Original Research Paper Anaesthesiology

THE EFFECT OF EPIDURAL DEXMEDETOMIDINE ON CHARACTERSTICS OF SPINAL ANAESTHESIA IN PATIENTS UNDERGOING LOWER ABDOMINAL SURGERIES

DR.ANKITA MADAN POST GRADUATE, FIRST AUTHOR, DEPARTMENT OF ANAETHESIOLOGY AND CRITICAL CARE, NIMS MEDICAL COLLEGE, JAIPUR.

DR.ANUMEHA JAIN PROFESSOR, SECOND AUTHOR, DEPARTMENT OF ANAETHESIOLOGY AND CRITICAL CARE, NIMS MEDICAL COLLEGE, JAIPUR.

DR. MEENAXI SHARMA PROFESSOR AND HEAD OF DEPARTMENT, THIRD AUTHOR,DEPARTMENT OF ANAETHESIOLOGY AND CRITICAL CARE, NIMS MEDICAL COLLEGE, JAIPUR

ABSTRACT

Background and Aims: Combined spinal–epidural (CSE) anaesthesia is being increasingly used for effective post-operative analgesia. This study was designed to evaluate the effect of epidural dexmedetomidine on characteristics of spinal anaesthesia for lower abdominal surgeries.

Methods: This was a prospective randomised, double-blind, controlled study involving fifty patients belonging to American Society of Anesthesiologists(ASA) Physical Status I and II who underwent surgery were randomly divided into dexmedetomidine(D) group and saline (S) group of twenty five each. All patients received CSE anaesthesia. Ten minutes before subarachnoid block (SAB), Group D received dexmedetomidine1 µg/kg diluted to 5 ml in normal saline (NS) and Group S received NS epidurally. Hyperbaric bupivacaine (15 mg) was administered intrathecally for both groups after epidural injection. Sensory and motor block characteristics, analgesia, sedation and haemodynamics were observed. Statistical analysis was performed using appropriate tests.

Results: Epidural dexmedetomidine as adjuvant to SAB in CSE produced faster onset and prolonged duration of sensory and motor blockade. There was prolonged duration of analgesia with improved sedation and low pain scores in post operative period in the dexmedetomidine group.

Conclusion: Administration of dexmedetomidine epidurally, 10 min before SAB, caused early onset and prolonged duration of motor blockade and analgesia, without any significant post-operative complication.

KEYWORDS : Dexmedetomidine, epidural analgesia, lower abdominal surgeries , spinal anaesthesia

INTRODUCTION

Combined spinal–epidural (CSE) anaesthesia offers a safe and inexpensive technique with the advantage of both spinal and epidural anaesthesia. It provides faster onset of surgical anaesthesia and prolongs the duration of post-operative pain relief[1].

Various adjuvants in addition to opioids have been used epidurally to prolong analgesia and reduce the incidence of adverse events observed when opioids are used alone.[2]

α_2-agonists are used as adjuvant drugs to local anesthetics [3,4,5]. They potentiate the effect of local anesthetics and allow a decrease in the required doses [4,6].

Dexmedetomidine is an α_2-adrenoreceptor agonist that is approved as an intravenous sedative and analgesic drug. It has an α_2/α_1 selectivity ratio which is eight times higher than that of clonidine [7].

Literature search revealed very few studies using dexmedetomidine and local anaesthetics sequentially via different routes in CSE to assess the influence of dexmedetomidine on characteristics of subarachnoid block (SAB). An attempt was made by this study to determine whether administration of dexmedetomidine alone as epidural adjuvant in CSE would provide prolonged analgesia without causing significant haemodynamic side effects.

MATERIALS AND METHOD

The study was done after receiving the approval of the ethical committee and written informed consent was taken from all patients before initiation of the procedure. Using statistical formula appropriate for the design of the study as advised by statistician, 50 patients between age group 18 to 65 years with ASA physical status I and II undergoing elective lower abdominal surgeries were included as study population.

