ORIGINAL RESEARCH PAPER

Medical Science

A COMPARATIVE STUDY BETWEEN EPIDURAL ROPIVACAINE AND EPIDURAL ROPIVACAINE WITH DEXMEDETOMIDINE IN PATIENTS UNDERGOING LOWER LIMB SURGERIES

KEY WORDS:
Dexmedetomidine, Ropivacaine, Epidural anaesthesia

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ABSTRACT

OBJECTIVE: To study the synergistic effect of adding dexmedetomidine to ropivacaine 0.75% in epidural anaesthesia for lower limb surgeries.

MATERIALS AND METHODS: 100 patients of American Society of Anaesthesiologist Grade I and II in age group of 20-60 years of either sex under going lower limb surgeries were included .They were assigned to two groups: Group A (n = 50), 18ml of 0.75% ropivacaine plus 2ml distill water. Dexmedetomidine Group B(n = 50), 18ml of 0.75% ropivacaine plus 1 mcg.Kg-1of dexmedetomidine diluted upto 2ml with distill water. Onset of sensory and motor block, duration of sensory and motor block, intensity of motor block, maximal dermatomal level of analgesia and hemodynamic parameters were studied.

RESULTS: Time for onset of sensory analgesia is 9. 06 ±1.16 mins in group A and 5.14 ±1.24 mins in group B which is highly significant (p<0.0001),Onset of motor analgesia 15.51 ± 1.78 min in group A and 8.36 ± 1.74 mins in group B. which is highly significant P < 0.0001. Significant difference was observed relation to duration of sensory block (216.61 ± 24.09 min Group A and 376.93±35.56 min Group B [P < 0.0001]), duration of motor block (151.51 ± 11.18 min Group A and 201.16 ±6.25 min Group B [P< 0.0001]), and produce more intense motor block (p<0.001).There was no difference in the maximal dermatomal level of analgesia.

CONCLUSION: Epidural Dexmedetomidine as an adjuvant to Ropivacaine is associated with prolonged sensory and motor block, hemodynamic stability, prolonged postoperative analgesia and when compared to plain Ropivacaine.

INTRODUCTION

Intrathecal anaesthesia and epidural anaesthesia are the most popular regional anaesthesia techniques used for lower limb, lower abdominal surgeries. The advantages of epidural anaesthesia being it,(Cousins MJ. 2009[1])(CollinVJ. 1993[2])provides effective surgical anaesthesia and can meet the extended duration of surgical needs, provides prolonged post-operative analgesia, reduces the incidence of hemodynamic changes.

Various epidural anaesthetics are used and still in great use. Some of them are bupivacaine, levo bupivacaine and ropivacaine. Bupivacaine and ropivacaine are popular among these and used frequently.

The newer amide local anaesthetic ropivacaine has minimal cardiovascular and central nervous system toxicity as well as a lesser propensity of motor block during epidural analgesia.(Zaric D et al 1996[3]) (McClellan KJ et al 2000[4]).The advantages of epidural anaesthesia are (Saraiva P.S.F et al 2008[5]).

1. Provides effective surgical anaesthesia and can meet the extended duration of surgical needs.
2. Provides prolonged post-operative analgesia.
3. Reduces the incidence of hemodynamic changes as a result of sympathetic blockade as it produces segmental anaesthesia unlike subarachnoid block anaesthesia.
4. There is no incidence of PDPH as the dura is not pierced.

The newer amide local anesthetic ropivacaine, shares many physiochemical properties with bupivacaine but with less systemic toxicity and greater margin of safety than other local anesthetic agents of similar duration of action. The safety of ropivacaine is due to its availability in pure S- enantiomer form. It has less neurotoxic and cardiotoxic potential and preferentially blocks sensory fibres to greater degree than the motor fibers. Recent clinical data have shown that ropivacaine is safe and effective for regional anesthetic techniques. Early recovery of motor function in comparison to bupivacaine is associated with decreased venous thromboembolism and shorter hospitalization (Stienstra R 2003)[6]. (Agarwal A et al 2010[7]).

α2 adrenergic agonists have both analgesic and sedative properties when used as an adjuvant in regional anaesthesia. Dexmedetomidine is a highly selective α2 adrenergic agonist with an affinity of eight times greater than clonidine.

