 – most severe pain). Diclofenac was given IM as rescue analgesia when VAS value was >4. Duration of post-operative analgesia was noted from deflation of tourniquet to VAS score of 4.

Statistical Methods

The recorded data were compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois,

Table 1: Gender distribution of study patients

Gender	Group A		Group B		Group C	
	No.	%age	No.	%age	No.	%age
Male	14	46.7	11	36.7	13	43.3
Female	16	53.3	19	63.3	17	56.7
Total	30	100	30	100	30	100

Chi-square=0.638; *P*=0.727 (not significant)

Table 2: Age, weight, and duration of surgery, among various groups

	n	Mean	SD	Range	*P*-value
Age (years)					
Group A	30	40.4	11.48	20–59	0.961
Group B	30	39.6	13.13	20–60	
Group C	30	39.6	12.57	21–59	
Weight (kg)					
Group A	30	61.8	6.94	51–74	0.758
Group B	30	60.7	7.87	48–74	
Group C	30	62.1	7.98	48–75	
Duration of surgery (min)					
Group A	30	30	49.8	5.52	0.722
Group B	30	30	49.5	6.02	
Group C	30	30	50.6	5.30	

USA). Continuous variables were summarized in the form of means and standard deviations and categorical variables were expressed as frequencies and percentages. Graphically, the data were presented by bar and lie diagrams.

RESULTS

The present observational study was conducted at Bone and Joints Hospital, Barzulla, an associated hospital of Government Medical College, Srinagar, over a period of 1½ years. Ninety (90) patients of ASA Class I and II of either sexes, between 20 and 60 years of age were observed and divided into three groups (30 patients each). Group A – received 40 ml, 0.5% lignocaine (preservative free). Group B – received 0.5% lignocaine with dexmedetomidine 0.5 μg/kg to make final volume 40 ml. Group C – received 0.5% lignocaine (preservative free) with dexmedetomidine 1 μg/kg to make final volume 40 ml. The parameters studied were onset of sensory and motor block, recovery of sensory and motor block, quality of block, visual analog scale (VAS), rescue analgesia, hemodynamic parameters, and any adverse effects. There were no significant differences in age, sex, weight, duration of surgery, and tourniquet time. The mean onset of sensory and motor blockade in Group A was 5.7 ± 0.757 and 10.8 ± 0.741 min, Group B was 3.7 ± 0.726 and 8.1 ± 0.686 min, and Group C was 1.4 ± 0.453 and 3.9 ± 0.460 min, respectively. Difference in mean onset of sensory and motor block between Group A and between Group B and C was statistically highly significant ($P < 0.001$).

Table 3: Comparison based on tourniquet duration among various groups

	Mean	SD	Comparison	*P*-value
Tourniquet duration (min)				
Group A	51.17	3.19	A vs. B	0.286
Group B	52.10	3.16	B vs. C	0.176
Group C	53.17	2.93	A vs. C	0.052
Onset of sensory block (min)				
Group A	5.7	0.757	A vs. B	<0.001*
Group B	3.7	0.726	B vs. C	<0.001*
Group C	1.4	0.453	A vs. C	<0.001*
Onset of motor block (min)				
Group A	10.8	0.741	A vs. B	<0.001*
Group B	8.1	0.686	B vs. C	<0.001*
Group C	3.9	0.460	A vs. C	<0.001*
Recovery time of sensory block (min)				
Group A	4.1	0.568	A vs. B	<0.001*
Group B	7.3	0.626	B vs. C	<0.001*
Group C	9.7	0.551	A vs. C	<0.001*
Recovery time of motor block (min)				
Group A	5.4	0.592	A vs. B	<0.001*
Group B	8.6	0.623	B vs. C	<0.001*
Group C	10.9	0.574	A vs. C	<0.001*
Time request for first analgesic (min)				
Group A	45.7	11.15	A vs. B	<0.001*
Group B	181.9	17.12	B vs. C	<0.001*
Group C	327.2	24.71	A vs. C	<0.001*
Total analgesic consumption in 24 h				
Group A	115	51.12	A vs. B	<0.001*
Group B	52.5	44.69	B vs. C	0.012*
Group C	22.5	34.96	A vs. C	<0.001*

Table 4: Quality of block among various groups

Quality of block	Group A		Group B		Group C	
	No.	%age	No.	%age	No.	%age
Poor	1	Xc 83.3	0	0.0	0	0.0
Fair	4	13.3	1	3.3	0	0.0
Good	5	16.7	2	6.7	1	3.3
Excellent	20	66.7	27	90.0	29	96.7
Total	30	100	30	100	30	100

