e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(10); 1116-1122

Original Research Article

Efficacy of Epidural Dexmedetomidine versus Epidural Fentanyl for Lower Abdominal Surgeries using Combined Spinal Epidural Technique (CSE) with Isobaric Ropivacaine

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Received: 25-07-2023 / Revised: 28-08-2023 / Accepted: 30-09-2023

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Conflict of interest: Nil

Abstract:

Background: Management of post-operative pain is still one the great concerns of anesthesiologists. Various adjuvants have been used with local anesthetics in regional anesthesia to provide good operating conditions and an excellent intra operative and prolonged postoperative analgesia. Dexmedetomidine is the new agent that is being used as a neuraxial adjuvant apart from opioids which is quite a familiar trend.

Aim: The aim of this study was to evaluate the ease of performing surgery, effectiveness of post-operative analgesia using visual analogue scale score, patient satisfaction score, total rescue analgesic consumption when fentanyl or dexmedetomidine were given as an additive to ropivacaine for epidural anesthesia.

Material and Methods: 100 adult patients belonging to American Society of Anesthesiologists class I and II, of either sex, aged between 18-65 years posted for elective lower abdominal surgeries (mainly low anterior resection that were completed within three hours of duration) were enrolled for the study and were divided into two groups of 50 patients each. Group F received 10ml of 0.5% isobaric ropivacaine with fentanyl 1 µg/kg for postoperative analgesia and Group D received 10ml of 0.5% isobaric ropivacaine with dexmedetomidine 1µg/kg for postoperative analgesia. The study drugs were given in 5ml boluses at 30 minutes and 60 minutes after initial intrathecal administration. The post-operative analgesia scores, rescue analgesic consumption and patient satisfaction scores were observed.

Results: It was of great ease for both surgeons as well as patients who received epidural dexmedetomidine and fentanyl as an adjuvant to ropivacaine providing excellent operating conditions, lower post-operative visual analogue scale score and a good patient satisfaction score.

Conclusion: Dexmedetomidine seems to be a better alternative to fentanyl as adjuvant to epidural ropivacaine.

Keywords: Dexmedetomidine, fentanyl, ropivacaine, combined spinal epidural anesthesia, postoperative analgesia.

Introduction

Relief of pain during surgery is one major component of balanced anesthesia, but this pain relief should be extended to the postoperative period also. The use of neuraxial blockade using local anesthetic agents via the epidural route for postoperative analgesia has gained impetus in the last few decades. Adding other drugs to the neuraxial block as an adjuvant is a widespread trend to prolong the duration of analgesia without any added side effects [1]. The use of neuraxial opioids is associated with quite a few side effects (such as respiratory depression, nausea, urinary retention, and pruritis), so various options including α-2 agonists like clonidine, dexmedetomidine, magnesium and dexamethasone are being extensively evaluated as alternatives with an emphasis on opioids sparing side effects. Alpha-2 agonist like dexmedetomidine when used as an adjuvant has been shown to increase sensory and motor block duration in epidural anesthesia with

ropivacaine and prolongs postoperative analgesia with no significant hemodynamic instability [2]. Epidural analgesia has become the most commonly used technique for effective postoperative pain relief following open abdominal surgery [3]. The addition of opioids such as fentanyl lowers the dose of local anesthetic required and also provides superior analgesia by its action on a separate pain pathway, namely, μ-opioid receptors. Dexmedetomidine is a highly selective alpha-2A receptor agonist that decreases the sympathetic outflow and nor-epinephrine release and mediates analgesic effects [4]. Epidural anaesthesia and analgesia have commonly been used for the management of postoperative pain after abdominal surgery and shown to decrease hospital stay, morbidity, and overall mortality [5].

The role of regional anaesthesia is increasing in day-to-day practice and we conducted this study with the primary aim of comparing the efficacy of epidural dexmedetomidine and fentanyl as adjuncts to ropivacaine in lower abdominal surgeries to observe the effects and benefits of regional anaesthesia in pain management.