Patients with ASA grading > 2, body mass index ≥30, hypersensitivity to any of the drugs which are to be used in the study, with contraindications for spinal and epidural analgesia were excluded from the study.

Patients selected were randomly allocated into Group D and Group S of twenty five each using a computer-generated random number sequence. The drug solution for both groups was prepared by an anaesthesiologist not involved in the study. The allocation sequence and the drug received by the patients were not revealed to the investigating anaesthesiologist until the end of data collection.

After intravenous (IV) access, the patients were preloaded with infusion of Ringer lactate (20 ml/kg). The epidural space was identified at L_2–L_3 interspace with 18 G Tuohy needle using loss of resistance technique under strict asepsis, and a 20 G epidural catheter was then advanced into the epidural space. Correct placement of epidural catheter was verified with a test dose of 3 ml of lignocaine (2%) with adrenaline (1: 200,000). Group D received injection dexmedetomidine 1.0µg/kg diluted in 5 ml of normal saline (NS) via epidural catheter 10 min before SAB. Group S received 5 ml NS 10 min before SAB. Hyperbaric bupivacaine 0.5%, 15 mg (3 ml) was given intrathecally to both groups at L_3–L_4 interspace using 25G Quincke needle.

Sensory block was assessed bilaterally using loss of sensation to pinprick with a short hypodermic needle in midclavicular line.

Motor blockade was assessed using modified Bromage scale[8](0: No motor block; 1: Inability to raise extended legs; 2: Inability to flex knees; 3: Inability to flex ankle joints). Surgery was commenced after sensory block at T_6 dermatome was attained.

In this study, onset of sensory block was defined as time taken to achieve loss of sensation to pinprick at T_{10} dermatome level following SAB. Time taken to achieve Bromage 3 following SAB was defined as onset of motor block. Time taken for two segment regression of sensory block was noted, and time taken for motor

block to recede from Bromage 3 to Bromage 0 was recorded as the duration of motor block.

Basal heart rate (HR), respiratory rate, non-invasive arterial blood pressure and oxygen saturation were recorded before placement of epidural catheter and every 5 min till the end of surgery.

Intra- and post-operative sedation was assessed using Ramsay Sedation Score[9](1: Anxious or restless or both, 2: Co-operative, oriented and tranquil, 3: Responding to commands, 4: Asleep, brisk response to light, glabellar tap or auditory stimuli, 5: Asleep, sluggish response, 6: Asleep, unarousable).

Post-operatively, pain was assessed using visual analogue scale[10] (VAS) (0: No pain, 2–4: Mild pain, 5–7: Moderate pain, 8–10: Worst pain). Duration of analgesia was the time from onset of sensory block at T_{10} till the patient complained of pain. Sedation score, VAS and haemodynamic parameters were observed at 30 min, 60 min, 2^{nd}, 3^{rd}, 4^{th}, 5^{th} and 6^{th} h post-operatively.

Hypotension was defined as systolic blood pressure <90 mmHg or >30% decrease in baseline mean arterial pressure, treated with IV crystalloid 250 ml bolus and injection mephentermine 6 mg IV. Bradycardia was defined as HR < 50/min and treated with injection atropine 0.6 mg IV. Other side effects like nausea and vomiting were also looked in both the groups.

Sensory and motor block characteristics and time to request for analgesics were recorded in both groups.

Fischer exact test and Chi-square test were applied for nominal data. Unpaired *t*-test was used for parametric data. $P < 0.05$ considered statistically significant.