Various Studies have shown that the dose of clonidine is 1.5 – 2 times higher than dexmedetomidine when used via epidural route. The anaesthetic and the analgesic requirement of local anaesthetics get reduced to a huge extent by the use of dexmedetomidine because of its analgesic properties and augmentation of local anaesthetic effects as they cause hyperpolarisation of nerve tissues by altering trans membrane potential and ion conductance at locus coeruleus in the brainstem(Saraiva P.S.F et al 2008[5]). The stable haemodynamic and the decreased oxygen demand due to enhanced sympathoadrenal stability make it a very useful pharmacologic agent to use in various surgeries and post-operative pain relief. Therefore a study was undertaken to compare epidural efficacy of 0.75% ropivacaine with dexmedetomidine and 0.75% ropivacaine alone in lower limb surgeries.

OBJECTIVE

To study the synergistic effect of adding dexmedetomidine to ropivacaine 0.75% in epidural anaesthesia for lower limb surgeries.

METHODS

A study entitled "Comparative study of Epidural Ropivacaine with Dexmedetomidine and Ropivacaine alone in lower limb surgeries" was undertaken in SILCHAR MEDICAL COLLEGE AND HOSPITAL, SILCHAR during the period 1st June 2017 to 31st may 2018. The study was undertaken after obtaining ethical committee clearance as well as informed consent from all patients.

One hundred patients, scheduled for various elective lower abdominal and lower limb surgical procedures belonging to ASA class I and II were included in the study.

The study population was randomly divided using computer generated randomization numbers into two groups with 50 patients in each group.

1. **Group A (n=50)** - 18ml of 0.75% ropivacaine (Ropivacaine 0.75% preservative free – ROPIN 0.75% 20 ml ampoules – Neon laboratories India limited).+ 2ml distill water .

2. **Group B (n=50)** - 18ml of 0.75% ropivacaine + 1 µg/kg of dexmedetomidine diluted up to 2 ml with distilled water.
(inj. DEXTOMID-1ml=100mcg,1ml ampoule**)**

Inclusion criteria for the study

1. Adult patients aged between 20 to 60 years of both sex.
2. Patients belonging to ASA class I and II posted for elective lower limb surgical procedures.
3. Weight > 50 kgs
4. Height 150-180cms

Exclusion criteria for the study

1. Patient refusal for regional anaesthesia.
2. Pregnancy and lactation.
3. Patients posted for Emergency surgeries.
4. Obese patient with BMI > 30.
5. Patients having:

- raised intracranial pressure
- severe hypovolemia
- bleeding coagulopathy
- local infection
- uncontrolled hypertension/ diabetes mellitus
- neurological disorder and deformities of spine
- cardiac disease
- hepatic disease
- allergy to local anaesthetics and dexmedetomidine

Equipments

1. I.v. cannula and i.v. fluids,11G needle.
2. Epidural set - 18 Gauze Tuohy needle.
3. Syringes: 2cc, 5cc, 10cc, 20 cc.
4. Drugs:

a) Study agent

- 0.75% Inj.ropivacaine ampoule (preservative free)
- Inj.dexmeditomedine 100mcg ampoule
- Distilled water

b) Emergency drugs like atropine, ephedrine, etc.

c) Others

- Injection 2% lignocaine
- Injection 2% lignocaine with adrenaline
- Injection Midazolam
- Injection Ondansetron
- Injection Ranitidine
- Injection Tramadol
- Injection Glycopyrrolate

5. Boyle's apparatus
6. Resuscitation equipment, oxygen, AMBU Bag, Laryngoscope, tracheal tubes of appropriate sizes, suction apparatus and emergency drug tray.
7. Monitoring equipment

- Pulse oximeter
- ECG
- NIBP

Patient preparation.

A routine pre-anaesthetic examination was conducted on the evening before surgery, assessing

- History and general condition of the patient
- Airway assessment by Mallampatti grading.
- Nutritional status, height and weight of the patient
- A detailed examination of the Cardiovascular system, Respiratory system and Central nervous system
- Examination of the spine

The following investigations were done in all patients

- Hemoglobin estimation
- Bleeding time and clotting time
- Random blood sugar
- Blood urea and Serum creatinine.
- Standard 12-lead electrocardiogram

The patients were premedicated with tablet alprazolam 0.5 mg and tablet ranitidine 150 mg orally at bed time on the previous night before surgery. They were kept nil orally 10 pm onwards on the previous night.

On the day of surgery, patient's basal pulse rate Respiration rate and blood pressure were recorded. A peripheral intravenous line with 18 gauge cannula after local anaesthesia was secured in one of the upper limbs. All the patients were preloaded with 500 ml of Ringer lactate 30 minutes prior to the epidural procedure. Multiparameter monitor was connected which records heart rate, non-invasive measurement of systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure(MAP), continuous electrocardiogram (ECG) monitoring and oxygen saturation (SPO2).