Material and Methods

This prospective, observational study was conducted in the Department of Anesthesiology and Critical Care, at Sheri-Kashmir Institute of Medical Science (Deemed University), Soura, Srinagar, Jammu and Kashmir after approval by the Institutional Ethical Committee. Informed written consent was obtained from all the patients for participation in this study. A total number of 100 adult patients belonging to the American Society of Anesthesiologists (ASA) Grade I and II, of either sex, aged between 18-65 years posted for elective lower abdominal surgeries were enrolled for the study. Uncooperative patients, pregnant patients, patients requiring emergency surgery, any allergy to drugs used or with severe cardiopulmonary and renal ailments, and laparoscopic surgeries or any procedure extending beyond 3 hours duration were excluded from the study.

The study population was divided into two groups; Group F (n=50) who received 10ml of 0.5% isobaric ropivacaine with fentanyl 1 μg/kg for postoperative analgesia and Group D (n=50), who received 10ml of 0.5% isobaric ropivacaine with dexmedetomidine 1μg/kg for postoperative analgesia. The study drug was given in 5ml boluses at 30 minutes and 60 minutes after initial intrathecal administration. Patients were briefed about the procedure to be done and the technique of spinal and epidural anesthesia in their local language and explained the standard visual analogue pain scale for pain evaluation in the postoperative period. The lumbar area was prepared aseptically and draped and inter-vertebral space at L3-4 and L2-3 was identified and combined spinal epidural anaesthesia was performed using a two-level approach. Another space, one level below the epidural insertion was identified, and the standard spinal procedure was performed using a 27G Whitacre spinal needle. The onset of sensory blockade at T10 level was checked with loss of temperature sensation to ice packs and the Motor block of lower limbs was assessed by using the Bromage Scale. The target sensory level was the T4 segmental dermatome.

Hemodynamic variables such as heart rate, NIBP, SpO2, and arterial blood pressure were monitored throughout the intra-operative period and systolic blood pressure of less than 90 mm of Hg was treated with ephedrine hydrochloride 6 mg IV and intravenous fluids as required. Bradycardia (heart rate < 60/min) was treated with 0.6 to 1.2mg atropine. The variables that were recorded between Group F and Group D were:

1) Duration of postoperative analgesia in two groups.
2) Quality of postoperative analgesia in two groups.
3) Timing of first rescue analgesia in two groups.
4) Total postoperative rescue analgesic requirement.

Any intra-operative and postoperative side effects (in the form of nausea, vomiting, pruritus, shivering, urinary retention, respiratory depression, hypotension, or bradycardia) during the first 24 hours were recorded. Total postoperative analgesic consumption and epidural top-ups were recorded. Rescue analgesia was given postoperatively in the form of an injection of tramadol 1.5mg/kg in Normal Saline (total volume 10ml) through an epidural catheter. Quality of postoperative analgesia was assessed by patient satisfaction score, as judged by patients themselves; 4 (excellent), 3 (good), 2 (fair), 1 (poor). Repeat top-ups of the same dosage were administered as and when necessary to keep VAS <4. All cases were followed up to 24 hours post-surgery, and the epidural catheter was then removed.

Statistical analysis

The recorded data was compiled and entered in a spread sheet (Microsoft Excel) and then exported to the data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as mean±SD and categorical variables were summarized as frequencies and percentages. Student's independent t-test was employed for comparing continuous variables.

The chi-square test or Fisher's exact test, whichever was appropriate, was applied for comparing categorical variables, the p-value of less than 0.05 was considered statistically significant.

Results

A total of 100 patients who underwent lower abdominal surgery were enrolled in the study and were divided into two groups. The demographic characteristics in both groups exhibited marked similarities and were comparable with respect to mean age, gender distribution, ASA status, and duration of surgery. (p>0.05) [Table 1].

