COMPARATIVE STUDY OF INTRAVENOUS INFUSION OF DEXMEDETOMIDINE VERSUS INTRATHECAL DEXMEDETOMIDINE IN SPINAL ANAESTHESIA WITH HEAVY BUPIVACAINE

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ABSTRACT

BACKGROUND

Dexmedetomidine, a highly selective α_2-adrenoceptors agonist has recently been introduced in anaesthesia practice. It is currently being used for continuous intravenous sedation in the intensive care setting and procedural sedation in non-intubated patients. Its benefits as an adjuvant to local anaesthetics in peripheral nerve blocks. Dexmedetomidine by virtue of its sedative, analgesic, anxiolytic, sympatholytic, anaesthetic-sparing and haemodynamic stabilising properties have been used as an adjunct to local anaesthetics for prolongation of effect.

MATERIALS AND METHODS

This study was conducted on 60 patients undergoing various lower abdominal and lower limb surgeries under subarachnoid block in two groups. Group "IT"- (n=30) intrathecal dexmedetomidine - 16 mcg with 0.5% bupivacaine, total of 3.2 mL. Group "IV" - (n=30) intrathecal 0.5% bupivacaine 3.2 mL followed by intravenous infusion of dexmedetomidine 1 mcg/kg given over 10 mins. followed by maintenance dose of 0.25 mcg/kg/hr. of infusion of dexmedetomidine.

RESULTS

The mean time for onset of sensory block was 2.6 minutes for group IT and 3.22 minutes for Group IV with p value of 0.03, which is clinically and statistically significant. The mean time for onset of motor block was 4 minutes for group IT and 5 minutes for Group IV with p value of 0.01, which is clinically and statistically significant.

CONCLUSION

Intrathecal dexmedetomidine with bupivacaine provides better haemodynamic stability, faster onset of sensory and motor blockade, provides longer duration of sensory and motor blockade and also adequate postoperative analgesia compared with intravenous infusion of dexmedetomidine in spinal anaesthesia with bupivacaine.

KEYWORDS

Spinal Anaesthesia, Intrathecal Dexmedetomidine, Intravenous Dexmedetomidine, Heavy Bupivacaine, Bromage Scale.

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BACKGROUND

Today, 0.5% heavy bupivacaine is commonly used for spinal anaesthesia because of its high potency and longer duration of action. Many additives have been added to bupivacaine for faster onset of action, prolonging duration of block and for postoperative analgesia.

Dexmedetomidine, a highly selective α_2-adrenoceptors agonist has recently been introduced in anaesthesia practice.[1]

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It is currently being used for continuous intravenous sedation in the intensive care setting and procedural sedation in non-intubated patients. It benefits as an adjuvant to local anaesthetics in peripheral nerve blocks.

The α_2-adrenoceptors by virtue of their sedative, analgesic,[2] anxiolytic, sympatholytic, anaesthetic-sparing and haemodynamic-stabilising properties have been used as an adjunct to local anaesthetics for prolongation of effect.

Studies showed that dexmedetomidine prolongs the duration of local anaesthetic when given through intrathecal route[3] and intravenous route.[4]

Aims and Objectives of this Study

Aim- "Comparative study of IV infusion of dexmedetomidine versus intrathecal dexmedetomidine in spinal anaesthesia with heavy bupivacaine."

Objectives

a. To study and evaluate the role of IV dexmedetomidine and intrathecal dexmedetomidine as additive for perioperative analgesic in spinal anaesthetic cases with 0.5% bupivacaine.
b. To compare the efficacy of IV dexmedetomidine with intrathecal dexmedetomidine in the quality, onset, duration and effectiveness of sensory and motor blockade in patients under spinal anaesthesia with 0.5% bupivacaine.
c. To study and compare haemodynamics during spinal anaesthesia with intravenous dexmedetomidine versus intrathecal dexmedetomidine during perioperative period.

MATERIALS AND METHODS

This prospective randomised single-blind study was conducted on 60 patients undergoing various lower abdominal and lower limb surgeries under subarachnoid block at Dr. Pinnamaneni Siddhartha Institute of Medical Sciences and Research Foundation, Chinoutpalli, between October 2013 - November 2015. This study was conducted over a period of 24 months.

Inclusion Criteria

Include, patients aged between 18-50 years of both sex belonging to ASA grade I and II.

Exclusion Criteria

1. Patient's refusal.
2. Age less than 18 yrs. or greater than 50 yrs.
3. Emergency surgeries.
4. Known case of hypersensitive reactions to local anaesthetics.
5. Patients with medical complications like anaemia, heart disease.
6. Severe hypovolaemia, shock, septicaemia and hypertension.
7. Patients with coagulation disorders or on anticoagulant therapy.
8. Local infection at the site of proposed puncture for spinal anaesthesia.

