How to Cite:
Kishan, C., Kumar, N. S., Rao, G. H., & Madhala, K. (2022). Comparative study of Intravenous Dexmedetomidine as Premedication versus supplementation for spinal anaesthesia with Intrathecal 0.75% Isobaric Ropivacaine in elective lower limb surgeries and lower abdominal surgeries: Government general hospital, Nizamabad. *International Journal of Health Sciences*, *6*(S1), 12144–12155. https://doi.org/10.53730/ijhs.v6nS1.8040

Comparative study of Intravenous Dexmedetomidine as Premedication versus supplementation for spinal anaesthesia with Intrathecal 0.75% Isobaric Ropivacaine in elective lower limb surgeries and lower abdominal surgeries: Government general hospital, Nizamabad

Chintala Kishan
Associate Professor, Department of Anaesthesia, Ayaan Institute of Medical sciences Teaching Hospital and Research center, kanakamamidi, Moinabad, Rangareddy, Telangana, India.

Neela Sandeep Kumar
Assistant Professor, Department of anesthesiology, Government Medical College and Government general hospital. Nizamabad, Telangana, India.

Gullapalli Hanumantha Rao
Associate Professor, Department of Anaesthesia, Kakatiya Medical College and Kakatiya general hospital, Warangal, Telangana, India.

Kiran Madhala
Associate professor, Department of anesthesiology, Government Medical College and Government general hospital. Nizamabad, Telangana, India.
Corresponding author email: drkiranmadala7@gmail.com

***Abstract*---**Background: Spinal anesthesia is commonly administered intraoperatively. However, relative short duration of action is associated with local anesthetics. A variety of adjuvants is used for prolongation of postoperative analgesia. Aims and Objectives: Comparative analysis of intravenous dexmedetomidine as a premedication and spinal anesthesia treatment with intrathecal isobaric ropivacain of 0.75% in elective lower limb surgery and lower abdominal surgery. Material and Methods: Following approval by the ethical committee, 60 patients scheduled for elective lower limb orthopedic surgery and lower abdominal surgery were chosen and randomized into two groups (n=30). The patient was then intrathecally

administered 3 ml amount of 0.75 percent isobaric ropivacaine in lateral location. Another syringe containing dexmedetomidine was given after 10 minutes of placement, for 10 minutes using syringe pump. Comparison of sensory block initiation, analgesic effects and hemodynamic effects was made between the 2 classes. Results: Comparison of age distribution of (P=0.164) was not statistically important. In Group P, the median age was (40.96 ± 15.3 years) and in Group S (44.33 ± 12.66 years). Both groups' Mean HR is comparable except for three time periods of 10, 20, 30 minutes in which HR is significantly low in the premedication group compared to group S with P (P<0.05). In group S with P (P<0.04), the mean of SBP is slightly smaller in premedication than in group S with P. The Sensory Blockade Mean Highest level of both groups is similar but Group P reached a comparatively higher level than Group S, with no statistical significance P>0.05. There was no statistically meaningful difference between the two parties for the adverse effects (P>0.05). Conclusion: Dexmedetomidine as premedication or spinal anesthesia treatment with 0.75 per cent intrathecal isobaric ropivacaine in elective lower limb surgery and lower abdominal surgery. However, clinical studies to prove its efficacy and safety and varying dosages for supplementation of spinal local anaesthetics are recommended.

***Keywords*---**Dexmedetomidine, Isobaric ropivacaine, Intrathecal, Supraclavicular, Sensory block.

Introduction

Preference for neuraxial anesthesia was a growing trend especially in orthopedic surgeries with lower limbs due to its advantages over general anesthesia including protection, efficacy and reduced adverse effects leading to shortened hospital stays [1]. In addition, with the increasing knowledge that postoperative analgesia plays a significant role in patients' improved postoperative outcomes, importance is put on interventions that have positive effects on the pain score resulting in reduced postoperative rescue analgesic requirements [2].

In this sense, promising findings were reported using neuraxial adjuvants[3, 4] to minimize the need for rescue analgesics relative to local anesthetic agents (LA) alone. As an adjuvant to intrathecal LA, the dexmedetomidine, α2 receptor agonist, has been shown to be effective in prolonging postoperative analgesia. [5,6] Likewise, intravenous dexmedetomidine as an adjuvant in the subarachnoid block results in extended analgesic length and a drop in post-operative rescue analgesic requirements[7].