The onset of sensory and motor block was significantly faster in Group D in comparison to Group F, with mean time of onset of sensory block of 11.4±1.52 mins in Group D as compared to 14.2±1.83 mins in Group F and mean onset of motor block in 10.4±1.65 mins in Group D as compared to 12.1±1.84 mins in Group F and the difference was statistically significant (p-<0.001) (Table 2).

Comparison of hemodynamic parameters in both groups: Baseline heart rate was comparable between the two groups (p-value 0.316). From 10 minutes onwards, a lower mean heart rate was observed in group D (73.58 ±5.63) as compared to group F (83.16±4.74). Thereafter, the mean heart rate remained significantly lower in group D as compared to group F throughout the entire intra-operative period. Similarly, the baseline (BL) SBP readings were comparable between the two groups. From 10 minutes onwards, a lower mean SBP was observed in group D as compared to group F. The difference in mean SBP between the two groups was statistically significant (p<0.001 [Table 3]. The baseline DBP readings were comparable between the two groups. The comparison between the intra-operative diastolic blood pressure (DBP in mmHg) at various intervals of time between the two groups was statistically significant (p<0.001) with lower mean DBP in group D. Intra-operative DBP (mmHg) ranged from 75-85 mmHg with the mean of 78.24±4.88 in Group F and 69-75 mmHg with the mean of 72.60 ±4.37 in Group D [Table 3]. The baseline (BL) MAP between the two groups was comparable (p>0.05). Intra-operative MAP (mmHg) ranged from 90-95 mmHg with a mean of 91.70±4.37 in Group F and 80-90 mmHg with a mean of 84.65± 3.67 in Group D. A lower MAP was observed in Group D as compared to Group F throughout the intraoperative period. The difference in MAP was statistically significant (p<0.001) at all intervals of time except at 5 minutes (p-value 0.184) [Table3]. Although lower values of systolic, diastolic, and mean blood pressure were observed with the use of epidural dexmedetomidine, no episode of hypotension.

Comparison of post-op block characteristics in both the groups: While comparing the post-operative block characteristics between the two groups it was seen that Group D had a better post-operative profile than Group F (Table 4) with a lower VAS score in Group D (1.72±1.21) as compared to Group F (2.42±1.38). With lower VAS scores, the time to first rescue analgesia was significantly longer in Group D (8.7±1.59 hours) while the time to first rescue analgesia was comparatively earlier in Group F (after 5.96±1.46).

The total rescue analgesic requirements both in number of doses and in milligrams were significantly lower in Group D as compared to Group F thus having a better patient satisfaction score in Group D in comparison to patients in Group F (Table 5). All of these differences were highly significant statistically (P<0.001)

The side effects of the two study drugs were also noted. In Group F, 3 patients (6%) had nausea and 2 patients (4%) had vomiting, while in Group D it was slightly lower. Incidence of bradycardia was somewhat greater with Group D as compared to Group F and no patient in Group F showed bradycardia. However, the difference between the side effects of the two groups was not significant statistically. There was no incidence of hypotension, pruritus, urinary retention, headache, or shivering in any of the groups.

Table 1: Demographic profile of patients of both the groups

Demographic characteristics	Group F (n=50)	Group D (n=50)	P-value
Age (in years)	42.7±11.71	41.3±13.72	0.579
Gender (M/F)	31/19	28/22	0.542
ASA(I/II)	41/9	39/11	0.617
Mean duration of surgery(mins)	141.2±32.72	145.1±33.18	0.551

Table 2: Comparison of initial block characteristics in both the groups

Block characteristics	Group F	Group D	P-value
Onset of sensory block (mins)	14.2±1.83	11.4±1.52	<0.001
Onset of motor block(mins)	12.1±1.84	10.4±1.65	<0.001

Table 3: Comparison of hemodynamic parameters in both groups

Hemodynamic parameters	Group F	Group D	P –value
Heart rate(beats/min)			
Base line	85.14±4.78	84.08±5.70	0.316
After 10mins	83.16±4.74	73.58±5.63	<0.001