Chi-square=12.21; *P*=0.031*

Table 5: Complications among various groups

Complications	Group A		Group B		Group C		*P*-value
	No.	%age	No.	%age	No.	%age	
Dry mouth	0	0.0	2	6.7	3	10.0	0.227
Bradycardia	0	0.0	1	3.3	2	6.7	0.355
Tinnitus	0	0.0	0	0.0	1	3.3	0.364
Perioral numbness	0	0.0	0	0.0	1	3.3	0.364

In our study, the mean recovery of sensory and motor blockade in Group A was 4.1 ± 0.568 and 5.4 ± 0.592 min, Group B was 7.3 ± 0.626 and 8.6 ± 0.623 min, and Group C was 9.7 ± 0.551 and 10.9 ± 0.574 min,

respectively. Difference in mean recovery of sensory and motor block between Group A, Group B, and Group C was statistically highly significant ($P < 0.001$). Quality of blockade was excellent in 66.7% cases in Group A, 90% of cases in Group B, and 96.7% of cases in Group C. It was good in 16.7% of cases in Group A, 6.7% of cases in Group B, and 3.3% of cases in Group C. The quality of block was not found poor in any case of Group B and Group C. In our study, the visual analog scale (VAS) was lowest and statistically significant in patients who received dexmedetomidine as adjuvant in IVRA as compared to the patients received lignocaine only. Comparing the VAS among the two groups who received dexmedetomidine in IVRA in our study, the VAS was lowest and statistically significant in group who received 1 μg/kg dexmedetomidine as compared to group received 0.5 μg/kg of dexmedetomdine in IVRA. Total analgesic consumption (diclofenac) in 24 hours postoperatively was 115 ± 51.12 mg in Group A, 52.5 ± 44.69 mg in Group B, and 22.5 ± 34.96 mg in Group C, respectively. Difference in analgesic consumption in 24 h was statistically significant between the three groups. There were only few incidence of side effects which we encountered in our study like, dryness of mouth which was observed in 2 (6.7%) cases in Group B and 3 (10%) cases in Group C ($P > 0.227$), bradycardia was noted in 1 (3.3%) in Group B and 2 (6.7%) in Group C ($P > 0.355$), and tinnitus in 1 (3.3%) ($P > 0.364$) and perioral numbness were noted in 1 (3.3%) ($P > 0.364$) case only in Group C. All the results regarding the adverse effects were statistically insignificant among the groups. Hemodynamically, all patients were stable during both intraoperative and post-operative period, and statistically insignificant differences were found regarding systolic blood pressure, diastolic blood pressure, mean arterial pressure, and mean pulse and respiratory rate [Tables 1-5].

DISCUSSION

In our study, the mean onset of sensory and motor blockade in Group A was 5.7 ± 0.757 and 10.8 ± 0.741 min, Group B was 3.7 ± 0.726 and 8.1 ± 0.686 minutes, and Group C was 1.4 ± 0.453 and 3.9 ± 0.460 min, respectively. Difference in mean onset of sensory and motor block between Group A and between Groups B and C was statistically highly significant ($P < 0.001$). Memis *et al.* (2004)[16] in his study also found that the addition of dexmedetomidine to lignocaine for IVRA leads to significant decrease in sensory and motor blocks onset time compared with control group. Gupta *et al.* (2014)[17] in their study also found that adding 1 μg/kg of dexmedetomidine to lignocaine for IVRA leads significant decrease in sensory and motor block onset time as compared to adding 0.5 μg/kg of dexmedetomidine. Abdelkader *et al.*[18] in their study also found that addition of dexmedetomidine to lignocaine for IVRA leads to significant decrease in sensory and motor block onset times. Study also correlates with Bhaumik *et al.* (2016)[19] who in their study also found that adding dexmedetomidine to lignocaine as an adjuvant in intravenous regional anesthesia significantly shortens the onset of sensory and motor block as compared to lignocaine alone. Our study is also in agreement with the study of Jewliker and Suryawanshi (2017)[20] who also concluded that addition of dexmedetomidine to lignocaine provides intravenous regional anesthesia with quicker onset of sensory and motor block.