Ropivacaine has been used in infants for systemic penetration, epidural, brachial and peripheral blocks of nerves, and clinical reports suggest that ropivacaine is both effective and safe in children for regional anesthesia [8, 9]. Ropivacaine's lipid solubility is smaller than that of bupivacaine, which explains its significantly lower potency compared with bupivacaine [10]. In an equivalent dosage of

milligrams ropivacaine offers a shorter analgesic duration and a lower motor block than bupivacaine, particularly when small doses are used.

This research was performed to compare the health, consistency, efficacy of Intravenous Dexmedetomidine 0.5 µg / kg as a premedication versus treatment in patients with intrathecal isobaric 0.75% ropivacaine for lower abdominal and lower limb surgery.

Materials and Methods

After approval by the Committee on Institutional Ethics and written informed consent, study was conducted at Anesthesiology Department, Government General Hospital, Nizamabad. Study length Aug 2015-November 2016. Sixty patients aged between 18 years and 70 years of physical status ASA grade 1 and ASA grade 2 undergoing elective lower limb and lower abdominal surgery lasting more than 30 minutes will be included in the study.

That patient was pre-operatively examined, and consent was given to the treatment described and written and advised. All the regular examinations needed for pre-operative examination and the planned surgery will be carried out. All patients were tablet rantac150 mg to be pre-medicated, tablet alprazolam 0.5 mg overnight. As per normal protocol, patients were eligible for a time of total fasting. Upon arrival in the operating room, 18 G Intravenous cannula was secure intravenous line, and iv fluids be started as per standard protocol for patients. Patients based on a sealed opaque technique of envelope allotted to the respective group.

Now, as per the sealed opaque envelope application, were must fill two syringes one containing 0.5mcg / kg dexmedetomidine in 10 ml of regular saline and the other 10 ml of normal saline syringe, marking it as syringe A & B. (10ml was taken in syringe pump-suitable syringes of 20ml or 50ml). Patient was sifted onto linking operating table controls.

Experimental study

Group P (n=30) was administered with a syringe pump to infuse dexmedetomidine containing solution over 10 minutes. Then in lateral position the patient was given 3 ml volume of 0.75 percent Isobaric Ropivacaine Intrathecally. Patient was placed in supine condition during spinal treatment. A further syringe of regular saline was given after 10 minutes of placement, using syringe pump for over 10 minutes.

A syringe pump was used to infuse **Group S (n=30**) with standard saline containing solution over 10 minutes. Then in lateral position the patient was given 3 ml volume of 0.75 percent Isobaric Ropivacaine Intrathecally. Patient was placed in supine condition during spinal treatment. Another syringe containing dexmedetomidine was given after 10 minutes of placement, for 10 minutes using syringe pump.

The primary investigator had been blinded to the contents of the syringes during the experiment. Monitoring was done using multi-parameter automated monitoring. This has been tracked critical parameters such as pulse rate, non-invasive blood pressure, respiratory rate, SPO_2.

L3-L4 space was pierced with spinal needle under all aseptic precautions and the total volume of 3 ml of drug 0.75 percent isobaric ropivacaine was intrathecally deposited. Immediately after the deposition was done, the patients were forced to lie in the place of the supine. If the pulse oximetry reading fell below 95%, oxygen was delivered via a mask. Hypotension defined as, a reduction in systolic blood pressure by more than 20 percent from baseline or less than 90 mm Hg SBP (systolic blood pressure) was treated with incremental intravenous doses of mephentramine 6 mg and additional intravenous fluid as per the standard protocol.

Bradycardia described as having heart rhythm less than 60 beats per minute treated with 0.01mg / kg intravenous atropine as per normal treatment. Saline cotton swab along the midclavicular line has been analyzed for sensory monitoring, for onset and dermatomal levels were measured every 20 sec before the maximum level for two consecutive tests had normalized. At this point, now as per the sealed envelope code, co-worker will load the drug and for group P patients normal saline is given in 10ml normal saline, if its group S patient was given 10ml of 0.5mcg / kg IV demedetomidine over ten minutes as a supplement.