Mean	83.26±5.43	74.16±4.79	<0.001
Systolic blood pressure (mmHg)			
Base line	121.27±4.72	120.68±5.57	0.241
After 10 min	119.92±4.54	109.04±5.65	<0.001
Mean	118.95±4.62	109.01±3.24	<0.001
Diastolic blood pressure (mmHg)			
Base line	81.88±6.77	81.72±5.52	0.897
After 10 min	79.90±6.66	73.30±5.52	<0.001
Mean	78.24±4.88	72.60±4.37	<0.001
Mean arterial pressure (mmHg)			
Base line	95.22±5.74	94.71±4.90	0.632
After 10 mins	93.24±5.61	85.21±4.91	<0.001
Mean	91.70±4.37	84.65±3.67	<0.001

Table 4: Comparison of post-op block characteristics in both the groups

Post op block characteristics	Group F	Group D	P-value
• Post op VAS score	2.42±1.38	1.72±1.21	0.008
• Time to first rescue analgesia (in hours)	5.96±1.46	8.7±1.59	<0.001
• Total rescue analgesic doses	2.84±0.745	1.82±0.561	<0.001
• Total analgesic consumption (in mg)	284±73.85	182±56.03	<0.001

Table 5: Showing patient satisfaction score in two groups

Patient Satisfaction Score	Group F		Group D		P-value
	No.	%age	No.	%age	
Excellent	2	4	16	32	<0.001*
Good	15	30	29	58	
Fair	27	54	5	10	
Poor	6	12	0	0	
Total	50	100	50	100	

Discussion

Postoperative pain relief is a growing concern for an anesthesiologist. A multimodal approach for postoperative pain relief using a combination of opioids, NSAIDs and local anesthetics is superior to any modality alone and is highly recommended. Combination regimens have been suggested to be more rational and effective, as they decrease the pain score and postoperative analgesic requirements.

Combined spinal-epidural anaesthesia is a regional anaesthetic technique, which combines the benefits of both spinal anaesthesia and epidural anaesthesia and analgesia. The spinal component gives us a rapid onset of a predictable block and the indwelling epidural catheter gives the ability to provide prolonged analgesia and also to titrate the dose given to the desired effect. The combination of spinal and epidural anesthesia (CSE) provides an efficient and profound block of both sensory and motor nerves, and the presence of an epidural catheter provides flexibility in prolonging surgical block and postoperative pain relief [6]. Soresi was the first to report this technique [7]. Dexmedetomidine is a highly selective α2 adrenergic agonist. Intrathecal α2 receptors are found to have an antinociceptive action for both somatic and visceral pain. Intrathecal α2 adrenoceptor agonists act by depressing the release of C-fiber transmitters and by hyperpolarization of postsynaptic dorsal horn neurons [6].

Demographic data between the two groups were compared (Table 1). The difference in demographic data between the two groups was not of any statistical significance with p values of 0.579 for age, 0.542 for gender, 0.617 for ASA status, and 0.551 for duration of surgery respectively.

Hemodynamic parameters including heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial blood pressure were seen. In our study, baseline hemodynamic parameters were comparable. Intra-operatively, a lower mean heart rate was observed with epidural dexmedetomidine as an adjuvant to ropivacaine as compared to fentanyl. Systolic, diastolic, and mean arterial pressures were also significantly lower with dexmedetomidine as compared to fentanyl (Table 3). Similar results were seen in the study conducted by Kiran S et al.[1], who observed a significantly lower heart rate and mean arterial pressure in patients receiving epidural dexmedetomidine as adjuvant to ropivacaine in comparison with fentanyl in patients undergoing infra-umbilical surgeries. In a study conducted by Jain D et al.,[9] who studied the effect of epidural dexmedetomidine, in conjunction with intrathecal bupivacaine on hemodynamic properties and quality of analgesia and found a significant fall in