With the patients in sitting position under aseptic precautions, Skin wheal was raised with 2% lignocaine and lumber epidural space was identified with loss of resistance to air using 18G Tuohy needle via the midline approach at either L2-3 or L3-4 inter spinous space. A test dose of 3 ml of 2% lignocaine with 1:200000 adrenaline was injected through the Needle after negative aspiration for blood and CSF was given to rule out intravascular or intrathecal injection. After ruling out intrathecal and intravascular placement of the Needle, study drug was injected in increments of 2.5 ml. The patients were turned to supine position after Injection of Drug.

Assessment of sensory and motor blockade were done at the end of each minute with the patient in supine position after completion of the injection of 18 ml ropivacaine, 100mcg of dexmedetomidine diluted upto 2 ml with distilled water of the study drug, which is taken as the starting time. The onset time for sensory and motor block, the maximum level of sensory block, intensity of motor block and sedation score were recorded. Sensory blockade was assessed using a short bevel 22 gauge needle and was Tested in the mid clavicular line on the chest, trunk and lower limbs on either side.

Motor blockade in the lower limbs was assessed using modified Bromage scale.

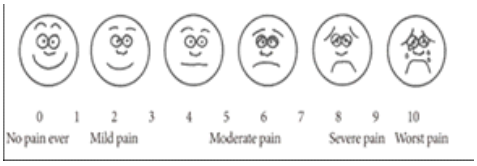
0 – able to perform a full straight leg raise over the bed for 5 sec
1– Unable to perform the leg raise but can flex the leg on the knee articulation
2 – Unable to flex the knee but can flex the ankle
3 – unable to flex ankle but can move the toes
4 – unable to move toes (total paralysis).

Table 1 - **Ramsay scale for the assessment of the level of sedation**

LEVEL OF ACTIVITY	POINTS
Patient anxious, agitated or restless	1
Patient cooperative, orientated and tranquil	2
Patient responding only to verbal commands	3
Patient with brisk response to light glabella tap or loud auditory stimulus	4
Patient with sluggish response to light glabella tap or loud auditory stimulus	5
Patient with no response to light glabella tap or loud auditory stimulus	6

Analgesia was scored by Visual Analog Scale Visual analogue scale (VAS):

The visual analogue scale (VAS) is a measurement tool for subjective characteristics or attitudes that cannot be directly measured. The scale that was used in this study consisted of a straight line 10 cm in length. The patients were asked to place a line perpendicular to the VAS line at the point that represents their pain intensity. Using a ruler, the score is determined by measuring the distance in cm on the line between the "no pain" anchor and the patient's mark, providing a range of scores from 0-10. A higher score indicates greater pain intensity



0-no pain
1,2,3-mild pain
4,5,6-moderate pain
7,8,9-severe pain
10- worst pain ever.

Measurements of blood pressure, heart rate, Respiration Rate and oxygen saturation recorded every 10 minutes till the end of 2 hour and then every 30 minutes till the end of sensory blockage or patient ask for Rescue analgesia. Intraoperatively and postoperatively complications like fall in blood pressure, variation in heart rate were noted and treated.

Hypotension is defined as reduction of systolic blood pressure more than 20% from basal systolic blood pressure or SBP less than 90 mmHg and is treated with increased rate of intravenous fluids and if needed injection mephentermine 3 mg (I.V) given in increments. Bradycardia (<50 beats/min) was treated with injection Atropine 0.6 mg (I.V).

After the surgery, patients referred to the recovery room (PACU) post anaesthesia care unit where they remained until there was complete recovery of sensory and motor blockade. Inj.tramadol given once the patient complains of pain. Postoperatively vital parameters recorded every 30 minutes and also duration of sensory and motor blockade, any adverse events like nausea, vomiting, pruritis, shivering etc. treated simultaneously.

Onset of sensory blockade: is taken as the time from the completion of the injection of the study drug till loss of sensation at T10 level.

Onset of motor blockade: is taken from the completion of the injection of study drug till the patient develops modified Bromage scale grade 1 motor blockade.

Duration of motor block: is taken from the time of injection till the patient attains complete motor recovery (Bromage 0).

Duration of sensory block: is taken from the time of injection till the patient complains of pain at the T10 dermatome.

The results of the study were statistically analysed between the two groups

RESULTS

Table 1. Demographic profile of patients.