Testing was then conducted every 30 minutes until the point of block regression of two segments and full sensory block length. Patients with spinal concentrations of T2 or less were excluded for 58. Supplementation so as to avoid unforeseen complications. Data concerning the time from the time of injection to reach the highest dermatomic level of sensory blockade, time for two sensory regressions in the segment was collected. Updated bromage scale was appraised for the engine block. Sedation was measured at different time points using Ramsay sedation scale as defined in preformed research.

Patients were moved to the post-anesthesia care and recovery unit after the surgery where they will remain until the sensory and motor blockade is fully recovered. Postoperative vital parameters were recorded every fifteen minutes, as well as any adverse events such as nausea, vomiting, pruritus, shivering, *etc*. When patient complains of pain at surgical site, the time for rescue analgesia was recorded and treated with suitable analgesic. It also noted time to recover the lower limb motor function defined as time to hit changed bromage scale 0. All the parameters were reported and evaluated statistically according to the preformed ones.

Statistical analysis

All parametric data are presented as mean ± SD and non-parametric data tabulated. All parametric data statistically analysed using Z test and non-parametric data analyzed using Chi-square test and Fisher exact test as appropriate. P value < 0.05 was considered as statistically significant. Statistical analysis was performed using the statistical packaged for originPro 8.5.

Results

The comparison of age distribution was statistically not significant with (*P* valu=0.164).The mean age in Group P was (40.96±15.3 years) and in Group S was (44.33±12.66years).Hence both groups are comparable. Comparison of gender distribution was statistically not significant (*P*=0.754). Hence both groups are comparable. ASA grade in both the groups were no statistically significant difference between the two groups in ASA grade (*P*=0.663).The mean height in Group P was 166.80 ± 3.77 cms which was comparable with the Group S-166.07 ± 4.87 cm and the difference was statistically not significant (*P*=0.518).

The mean weight in Group P was 62.47 kgs with 5.036 SD and was equal to Group S 65.03 kgs with 5.136 SD and the disparity was not statistically important (*P* value 0.05). Surgery (Lower abdominal-soft tissue surgery) performed total patient numbers 51 (group-P=25 and group-S=25), ortho (lower limb) performed total patient numbers 9 (group-P=5; group-S=4). There was no statistically meaningful difference between the P values of the two classes 1.0.
The mean HR of both groups is similar except for three time intervals of 10, 20, 30 minutes in which HR in premedication group is slightly lower than group S with P value<0.05 as shown in table-1.

Table 1
Heart rate at different time intervals between the study groups

Pulse	Group-P (N=30)	Group-S (N=30)	*P*- value
	(Mean ± SD)		
0 min	82.10 ± 9.98	85.56 ± 8.13	0.146
5 min	74.83 ±9.28	79.83 ±8.74	0.036*
20 min	64.90 ±8.96	70.23 ±8.22	0.020*
30 min	64.30±6.90	68.13 ±7.34	0.042*
40 min	65.00 ±5.01	66.10 ±3.80	0.343
50 min	66.13 ±4.29	65.00 ±3.28	0.256
60 min	65.36 ±10.21	67.26±5.21	0.369
90 min	70.733±3.15	69.76 ±5.71	0.428
120 min	75.83 ±7.14	73.93 ±8.59	0.363

**P < 0.05 was considered statistically significant (Chi square); **P < 0.001was highly significant; nsp = not significant*

The Mean SBP of both groups is comparable at 60 minutes, except for one time period. In group S of premedication, the mean of SBP is significantly low than in group S with P (*P*<0.04 as shown in table -2.

Table 2
Systolic blood pressure at different time intervals between the treatment groups

SBP	Group-P (N=30)	Group-S (N=30)	*P*- value
	(Mean ± SD)		
0 min	132.93 ± 12.29	136.60 ±11.55	0.239
5 min	114.93±22.52	124.37±13.25	0.54

20 min	109.06±12.950	110.23±15.41	0.752
30 min	108.76±13.96	108.40±13.18	0.917
40 min	106.83±13.68	107.80±13.87	0.787
50 min	104.80±13.81	109.60±11.26	0.146
60 min	104.20±13.41	113.03±9.19	0.004*
90 min	117.30±12.37	116.83±10.75	0.825
120 min	121.93±13.20	120.60±10.25	0.672