heart rate and mean arterial pressure 10±5 minutes after epidural injection of dexmedetomidine that persisted at all the time intervals till the end of the study period. Similarly, in a study conducted by Bajwa SJ et al. [2], a lower heart rate and mean arterial pressure in patients receiving epidural dexmedetomidine. However, in some studies as by Mahendru et al.[10], Ravipati P et al. [11] and Kanazi et al.[12]showed no significant change in hemodynamic parameters in the dexmedetomidine group. This may be due to the reason that the amount of drug volume used in their study was less (3 ml) as compared to 10 ml used in our study. Similarly, Kanazi et al.[12] used 1.9 ml of total drug volume versus 10 ml in the current study. A similar fall in heart rate with the use of epidural dexmedetomidine was also reported in studies by Varghese LA et al.[13], Ahmed el attar et al[6] and Zeng XZ et al [14].

In this study, the onset of sensory block was earlier with dexmedetomidine (group D 11.4±1.52 min) as compared to fentanyl (14.2±1.83 min in Group F), and the difference in time of onset was statistically significant ($p<0.001$) (Table 2). Similarly, the onset of motor block was also earlier in group D as compared to group F (10.4±1.65 min in group D as compared to12.1±1.84 min in group F), p-value <0.001 (Table 2).

Similar results were seen in the study conducted by Kiran S et al. [1], where they observed an earlier onset of sensory block with dexmedetomidine (10.8±2.7 min) as compared to fentanyl (12.8 ± 1.8 min). They also observed a statistically significant difference with regard to the degree of motor block, with the dexmedetomidine group faring better than the fentanyl group. These results are also supported by the results of the studies done by Varghese et al. 2017[13], Ravipati P et al. 2017 [11], Ahmed el attar et al. 2015[8], and Bajwa SJ et al. 2011[2]. They all reported earlier onset of sensory and motor block in the dexmedetomidine group in comparison to the fentanyl group in their respective studies. Dexmedetomidine shortened the onset of sensory block of epidural ropivacaine when used as an adjuvant as compared to epidural ropivacaine alone in a study by Kaur S et al. 2014[15]. Mahendru et al.[10] , however, did not observe any significant difference in the onset of sensory and motor blockade between dexmedetomidine and fentanyl when used as an adjuvant to intrathecal bupivacaine, but the duration of sensory and motor blockade was prolonged in the dexmedetomdine group as compared to fentanyl group.

While comparing the post-operative characteristics a significant difference was noted in both the groups. Patients in the dexmedetomidine group (group D) had a lower VAS score at most of the study stages than the patients in the fentanyl group (Group F), thus indicating better post-operative analgesia and thus more time to first rescue analgesia, less requirement of rescue analgesic doses both in number and milligrams in group D as compared to Group F and this difference was highly significant statistically (Table 4).

Similar results were obtained in the study conducted by Mahendru et al.[10], who in their study compared epidural dexmedetomidine, clonidine, and fentanyl as an adjuvant to hyperbaric bupivacaine and observed a lower VAS score (<3) in patients receiving dexmedetomidine as compared to patients receiving fentanyl and clonidine. Similarly, Gupta R et al.[16], observed a lower VAS score in the dexmedetomidine group in comparison to the fentanyl group. Our results are in concordance with other studies conducted by Parmar NK et al.[17], Kaur et al.[15], Varghese et al.[13] and Ahmed el attar et al.[8], who all observed a lower VAS score for pain in patients receiving dexmedetomidine, thus longer time to first rescue analgesia and overall less consumption of rescue analgesia in patients receiving dexmedetomidine. The patient satisfaction score was also significantly better in group D as compared to group F (p-value <0.001) (Table 5). Most of the patients in Group D had excellent and good patient satisfaction scores, whereas the patient satisfaction score of most patients in Group F was average to poor. These results are similar to the study conducted by Kaur S et al.[15]. They observed better patient satisfaction scores in patients receiving dexmedetomidine as an epidural adjuvant to ropivacaine as compared to epidural ropivacaine alone. Qureshi F et al.[18] demonstrated the superior efficacy, in terms of postoperative analgesia and patient satisfaction scores, of epidural ropivacaine plus dexmedetomidine over that of ropivacaine alone in patients undergoing surgery for the thoraco-lumbar spine. A higher incidence of bradycardia was seen with epidural dexmedetomidine as compared to epidural fentanyl. However, the difference was not statistically significant. It was successfully reversed by i.v atropine administration and did not recur during the post-operative period Although, lower values of systolic, diastolic, and mean blood pressure was observed with the use of epidural dexmedetomidine, no episode of hypotension, significant enough to warrant treatment was observed with the use of either dexmedetomidine or fentanyl. Similar results were found in a study conducted by Kaur S et al.[15], Gupta R et al.[16], Varghese et al.[13], wherein more bradycardia was observed with the dexmedetomidine group as compared to fentanyl, but it was also not statistically significant. Our results are also consistent with a systematic review and meta-analysis conducted by Hussain N et al. [19], Wu HH et al.[20], also showed an increased risk of bradycardia with dexmedetomidine. Similar results