Demographic Data	Group A	Group B	p value
Age (Year) (Mean ± SD)	36.06±11.30	37.12±11.30	0.60
Sex (M:F)	43:7	42:8	0.779
Weight (kg) (Mean ± SD)	62.40±7.54	64.06 ±7.49	0.279
ASA Grade (I/II)	40:10	42:8	0.606
Height (CM)	163.77 ±3.37	164.44 ± 3.24	0.316

*(p-value < 0.05 considered statistically significant).

Table 2. Types of surgery in the two groups.

TYPE OF SURGERY	GROUP A	%	GROUP B	%	TOTAL
Internal fixation of femur.	17	34	18	36	35
Internal fixation of tibia.	14	28	13	26	27
internal fixation patella	13	26	14	28	27
implant removal	6	12	5	10	11
	50		50		100

Table 3. Distribution of initial and post block characteristics.

Variables	Group A	Group B	p value
Onset of sensory block (in minutes) (Mean ± SD)	9.06± 1.16	5.14±1.24	0.0001
Duration of sensory block (in minutes) (Mean ± SD)	216.61±24.09	376.93±35.56	0.0001
Onset of motor blockade (minutes)	15.51±1.16	8.36±1.24	0.0001
Duration of motor blockade (minutes)	151.51±11.18	201.16±6.25	0.0001

* (p-value<0.05 considered statistically significant).

Table 4. Maximum Level of Sensory Blockade Attained

Max. sensory level	Group A	Group B
T5	03	05
T6	30	37
T8	17	7
T10	0	1

* (p-value<0.05 considered statistically significant

Table 5. Grades of Motor Blockade

BROMAGE SCORE	GROUP A	GROUP B	P VALUE
2	16	0	0.0001
3	34	35	
4	0	15	

* (p-value<0.05 considered statistically significant

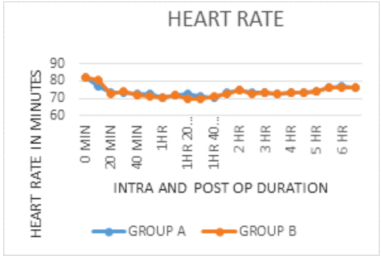


Figure 1. mean heart rate between two groups

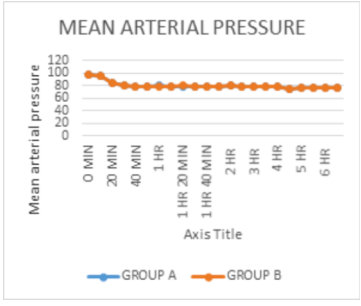


Figure 2. Mean arterial blood pressure (mmHg) at various time intervals

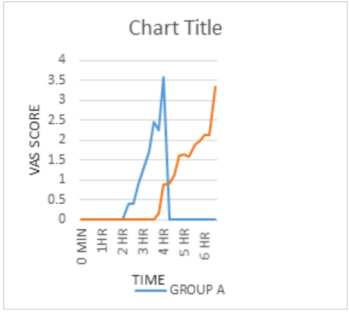


Figure 3: line diagram showing comparison of vas between two groups

The study was successfully conducted on all 100 patients and there was no perioperative protocol deviation. All patients were cooperative with subsequent assessment of pain. The two treatment groups were comparable as regard to their demographic profile and type of surgery (Tables 1).

The mean time for onset of sensory analgesia was 9.06± 1.16 mins in group A while in group B it was 5.14±1.24 which is statistically highly significant. (p= 0.0001) . The mean duration of sensory block is 216.61±24.09 mins in group A and 376.93±35.56 mins in group B. There is statistically highly significant difference between the groups (p=0.0001).

The mean time taken for the onset of motor blockade is 15.51±1.16 mins in group A and 8.36±1.24 mins in group B. There is highly statistical significant difference between the groups (p=0.0001). The mean duration of motor blockade is 151.51±11.18 mins in group A and 201.16±6.25 mins in group B. There is statistically highly significant difference between the group (p=0.0001)

Table 5 showing grade of motor blockade in both the groups. Number of patients with Bromage 2 was 16 in group A and 0 in group B ,pt. with bromage 3 was 34 in group A while 35 in group B whereas patients with Bromage 4 were 0 in group A and 15 in group B. More Intense motor blockade of Bromage 4 was found in patients of dexmedetomidine group compared to patients in plain Ropivacaine group, the p value being 0.0001 is highly significant.