Method

After meeting inclusion criteria, 60 patients were randomly divided into 2 groups, 30 each based on computer generated randomisation Table. Group "IT"-(n=30) intrathecal dexmedetomidine - 16 mcg with 0.5% bupivacaine, total of 3.2 mL. Group "IV"-(n=30) intrathecal 0.5% bupivacaine 3.2 mL followed by intravenous infusion of dexmedetomidine 1 mcg/kg given over 10 mins. followed by maintenance dose of 0.25 mcg/kg/hr. of infusion of dexmedetomidine.

Procedure

After shifting patients to operating room, IV access was obtained on the forearm with 18G cannula. All subjects were preloaded with 20 mL/kg of Ringer lactate solution over 10 mins. Baseline haemodynamic parameters were noted after applying standard monitors (pulse oximetry, NIBP and ECG). Based on the group the patient belonged to, study drug was injected intrathecally with 23 gauge Quincke needle at the L3 and L4 subarachnoid space in sitting position.

Under strict aseptic precautions, patient received either 3.2 mL of preparation containing 16 mcg of dexmedetomidine with 0.5% heavy bupivacaine or 3.2 mL of the intrathecal 0.5% heavy bupivacaine followed by intravenous dexmedetomidine loading dose of 1 mcg/kg given over 10 mins., followed by maintenance dose of 0.25 mcg/kg/hour of dexmedetomidine till the end of the surgery according to randomisation.

The anaesthetic solution was injected at 0.5 mL/sec after aspiration of clear CSF. Immediately after spinal block, subjects were placed supine. Haemodynamic parameters, sensory and motor blockade were assessed by anaesthesiologist at 0,1,3,5,10,20,30,45,60,120 and 180 mins. following block. Thereafter, observation was continued at 30 minutes intervals until the motor block regressed completely as defined by Modified Bromage score.

The segmental level of sensory block to pinprick was assessed on both sides. The surgery was allowed to start once sensory block had reached at least T10 dermatome. General anaesthesia was induced when the case was labelled as failure. No cases in both the groups were converted to general anaesthesia in our study.

Parameters Evaluated.

Degree of motor block was assessed using Modified Bromage score.

0=full movement,
1=inability to raise extended leg, can bend knee,
2=inability to bend knee, can flex ankle,
3=no movements.

Duration of Motor Block- Defined as the time from intrathecal injection to the regression of motor block to Bromage score 0.

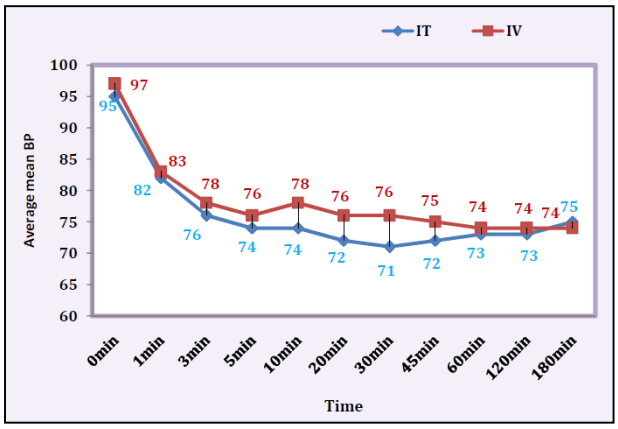
Haemodynamic parameters- HR, systolic blood pressure, diastolic blood pressure, mean arterial pressure was assessed at 0,1,3,5,10,20,30,45,60,120 and 180 minutes or till end of surgery, whichever is late.

The segmental level of sensory block to pinprick was assessed on both sides. The surgery was allowed to start once sensory block had reached at least T10 dermatome. General anaesthesia was induced when the case was labelled as failure. A fall of systolic BP <20% of baseline was considered as hypotension and was treated with 250 mL bolus of Ringer's lactate solution. If hypotension was not corrected after 2 boluses of Ringer's lactate solution, then IV mephentermine 3 mg is given as required. Heart rate of <50 beats/minute was considered as bradycardia and was treated with Inj. Atropine 0.6 mg IV. The end of study period was defined as the time at which the sensory block had regressed below the T10 dermatome or at which the Bromage score was 0, whichever occurred later.

RESULTS

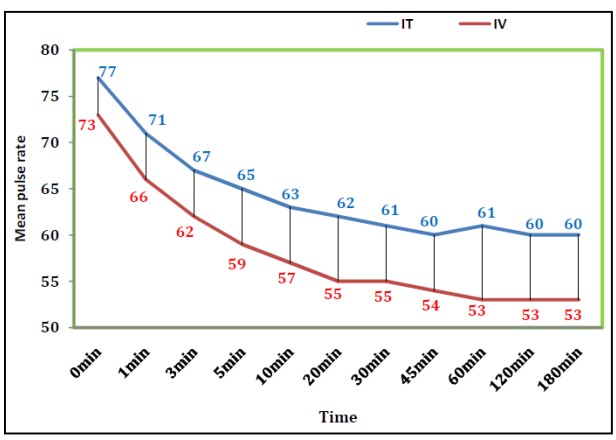
Patients were distributed equally according to age, sex, ASA grade among both groups.