In our study, the mean recovery of sensory and motor blockade in Group A was 4.1 ± 0.568 and 5.4 ± 0.592 min, Group B was 7.3 ± 0.626 and 8.6 ± 0.623 min, and Group C was 9.7 ± 0.551 and 10.9 ± 0.547 min, respectively. Difference in mean recovery of sensory and motor block between Group A and between Groups B and C was statistically highly significant ($P < 0.001$). Jewliker and Suryawanshi (2017)[20] in their study also concluded that addition of dexmedetomidine as an adjuvant to lignocaine in IVRA prolongs the recovery time of sensory and motor block as compared to lignocaine alone. Bhaumik *et al.* (2016)[19] also showed prolonged regression of sensory and motor block when dexmedetomidine was used as adjuvant to lignocaine in IVRA. Our study results were also in agreement with the results of Abdelkader *et al.* (2015)[18] who found that adding 0.5 μg/kg of dexmedetomidine to lignocaine prolonged the recovery time of sensory and motor block in the group in which dexmedetomidine was used as adjuvant as compared to group in which only lignocaine was used. Another study done by El–Shalakany and Salah[21] also reported prolonged regression of sensory and motor block in group having 0.5 μg/kg of dexmedetomidine as an additive in comparison to group in which only lignocaine was used. Our study results are also in agreement with those of Memis *et al.*[16] who found prolonged recovery of sensory and motor block in dexmedetomidine group in IVRA block.

The mean duration of post-operative analgesia in our study was 45.7 ± 11.15 min in Group A, 181.9 ± 17.12 min in Group B, and 327.2 ± 24.71 min in Group C. Duration of analgesia was significantly longer in Group B than Group A which is statistically highly significant ($P < 0.001$) and also in Group C than Group B ($P < 0.001$). This result correlates well with the study conducted by Memis *et al.* (2004)[16] and Esmaoglu *et al.* (2005),[22] they found significantly prolonged duration of analgesia with dexmedetomidine group when compared with control group. Gupta *et al.* (2014)[17] also found prolonged duration of analgesia in group containing 1 μg/kg of dexmedetomidine as an additive when compared with group containing 0.5 μg/kg

of dexmedetomidine as additive. Similar results were found in study conducted by Abdalkader *et al.*[18] in which they found that addition of dexmedetomidine decreased postoperative analgesic requirements. Prolonged duration of postoperative analgesia was also confirmed by Bhaumik *et al.*[19] in their study group in which dexmedetomidine was used as an adjuvant to lignocaine in IVRA as compared to study group in which only lignocaine was used. Our study results are also in agreement with that of Jewliker and Suryawanshi[20] who also found prolonged postoperative analgesia in the group in which dexmedetomidine was used as an adjuvant.

In our study, the visual analog scale (VAS) was lowest and statistically significant in patients who received dexmedetomidine as adjuvant in IVRA as compared to the patients received lignocaine only. Comparing the VAS among the two groups which received dexmedetomidine in IVRA in our study, the VAS was lowest and statistically significant in group that received 1 μg/kg dexmedetomidine as compared to group that received 0.5 μg/kg dexmedetomidine in IVRA. Total analgesic consumption of diclofenac in 24 h postoperatively was 115 ± 51.12 mg in Group A, 52.5 ± 44.69 mg in Group B and 22.5+34.96 mg in Group C respectively. Difference in analgesic consumption in 24 h was statistically significant between Group A, Group B- and Group C ($P < 0.001$). Analgesic consumption was maximum in Group A and least consumption was seen in Group C. Bhaumik *et al.* (2016) [19] in their study of bier's block for upper limb surgery concluded that the patients who received dexmedetomidine as adjuvant in bier's block showed prolonged post-operative analgesia and lower requirement of rescue analgesia in post-operative period. Our study also correlates with the study conducted by El-Shalakany and Salah (2015)[21] who also found that low total analgesic was consumed in 24 h postoperatively in group containing 0.5 μg/kg of dexmedetomidine with lignocaine as compared to group containing only lignocaine. Abdalkader *et al.* (2015)[18] in their study also found that adding dexmedetomidine to lignocaine provided satisfactory intraoperative analgesia, lower VAS score, extended post-operative analgesia, and reduced the amount of post-operative analgesic.