RESULTS

All the enrolled patients completed the study. Demographic data were comparable between both groups.[TABLE 1]

Table 1: The demographic profile of patients of both the groups

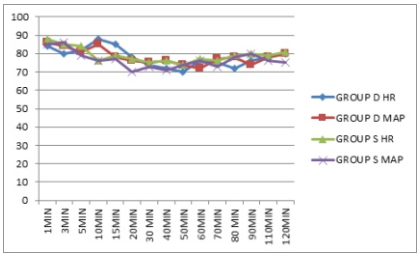
DEMOGRAPHIC DATA	GROUP D	GROUP S
Age(years)	42.86 ± 10.35	39.9 ± 8.41
Weight (kgs)	59.28 ± 6.67	58.52 ± 5.77
Height (cms)	155.82 ± 5.92	156.98 ± 5.39
BMI	21.02±2.95	20.83±3.22
ASA I/II	20/5	21/4
Duration of surgery (mins)	111.83± 19.98	113.67±20.49

Onset of sensory block at T_{10} was faster in Group D than Group S. The highest dermatome level achieved in Group D was T_5 which was seen in 53.3% whereas the highest level achieved in Group S was T_6. Time to attain Bromage3 block was 19.14±5.34mins in Group D and 15.36±6.81mins in Group S. Time to two-segment regression of sensory block in Group D was 193.67 ± 19.82 min and Group S was 109.33 ± 18.56 min ($P < 0.001$). Duration of motor block was 343.00 ± 32.92 min and 221.00 ± 29.17 min in Group D and Group S, respectively. Duration of analgesia was 299.00 ± 43.38 min in Group C and 152.50 ± 21.04 min in Group S ($P = 0.001$). All these differences were clinically significant ($P = 0.001$).[TABLE 2]

Table 2: Comparison of block characteristics in both the groups

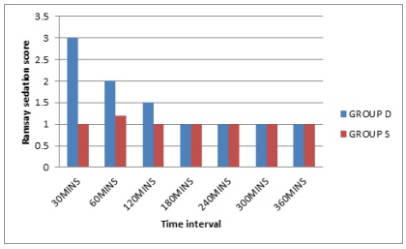
Block characteristics	GROUP D	GROUP S	P VALUE
Onset time of sensory block at T10(mins)	6.54±2.51	8.15±2.84	0.0389
Max sensory block level	T5	T6	
Time to max sensory block(mins)	12.34±3.75	15.74±3.96	0.0031
Time for complete motor block(mins)	15.36±6.81	19.14±5.34	0.0339
Time to two segment regression of sensory block (mins)	193.67 ± 19.82	109.33 ± 18.56	0.0001
Duration of motor block (mins)	343.00 ± 32.92	221.00 ± 29.17	0.0001
Duration of analgesia(mins)	299.00 ± 43.38	152.50 ± 21.04	0.0001

Haemodynamic parameters were comparable between the two groups and the difference was not clinically significant. [FIGURE1]



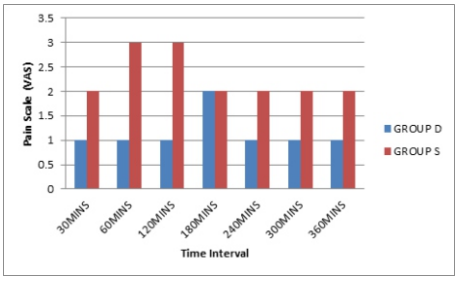
[FIGURE 1] Comparison of heart rate (bpm) and blood pressure (mean arterial pressure) (mm Hg) between two groups

Sedation scores were significantly higher in GROUP D in the post-operative period.{FIGURE 2}



[FIGURE 2] Comparison of post-operative sedation scores

GROUP D showed significantly lower pain scores as compared with GROUP S.[FIGURE 3]



[FIGURE 3]Comparison of post-operative pain scores between two groups

Side effects like nausea, vomiting , shivering and dry mouth were comparable in both the groups. Headache was only present in group D patients. Respiratory depression was not found in both the group in our study.[TABLE 3]

[TABLE 3] Comparison of side effects

	Group D	Group S
Nausea	4	5
Vomiting	2	1
Shivering	3	3
Headache	1	0
Respiratory depression	0	0
Dry mouth	1	1

DISCUSSION

The present study showed that Dexmedetomidine (1.0µg/kg) administered via epidural route as adjuvant to SAB in CSE produced faster onset of sensory block at T_{10} (6.54± 2.51 mins) and prolonged duration of sensory block (193.67±19.82 mins). It also produced faster onset of motor blockade(15.36±6.81) and prolonged duration

of motor block(343.00±32.92). The maximum level of sensory block achieved in Group D is T_5 level as founded in 53.3% of patients. It significantly prolonged the duration of analgesia (299.00±43.88) with improved sedation and pain scores in the post -operative period.