**P < 0.05 was considered statistically significant (Chi square); **P < 0.001was highly significant; nsp = not significant*

The Mean DBP of both groups are comparable except at two time periods at 10 and 60 minutes,in which Mean DBP is significantly low in premedication group than group S with P value<0.05 as shown in a table :3. The mean DBP of both groups is comparable except for two time periods of 10 and 60 minutes, in which the mean DBP in group premedication is significantly low compared to group S with P the value *P*<0.05 as shown in table:3

Table 3
Diastolic blood pressure at different time intervals between the treatment groups

DBP	Group-P (N=30)	Group-S(N=30)	*P*- value
	(Mean ± SD)		
0 min	81.23± 8.32	84.67± 8.84	0.127
5 min	71.66± 8.98	78.00± 10.10	**0.013***
20 min	66.50± 10.01	68.96± 7.01	0.274
30 min	69.90± 7.96	66.63± 8.00	0.119
40 min	68.80± 6.42	67.50± 8.53	0.508
50 min	67.56± 6.13	66.80± 7.24	0.660
60 min	65.56± 4.60	69.46± 5.51	**0.004***
90 min	70.16± 6.30	70.30± 7.10	0.939
120 min	73.21± 8.90	72.00± 7.40	0.525

**P < 0.05 was considered statistically significant (Chi square); **P < 0.001was highly significant; nsp = not significant*

The Median RSS (Ramsay sedation score) of both groups are comparable except at one time periods at 50 minutes,in which Median RSS is significantly low in premedication group than group S with P value <0.05. The S2 and T0 level of the mean onset of sensory blockade of both groups is comparable, and the onset is relatively early in group P premedication than group S, with no statistical significance *P* value>0.05.

The Sensory Blockade Mean Highest level of both groups is comparable, but Group P has reached a relatively higher level than Group S, with no statistical significance *P* value>0.05. The median length of two dermatomal analysis in Sensory Blockade of both groups is similar but was more longer in Group P rather than in Group S, with statistical significance P value=0.03. For premedication group P, the Maximum mean time of 1st analgesic time duration is slightly increased relative to group S, with statistical significance (*P*=0.022) as shown in a table-4.

Table 4
Comparison of Onset of sensory blockade

Variables	Group-P(N=30)	Group-S (N=30)	*P*- value
	(Mean ± SD)		
onset of sensory block at S2 level (in sec)	73.00 ± 21.03	78.00 ± 27.71	0.43
onset of sensory block at T10 level (in sec)	189.00 ± 28.33	201.00 ± 46.11	0.23
Highest level of sensory block	6.13 ± 1.548	6.87 ± 1.358	0.056
Duration of 2 dermatomal regression of sensoryblock (min)	105.0 ± 16.1	96.33 ± 22.2	0.033*
Regression of sensory block to T10(min)	127.33 ± 32.04	120.33 ± 32.21	0.40
1st analgesic request time(min)	184.33 ± 26.48	166.33 ± 32.53	0.02*
Complete duration of sensory block time(min)	256.67 ± 24.12	258.67 ± 27.26	0.76

**P < 0.05 was considered statistically significant (Chi square); **P < 0.001was highly significant; nsp = not significant*

The overall mean length of full initiation of MB (motor blockade) to modified bromage scale 3 is similar in both groups and with no statistical difference relative early in the premedication population (*P* = 0.75). The cumulative mean length of MB regression to modified bromage scale 0 is similar in both groups and fairly early with no statistical significance in the premedication community (*P* = 0.67) as seen in table-5.

Table 5
Comparison of onset of motor blockade

Variables	Group-P(N=30)	Group-S (N=30)	*P*- value
	(Mean ± SD)		
Onset of motorblock to modified bromage Scale 1 (sec)	208.00 ± 48.52	231.33 ± 17.85	0.28
Time to set complete MB to modified bromage Scale 3(sec)	542.67 ± 28.03	555.00 ± 38.93	0.75
Duration of complete MB time taken to regression of MBS from 3 to 2 (min)	147.00 ± 20.70	156.67 ± 43.16	0.27
Total duration of MB regression to modified bromage scale 0(min)	238.33 ± 25.06	241.33 ± 29.68	0.67

**P < 0.05 was considered statistically significant (Chi square); **P < 0.001was highly significant; nsP = not significant*

There was no statistically significant difference in the adverse effects among the two groups (*P*>0.05).