Fig 3 line diagram showing, vas score was zero in both groups for initial 2 hrs .vas score started increasing and pt complaining mild pain in group A after 2 hrs. pts in group B started complaining mild pain after 3hr 30 min .at 4 hr rescue analgesia given (50 mg tramadol i.v) as pt complaining severe pain, in group A, while in group B rescue analgesia given at 6.30 hr. p value was zero for initial 2 hr, from 2 hr 15 min to 6.30 hr p value was extremely significant (p< 0.0001)

There is no statistically significant difference in the mean heart rate between groups at various intervals.4 patients in B group developed bradycardia which was treated with inj.atropine 0.6mg

There is no statistically significant difference in mean arterial pressure between both the groups.

DISCUSSION

The results of the present study show that there is significant improvement in Group B regarding onset of sensory and motor block. Significant prolongation in duration of sensory and motor block with improved quality of intra and postoperative analgesia as compared to group A. There is significant difference in intensity of motor block with group B showing more intense block .The mechanism by which 2 adrenergic agonists prolong the motor and sensory block of local anaesthetics is an additive or synergistic effect secondary to the different mechanisms of action of local anaesthetics. Dexmedetomidine act by binding to the presynaptic C-fibers and post synaptic dorsal horn neurons. 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(Maze M et al 1991[8]) along with it inhibition of adenylate cyclase which may lead to hypnotic response (Memis D et al 2004[9]).

They produce analgesia by depressing the release of C-fiber transmitters and by hyperpolarisation of post synaptic dorsal horn neurons. The complimentary action of local anaesthetics and 2 adrenergic agonists accounts for their profound analgesic properties. The prolongation of motor block and intense quality of motor block may be the result of binding 2 adrenergic agonists to the motor neurons in the dorsal horn.

According to the results, it was found that there was a significant difference in the onset of sensory and motor block with the addition of dexmedetomidine to ropivacaine group compared to ropivacaine alone. It was found that, with the administration of dexmedetomidine, there was a significant increase in the duration of sensory analgesia. There was also enhancement of the intensity of motor block and greater duration of blockade by dexmedetomidine group.

There was no significant difference between the two groups regarding the maximum sensory level attained however dexmedetomidine group have higher block. There was also no significant difference between groups with regard to occurrence of hypotension and bradycardia at any time of the study.

Hence addition of dexmedetomidine to ropivacaine provides better operating conditions for surgeon and hemodynamic stability for patients, with significant postoperative analgesia without increasing the morbidity.

CONCLUSIONS

We conclude that epidural dexmedetomidine as adjuvant to ropivacaine produces synergistic effects with earlier onset time of sensory and motor block, prolonged sensory and motor blockade and good intraoperative sedation. Dexmedetomidine in a dose of 1 microgram kg-1 is a safe and effective adjuvant to ropivacaine in epidural blockade for lower limb surgeries.

REFERENCES:

1. Cousins MJ. (2009).“ Neural blockade in clinical anesthesia and pain medicine. 4th ed. Philadelphia”: Lippincott Williams and Wilkins.
2. Collin VJ. (1993). “ Principles of anesthesiology. 3rd ed. Philadelphia”: Lea and Febiger.
3. Zaric D, Nydahl PA, Philipson L, Samuelsson L, Heierson A, Axelsson K.(1996). “The effect of continuous lumbar epidural infusion of ropivacaine (0.1%, 0.2%, and 0.3%) and 0.25%bupivacaine on sensory and motor block in volunteers”: A double-blind study. Reg Anesth.21:14-25.
4. McClellan KJ, Faulds D.(2000). Ropivacaine: “An update of its use in regional anesthesia.” Drugs;60:1065-93.).
5. Saraiva P.S.F, Sabbag A.T, Costa P.D.S, Brienz L.A, Dalto.H.B et al. (2008). “Synergistic effect between dexmedetomidine and 0.75% ropivacaine in epidural anesthesia.” Brazilian journal of medical.54:
6. Stienstra R (2003). “The place of ropivacaine in anesthesia.”Acta Anaesthesiol Belg 54: 141-148.
7. Agarwal A, Verma RK, Srivastava S (2010) “Ropivacaine: The latest local anesthetic in the Indian Market.” J Anesth Clin Pharmacol 26: 223-228.
8. Maze M, Regan JW (1991) “Role of signal transduction in anesthetic action. Alpha 2 adrenergic agonists.” Ann N Y Acad Sci 625: 409-422.
9. Memis D, Turan A, Karamanlioglu B, Pamukcu Z, Kurt I (2004)“ Adding dexmedetomidine to lidocaine for intravenous regional anesthesia.” Anesth Analg 98:835-840.