epidural dexmedetomidine has greater selectivity for alpha^2 receptors with greater lipid solubility so easily penetrated in the meninges which leads to faster onset and prolonged duration of sensory and motor blockade [11,12]. They also cause augmentation of local anesthetic effects as they cause hyperpolarisation of nerve tissues by altering transmembrane potential and ion conductance at locus coeruleus in the brainstem[13,14].

In 2014, Zeng XZ *et al.(2014)* found that lowdose epidural dexmedetomidine improved thoracic epidural anaesthesia for nephrectomy. Sensory and motor blockade duration was longer in the dexemedetomidine group than in the control group. Pain score and analgesic requirement was lower in dexemedetomidine group[15].

In our study, dexmedetomidine group produced earlier onset of sensory block, prolonged duration of sensory block and motor block in comparison to bupivacaine alone which was statistically significant.

The analgesic effect of dexmedetomidine possibly produced by the stimulation of spinal cord at the dorsal root neuron level, where alpha-2 agonists inhibit the release of substance P in the nociceptive pathway and also inhibit the release of norepinephrine, at the nerve endings [16,17].

In 2009, A.M. El-Hennawy *et al.* studied the effect of adding clonidine or dexmedetomidine to bupivacaine in caudal block in children. They found that addition of dexmedetomidine or clonidine to caudal bupivacaine significantly prolonged analgesia in children undergoing lower abdominal surgeries without an increase in incidence of sideeffects[18]. In our study, there is prolonged duration of analgesia and less side effects in Dexmedetomidine group.

Sedative effect of dexmedetomidine is probably mediated by the activation of presynaptic alpha-2 adrenoreceptors in the locus coeruleus, leading to inhibition of release of norepinephrine [19]along with it inhibition of adenylate cyclase may lead to hypnotic response [20].In 2011 Bajwa *et al.* studied that dexmedetomidine was a better adjuvant than clonidine in epidural anesthesia for patient comfort, superior sedative and anxiolytic properties, intraoperative and postoperative analgesia [21]. In our study, sedation scores were higher in Group D in post-operative period.

Dexmedetomidine prevents intraoperative and postoperative nausea and vomiting as it does not decrease gut motility [22]. α-2 agonists does not cause the respiratory depression[23-24].

CONCLUSION

Epidural dexmetomidine when administered 10 min prior to SAB during CSE, produces prolonged analgesia and arousable sedation. It increased the speed of onset and prolonged the duration of sensory and motor blockade of intrathecal bupivacaine without significant haemodynamic adverse effects.