Discussion

Dexmedetomidine, a potent agonist of the α_2-adrenoceptor, has analgesic and sedative properties and was used originally for intravenous sedation. The use of dexmedetomidine as an adjuvant to spinal anesthesia has been widely reported to prolong the length of both arousable sedation for motor sensory blockade and analgesia [11]. In meta-analysis it has been shown that dexmedetomidine prolonged spinal anesthesia duration and improved postoperative analgesia [12].

The promoting effects of intravenous dexmedetomidine on the duration of spinal anesthesia and suggested that it could extend the length of the sensory barrier, motor block, and first analgesic order relevant to spinal anesthesia [13]. The investigators proposed the benefits of dexmedetomidine intravenous as a premedication for spinal anesthesia. Dexemedetomidine is also used for spinal anesthesia treatment and has similar benefits to adjuvant [14].

Patients demonstrate sedation effects with an average ramsay sedation score (RSS) of 2.93 and 2.80 respectively over a 60-minute duration, and the initiation of sedation effect with a score of 3 happens early in premedication community with no statistical significance ($p>0.05$). Similar analysis of harsoor *et al* [15] found that in dexmedetomidine group the mean intraoperative RSS was (2.34 ± 1.1) (P=0.034). The average RSS in the dexmedetomidine and midazolam groups was larger in the analysis of kaya *et al* [16] than in the saline group. In the analysis of gupta *et al*[17] the average mean RSS of (3.78 ± 0.47) in supplementation community patients was obtained after 20 min of intravenous dexmedetomidine.Dexmedetomidine affects the cerulean locus of the brain, which causes sedation that resembles normal sleep by regulation of sleep and stimulation of respiration[18].

Therefore, these findings are observed that the mean time for reaching T10 sensory block level was 189.00 ± 28.33 seconds in the premedication group and 201.00 ± 46.11 seconds with no statistical significance in the supplementation community (P=0.23). In their research, Harsoor *et al.*[15] find premedication with i.v. dexmedetomidine fastens sensory block time at the onset.Different analysis of lee *et al*[19], found 1.8 ± 2.6 minutes in the category of premedication and 2.5±3.5 minutes in power. Hamed *et al* [20], also observed little difference in starting time, recorded 2.8 ± 1.7 minutes in the support group and 2.9 ± 1.3 minutes in the control group , respectively. We conclude that there is no difference between the group of premedication and supplementation in onset time for the sensory block.

In our sample, the maximum degree of sensory block was in group P (6.3 ± 1.53) and in group S (6.8 ± 1.39), with no statistical discrepancy. Kaya *et al*[16], sensory block found to be higher in the dexmedetomidine premedication group (4.6 ± 0.6) than in the control group (6.4 ± 0.8). In the Kumar *et al* study[21], the highest sensory block frequency was higher in the dexmedetomidine group (6.8 ± 1) compared to the control group (7.66 ± 0.8).

In our sample, the mean time taken from injection to two dermatomal regression was 105±16.1 minutes in group P of premedication equal to 96.33±22.2 minutes in group S of supplementation with statistical significance (P=0.033). Similar

findings in lee *et al*[19], 86.5±24.3 min in group premedication and group control 57.6±23.2 minutes. Our results indicate a longer period in premedication community for two segmental regressions.

In Group P; 184.33±26.48 minutes the mean time needed for first analgesic demand is comparatively longer than in Group S; 166.3±32.53 minutes with statistical significance (P=0.02). Such values are equivalent to the reddy *et al* study [22], which observed 243.35±56.82 minutes in group of premedication and 140.75±28.52 minutes in group of controls. Our study has shown dexmedetomidine premedication prolongs analgesia's duration better than supplementation.

The overall length of the sensory obstruction in Group S (258.66 ± 26.2 minutes) was comparatively longer than in Group P (256.6 ± 2 6.2 minutes), with little statistical significance (*P*> 0.05). We infer that, according to the overall length of the sensory barrier, there is little distinction between premedication and supplementation.