were observed in studies by Ravipati P et al. [11] and Mahendru et al. [10]. The studies conducted by Kiran S et al.[1], Ravipati P et al. [11], Kaur et al.[15], Gupta R et al. [16], showed more incidence of hypotension with the dexmedetomidine group, but this difference was however statistically insignificant. The occurrence of other side effects like nausea, vomiting, pruritis, urinary retention, headache, and shivering were not comparable between the two groups.

Conclusion

This study concluded that dexmedetomidine seems to be a better alternative to fentanyl as an adjuvant to epidural ropivacaine. However, further research on this topic is desirable. Overall, our experience with dexmedetomidine was quite satisfactory during the surgical procedures under regional anaesthesia.

References

1. Kiran S, Jinjil K, Tandon U, Kar S. Evaluation of dexmedetomidine and fentanyl as additives to ropivacaine for epidural anesthesia and postoperative analgesia. Journal Anaesthesiology Clinical Pharmacology. 2018 Jan-Mar; 34(1): 41-5.
2. Bajwa SJ, Bajwa SK, Kaur J, Singh G, Arora V, Gupta S et al. Dexmedetomidine and clonidine in epidural anaesthesia: A comparative evaluation. Indian Journal of Anaesthesia. 2011 Mar; 55(2): 116-21.
3. Schultz AM, Werba A, Ulbing S, Gollmann G, Lehofer F. Peri-operative thoracic epidural analgesia for thoracotomy. Eur J Anaesthesiol. 1997; 14:600–3.
4. Jaakola ML, Salonen M, Lehtinen R, Scheinin H. The analgesic action of dexmedetomidine – A novel alpha 2-adrenoceptor agonist – In healthy volunteers. Pain. 1991; 46:281–5.
5. A Gupta, A. Bjornsson, M. Fredriksson, O. Hallbook ,C. Eintrei. Reduction in mortality after epidural anaesthesia and analgesia in patients undergoing rectal but not colonic cancer surgery: a retrospective analysis of data from 655 patients in Central Sweden. British Journal of Anaesthesia 2011;107(2): 164–70.
6. Felsby S, Juelsgaard P. Combined spinal and epidural anesthesia. Anesthesia & Analgesia.1995; 80: 821-26.
7. Soresi A. Episubdural anesthesia. Anesthesia & Analgesia. 1937; 16: 306-10.
8. Attar A E, Aleem M A, Beltagy R, Ahmed W. A comparative study of intrathecal dexmedetomidine and fentanyl as additives to bupivacaine. Research and Opinion in Anesthesia & Intensive Care.2015; 2:43–9.
9. Jain D, Khan RM, Kumar D, Kumar N. Perioperative effect of epidural dexmedetomidine with intrathecal bupivacaine on haemodynamic parameters and quality of analgesia. South African Journal of Anaesthesia Analgesia.2012; 18(1): 105-109.
10. Mahendru V, Tewari A, Katyal S, Grewal A, Singh M R and Katyal R. A comparison of intrathecal dexmedetomidine, clonidine, and fentanyl as adjuvants to hyperbaric bupivacaine for lower limb surgery: A double blind controlled study. Journal of Anaesthesiology Clinical Pharmacology. 2013 Oct-Dec; 29(4): 496–502.