REFERENCES

1. Rawal N, Holmström B, Crowhurst JA, Van Zundert A. The combined spinal-epidural technique. Anesthesiol Clin North America. 2000;18:267–95.
2. Wheatley RG, Schug SA, Watson D. Safety and efficacy of postoperative epidural analgesia. Br J Anaesth. 2001;87:47–61.
3. Strebel S, Gurzeler J, Schneider M, Aeschbach A, Kindler C.Small-dose intrathecal clonidine and isobaric bupivacaine for orthopedic surgery: a dose—response-study. Anesth Analg 2004; 99: 1231—8.
4. Dobrydnjov I, Axelsson K, Thorn S-E, et al. Clonidine combined with small-dose bupivacaine during spinal anesthesia for inguinal herniorrhaphy: a randomized double-blinded study. Anesth Analg 2003; 96: 1496—503.
5. Dobrydnjov I, Axelsson K, Samarutel J, Holmstrom B Postoperative pain relief following intrathecal bupivacaine combined with intrathecal or oral clonidine. Acta Anaesthesiol Scand 2002; 46: 806—14.
6. De Kock M, Gautier P, Fanard L, Hody J, Lavand'homme P. Intrathecal ropivacaine and clonidine for ambulatory knee arthroscopy. Anesthesiology 2001; 94: 574—8
7. Coursin DB, Maccioli GA. Dexmedetomidine. Curr Opin Crit Care 2001; 7: 221—6.
8. Bromage PR. A comparison of the hydrochloride and carbon dioxide salts of lidocaine and prilocaine in epidural analgesia. Acta Anaesthesiol Scand Suppl. 1965;75:193–200.
9. Ramsay MA, Savege TM, Simpson BR, Goodwin R. Controlled sedation with alphaxalone-alphadolone. Br Med J. 1974;2:656–9. [PMCID: PMC1613102][PubMed: 4835444]
10. Huskisson EC. Measurement of pain. Lancet. 1979;2:1127–31. [PubMed: 4139420]
11. De Wolf AM, Fragen RJ, Avram MJ, Fitzgerald PC, Rahimi-Danesh F (2001) The pharmacokinetics of dexmedetomidine in volunteers with severe renal impairment. Anesth Analg 93: 1205-1209.
12. Asano T, Dohi S, Ohta S, Shimonaka H, Iida H (2000) Antinociception by epidural and systemic alpha(2)-adrenoceptor agonists and their binding affinity in rat spinal cord and brain. Anesth Analg 90: 400-407.
13. Fukushima K, Nishimi Y, Mori K (1997) The effect of epidural administered dexmedetomidine on central and peripheral nervous system in man. Anesth Analg 84: S292
14. Correa-Sales C, Rabin BC, Maze M (1992) A hypnotic response to dexmedetomidine, an alpha 2 agonist, is mediated in the locus coeruleus in rats. Anesthesiology 76: 948-952.
15. Zeng XZ; Xu YM, CuiXG; Low-dose epidural dexmedetomidine improves thoracic epidural anaesthesia for nephrectomy Anaesthesia and Intensive Care 2014; 42(2): 185-90.
16. Kuraishi Y, Hirota N, Sato Y, Kaneko S, Satoh M, et al. (1985) Noradrenergic inhibition of the release of substance P from the primary afferents in the rabbit spinal dorsal horn. Brain Res 359: 177-182.
17. Jaakola ML, Salonen M, Lehtinen R, Scheinin H (1991) The analgesic action of dexmedetomidine--a novel alpha 2-adrenoceptor agonist--in healthy volunteers. Pain 46: 281-285.
18. E-Hennawy M, Abd-Elwahab AM, AbdElmaksoud AM; Addition of clonidine or dexmedetomidine to bupivacaine prolongs caudal analgesia in children. Br. J. Anaesth. 2009; 103 (2): 268-274
19. Maze M, Regan JW (1991) Role of signal transduction in anesthetic action. Alpha 2 adrenergic agonists. Ann N Y Acad Sci 625: 409-422.
20. Memis D, Turan A, Karamanlioglu B, Pamukcu Z, Kurt I (2004) Adding dexmedetomidine to lidocaine for intravenous regional anesthesia. Anesth Analg 98: 835-840.
21. Bajwa SJS, Bajwa SK, Kaur J, Singh G, Arora V, Gupta S, et al.; Dexmedetomidine and clonidine in epidural anaesthesia: a comparative evaluation. Indian J Anaesthe 2011: 55 (2): 116.
22. Panda A (2014) Effectiveness of Dexmedetomidine infusion in reducing postoperative nausea and vomiting after laparoscopic surgery. Transworld Medical Journal 2: 83-89.
23. Venn RM, Bradshaw CJ, Spencer R, Brealey D, Caudwell E, et al. (1999) Preliminary UK experience of dexmedetomidine, a novel agent for postoperative sedation in the intensive care unit. Anaesthesia 54: 1136-1142.
24. Hall JE, Uhrich TD, Barney JA, Arain SR, Ebert TJ (2000) Sedative, amnestic, and analgesic properties of small-dose dexmedetomidine infusions. Anesth Analg 90: 699- 705.