The mean start time for adjusted bromage score 3 motor unit in our sample is 542.6 ± 128.2 seconds in Group P and 555 ± 168.9 seconds in Group S with no statistical significance *P*>0.05.

In Group S (241.3 ± 29.68 minutes) the total duration of the engine blockade is relatively longer than in Group P (238.6±25 minutes) with no statistical significance (*p*>0.05). There was no difference between the two classes according to the overall motor block duration [23]. In our research, the use of low dose IV dexmeditomidine with spinal anesthesia isobaric ropivacaine is relatively cardiac stable with low occurrence of bradycardia 4 out of 30 cases in Group P, 3 out of 30 cases in Group S and reversible with atropine.Hypotension was noted in Group P in 4 out of 30 cases, and in Group S in 3 out of 30 cases without statistical significance p>0.05 and with mephentramine reversible. In harsoor et al study[15], 2 out of 25 cases in IV group dexmedetomidine and 1 out of 25 in control group were noticed.

This hemodynamic stabilization in our sample was possibly due to isobaric ropivacaine and i.v. dexmedetomidine given at a low dose of mcg / kg and over duration of 10 min instead of fast infusions of bolus and mainteinance. In our study, there is no report of respiratory depression, and no incidence of oxygen desaturation, despite satisfactory sedation.

Conclusion

Dexmedetomidine as premedication or spinal anesthesia treatment with 0.75 per cent intrathecal isobaric ropivacaine in elective lower limb surgery and lower abdominal surgery. Both premedication and supplementation of low dose 0.5 mcg / kg i.v. Dexmedetomidine in patients with spinal anesthesia yields exciting sedation without adverse effects, but there was no difference between the groups. Sensory block initiation was quicker, analgesia length was higher, and two sensory block dermatome regression was slower in the premedication community relative to the supplementation community.The maximum dermatomal sensory

blockade and complete blockade length between the groups were not important. Onset of motor blockade, overall motor blockade length, and motor blockade consistency were comparable between the two classes. Cardiac rates and changes in blood pressure were comparable between the groups. Nonetheless, clinical studies to prove its efficacy and safety and varying dosages for supplementation of spinal local anaesthetics are recommended.

Acknowledgements
Authors would like to thank the department faculty and their patients; without their support, this study would not have been possible.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflicts of interest.

Ethical approval: The study was approved by the Institutional Ethics Committee of Government general hospital, Nizamabad, Telangana, India.

References

[1] Mauermann WJ, Shilling AM, Zuo Z. A comparison of neuraxial block versus general anesthesia for elective total hip replacement: a meta-analysis. Anesthesia & Analgesia. 2006;103(4):1018-25..
[2] Gottschalk A, Durieux ME, Nemergut EC. Intraoperative methadone improves postoperative pain control in patients undergoing complex spine surgery. Anesthesia & Analgesia. 2011;112(1):218-23.
[3] Borah TJ, Dey S, Yunus M, Dev P, Karim HM, Bhattacharyya P. Effect of different doses of intrathecal nalbuphine as adjuvant to ropivacaine in elective lower limb surgeries: A dose finding study. Indian Journal of Anaesthesia. 2018;62(11):865-70
[4] Ture P, Ramaswamy AH, Shaikh SI, Alur JB, Ture AV. Comparative evaluation of anaesthetic efficacy and haemodynamic effects of a combination of isobaric bupivacaine with buprenorphine vs. isobaric levobupivacaine with buprenorphine for spinal anaesthesia–A double blinded randomised clinical trial. Indian journal of anaesthesia. 2019;63(1):49-54.
[5] Solanki SL, Bharti NA, Batra YK, Jain A, Kumar P, Nikhar S. The analgesic effect of intrathecal dexmedetomidine or clonidine, with bupivacaine, in trauma patients undergoing lower limb surgery: a randomised, double-blind study. Anaesthesia and intensive care. 2013;41(1):51-6.
[6] Yektaş A, Belli E. The effects of 2 μg and 4 μg doses of dexmedetomidine in combination with intrathecal hyperbaric bupivacaine on spinal anesthesia and its postoperative analgesic characteristics. Pain research and management. 2014;19:75-81.
[7] Annamalai A, Singh S, Singh A, Mahrous DE. Can intravenous dexmedetomidine prolong bupivacaine intrathecal spinal anesthesia?. J Anesth Clin Res 2013;4:372.
[8] Hansen TG. Ropivacaine: a pharmacological review. Expert review of neurotherapeutics. 2004 ;4(5):781-91.