11. Ravipati P, Isaac G A, Reddy P N, Krishna L, and Supritha T. A Comparative Study between Intrathecal Isobaric Ropivacaine 0.75% Plus Dexmedetomidine and Isobaric Ropivacaine 0.75% Plus Fentanyl for Lower Limb Surgeries. Anesth Essays Res. 2017 Jul-Sep; 11(3): 621–6.
12. Kanazi GE, Aouad MT, Jabbour-Khoury SI, Al Jazzar MD, Alameddine MM, Al-Yaman R et al. Effect of low-dose dexmedetomidine or clonidine on the characteristics of bupivacaine spinal block. Acta Anaesthesiol Scand. 2006 Feb; 50(2): 222-7.
13. Varghese LA, Taksande K. A comparison between intrathecal dexmedetomidine with hyperbaric bupivacaine and intrathecal fentanyl with hyperbaric bupivacaine in lower abdominal surgeries: A prospective double-blinded study. J Datta Meghe Inst MedSci Univ. 2017; 12: 99-109.
14. Zeng XZ, Xu YM, Cui XG, Guo YP, Li WZ. Low-dose epidural dexmedetomidine improves thoracic epidural anaesthesia for nephrectomy. Anaesthesia Intensive Care. 2014 Mar;42(2):185-90
15. Kaur S, Attri JP, Kaur G, Singh TP. Comparative evaluation of ropivacaine versus dexmedetomidine and ropivacaine in epidural anesthesia in lower limb orthopedic surgeries. Saudi Journal of Anaesthesia. 2014 Oct-Dec; 8(4): 463–9.
16. Gupta R, Verma R, Bogra J, Kohli M, Raman R and Kushwaha J K. A Comparative study of intrathecal dexmedetomidine and fentanyl as adjuvants to Bupivacaine. Journal of Anaesthesiology Clinical Pharmacology. 2011 Jul-Sep; 27(3): 339–43
17. Parmar N K, Bhandari G, Shahi K S, Chand G, Rani D, Sharma G et al. Effect of Intrathecal Ropivacaine with Dexmedetomidine for Operative and Post-Operative Analgesia: A Prospective Randomized Study. Journal of Evolution of Medical and Dental Sciences.2014; 3(11): 2917-25.
18. Qureshi F, Meena SC, Kumar V, Jain K, Chauhan R, Luthra A. Impact of Epidural Ropivacaine with Dexmedetomidine after Spine SurgeryInfluence of Epidural Ropivacaine with or without

Dexmedetomidine on Postoperative Analgesia and Patient Satisfaction after Thoraco-Lumbar Spine Instrumentation: A Randomized, Comparative, and Double-Blind Study. Asian Spine J. September 3, 2020.
19. Hussain N, Grzywacz VP, Ferreri CA, Atrey A, Banfield L, Shaparin N et al. Investigating the Efficacy of Dexmedetomidine as an Adjuvant to Local Anesthesia in Brachial Plexus Block: A Systematic Review and Meta-Analysis of 18 Randomized Controlled Trials. Regional Anesthesia and Pain Medicine. 2017 Mar/Apr; 42(2): 184-96.
20. Wu HH, Wang HT, Jin JJ, Cui GB, Zhou KC, Chen Y et al. Does Dexmedetomidine as a Neuraxial Adjuvant Facilitate Better Anesthesia and Analgesia? A Systematic Review and Meta-Analysis. PLoS One. 2014; 9(3): e93114.