Quality of blockade was excellent in 66.7% cases in Group A, 90% of cases in Group B, and 96.7% of cases in Group C. It was good in 16.7% of cases in Group A, 6.7% of cases in Group B, and 3.3% of cases in Group C. No patient showed poor quality of block in Group B and Group C. Memis *et al.* (2004)[16] and Esmaoglu *et al.* (2005)[22] also found statistically significant and excellent quality of blockade in most patients receiving dexmedetomidine in IVRA block. Gupta *et al.* (2014)[17] also showed better quality of block in the two groups containing 0.5 μg/kg and 1 μg/kg of dexmedetomidine. Bhaumik *et al.*[19] in their study of bier's block for upper limb surgery, also reported improved quality of intraoperative anesthesia in patients who received dexmedetomidine as adjuvant to lignocaine in bier's block as compared to patients who received lignocaine only in bier's block. Our study results also correlate with that of Jewliker and Suryawanshi (2017)[20] who in their study also found improved quality of anesthesia in patients who received dexmedetomidine as an adjuvant to lignocaine as compared to patients who received lignocaine only in bier's block.

The baseline pulse rate was 81.70, 79.83 and 80.70 per minute in A, B, and C, respectively. Comparing the mean baseline pulse rate in the subjects of all the three groups during the surgery, there was no significant difference between the groups ($P > 0.05$). The baseline systolic blood pressure was 124.07 ± 9.262, 122.67 ± 9.345, and 124.33 ± 9.517 per mm of Hg in Groups A, B, and C, respectively. The mean baseline systolic blood pressure was comparable in all the three groups ($P > 0.05$). Similarly, no statistically significant results were found on comparing the mean systolic blood pressure, during both intraoperative and post-operative period at different time intervals between the three groups. The baseline diastolic blood pressure was 79.30 ± 6.566, 76.97 ± 8.036, and 79.23 ± 7.546 mm Hg in Groups A, B, and C, respectively. On comparing the mean diastolic blood pressure in subjects of all the three groups at baseline and during the procedure, we found no significant difference between the groups ($P > 0.05$). On comparing the mean respiratory rate in subjects of all the three groups at baseline and during the procedure, we found no significant difference between the groups ($P > 0.05$). On comparing the mean SpO_2 in subjects of all the three groups at baseline and during the procedure, we found no significant difference between the groups ($P > 0.05$).

Kavlas and Karande (2015)[23] also found that addition of dexmedetomidine to lignocaine did not cause any significant difference in the pulse rate between the groups. Furthermore, no baseline or intraoperative difference was found between the groups on the basis of systolic or diastolic blood pressure, respiratory rate, or SpO_2. Gupta *et al.* (2014)[17] in their study also found that changes in pulse rate, blood pressure, and respiratory rate were not significant between the groups in which 0.5 μg/kg and 1 μg/kg of dexmedetomidine were added as adjuvant. Abdalkader *et al.*[18] in their study also found that mean arterial pressure, heart rate, and SpO_2 values at any intraoperative and postoperative period were comparable, with no statistically significant difference between the group having dexmedetomidine as additive and the group which did not had any additive. Similar study results were

reported by Bhaumik *et al.*[19] who also found statistically insignificant differences in hemodynamic parameters between the groups.

There were only few incidence of side effects encountered in our study like, dryness of mouth which was observed in 2 (6.7%) cases in Group B and 3 (10%) cases in Group C ($P = 0.227$), bradycardia was noted in 1 (3.3%) in Group B and 2 (6.7%) in Group C ($P = 0.355$), and tinnitus in 1 (3.3%) ($P = 0.364$) and perioral numbness were noted in 1 (3.3%) ($P = 0.364$) cases only in Group C. All the results were statistically non-significant among the groups. Similar results were found in a study by Gupta *et al.* (2014)[17] while comparing 0.5 μg/kg of dexmedetomidine with 1 μg/kg of dexmedetomidine as an additive to lignocaine. Our study also correlate with the study of Abdelkadera *et al.*[18] who reported statistically insignificant adverse effects in patients received dexmedetomidine in IVRA as adjuvant. Bhaumik *et al.*[19] in their study also reported statistically insignificant rate of complications in the group receiving dexmedetomine as an adjuvant. Our study results also correlate with that of Jewliker and Suryawanshi[20] who also found similar results in their study.

CONCLUSION

The addition of dexmedetomidine to lidocaine for IVRA shortens the onset times for both sensory and motor blockade, improves the quality of the anesthesia, and extends post-operative analgesia time. This study also demonstrated that the addition of 1 μg/kg dexmedetomidine to lignocaine for IVRA showed significantly better improvement in the quality of anesthesia and post-operative analgesia in comparison to 0.5 μg/kg dexmedetomidine, without causing any significant side effects.

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