[9] Kokki H, Ylönen P, Laisalmi M, Heikkinen M, Reinikainen M. Isobaric ropivacaine 5 mg/ml for spinal anesthesia in children. Anesthesia & Analgesia. 2005;100(1):66-70.
[10] Åkerman B, Hellberg IB, Trossvik C. Primary evaluation of the local anaesthetic properties of the amino amide agent ropivacaine (LEA 103). Acta anaesthesiologica scandinavica. 1988;32(7):571-8.
[11] Swami SS, Keniya VM, Ladi SD, Rao R. Comparison of dexmedetomidine and clonidine (α2 agonist drugs) as an adjuvant to local anaesthesia in supraclavicular brachial plexus block: A randomised double-blind prospective study. Indian journal of anaesthesia. 2012;56(3):243.
[12] Niu XY, Ding XB, Guo T, Chen MH, Fu SK, Li Q. Effects of Intravenous and Intrathecal Dexmedetomidine in Spinal Anesthesia: A Meta-Analysis. CNS neuroscience & therapeutics. 2013;19(11):897-904.
[13] Abdallah FW, Abrishami A, Brull R. The facilitatory effects of intravenous dexmedetomidine on the duration of spinal anesthesia: a systematic review and meta-analysis. Anesthesia & Analgesia. 2013;117(1):271-8.
[14] Tarbeeh GA, Mohamed AA. Effects of intrathecal bupivacaine, fentanyl versus bupivacaine–dexmedetomidine in diabetic surgical patients. Egyptian journal of anaesthesia. 2013;29(1):13-8.
[15] Harsoor SS, Rani DD, Yalamuru B, Sudheesh K, Nethra SS. Effect of supplementation of low dose intravenous dexmedetomidine on characteristics of spinal anaesthesia with hyperbaric bupivacaine. Indian Journal of Anaesthesia. 2013;57(3):265.
[16] Kaya FN, Yavascaoglu B, Turker G, Yildirim A, Gurbet A, Mogol EB, Ozcan B. Intravenous dexmedetomidine, but not midazolam, prolongs bupivacaine spinal anesthesia. Canadian Journal of Anesthesia/Journal canadien d'anesthésie. 2010 ;57(1):39-45.
[17] Gupta K, Tiwari V, Gupta PK, Pandey MN, Agarwal S, Arora A. Prolongation of subarachnoid block by intravenous dexmedetomidine for sub umbilical surgical procedures: A prospective control study. Anesthesia, Essays and Researches. 2014;8(2):175.
[18] Gertler R, Brown HC, Mitchell DH, Silvius EN. Dexmedetomidine: a novel sedative-analgesic agent. InBaylor University Medical Center Proceedings. BUMC Proceedings 2001;14:13–21
[19] Lee MH, Ko JH, Kim EM, Cheung MH, Choi YR, Choi EM. The effects of intravenous dexmedetomidine on spinal anesthesia: comparision of different dose of dexmedetomidine. Korean journal of anesthesiology. 2014 Oct;67(4):252.
[20] Hamed AM, Talaat SM. Effect of intravenous versus intrathecal low-dose dexmedetomidine on spinal block in lower limb orthopedic surgery. Ain-Shams Journal of Anaesthesiology. 2014;7(2):205.
[21] Kumar SK, Kumar CA, Murthy SG. A Comparative Prospective, Randomised, Double Blind Study of the Effect of IV Dexmeditomidine on Subarachnoid Block Versus 0.9 % Normal Saline as Control. Sch J App Med Sci. 2014; 2(5A):1517-1523.
[22] Reddy V, Shaik N, Donthu B, Sannala V, Jangam V. Intravenous dexmedetomidine versus clonidine for prolongation of bupivacaine spinal anesthesia and analgesia: A randomized double-blind study. Journal of Anaesthesiology Clinical Pharmacology. 2013; 29(3):342.

[23] Elcicek K, Tekin M, Kati. The effects of intravenous dexmedetomidine on spinal hyperbaric ropivacaine anesthesia. Journal of Anesthesia. 2010; 24(4):544-548.