Haemodynamic parameters-



Graph 1. Comparison of Mean Blood Pressures between the 2 Groups

There was fall in mean blood pressure following spinal anaesthesia in both groups. Maximum fall is noted at 30th and 45th minute. The magnitude of fall was similar in both groups and it is not clinically or statistically significant (p >0.05).



Graph 2. Comparison of Pulse Rate (Per Min.) Between the 2 Groups

There was fall in pulse rate following spinal anaesthesia in both groups. Maximum fall was noted in IV group after 20th minute of administration of spinal anaesthesia and it is clinically and statistically significant (p<0.05).

Block characteristics-

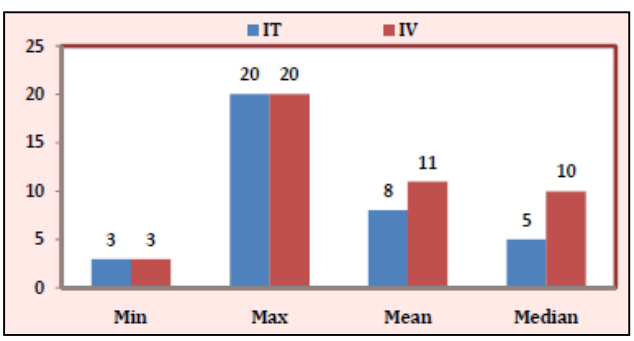
Group	Maximum Height of sensory block in dermatomal level			
	T_4	T_6	T_8	T_{10}
IT	14	15	1	0
	47%	50%	3%	0%
IV	0	11	18	1
	0%	37%	60%	3%
Total	14	26	19	1
	23%	43%	32%	2%
Chi-square value = 30.83; p<0.01; HS				

Table 1. Comparison of Maximum Height of Onset of Sensory Block between the 2 Groups

The maximum height of sensory block was attained in group IT with T4 in 47%, T6 in 50% and T8 in 3%. Group IV showed T6 in 37%, T8 in 60% and T10 in 3%. The difference in block height is clinically and statistically highly significant (p <0.01 HS).

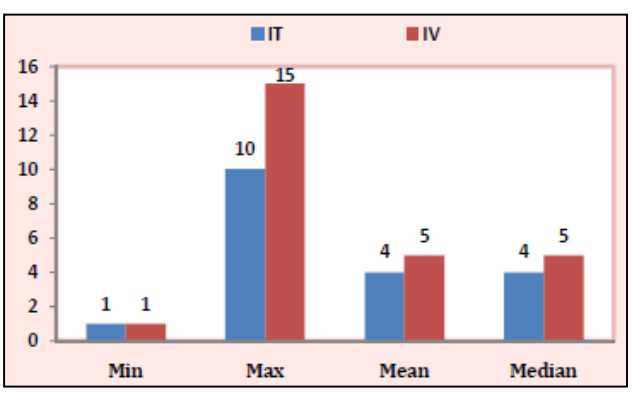
Variable	IT					IV					p-value
	Min	Max	Mean	Median	SD	Min	Max	Mean	Median	SD	
Onset of sensory block (min)	1	5	2.6	3	1.2	1	10	3.23	3	1.9	0.03
Time of Max Ht of sensory block(min)	3	20	8	5	4	3	20	11	10	5	0.02
Onset of Motor block Time(min)	1	10	4	5	2	1	15	5	4	3	0.01
Motor block Total Duration (min)	240	480	381	390	67	150	300	192	180	41	<0.01
First Analgesic Req (hrs)	5	11	8	8	1	3	6	5	5	1	<0.01

Table 2. Comparison of Block Characteristics of Both Groups



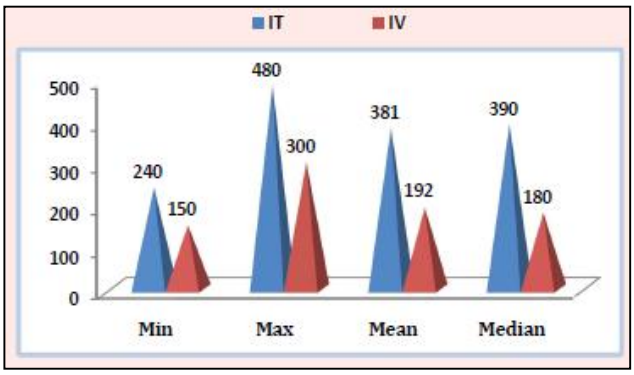
Graph 3. Comparison of Time of Maximum Height of Sensory Block in 2 Groups

The mean time for attaining maximum height of sensory block was 8 minutes for group IT and 11 minutes for Group IV with p value of 0.02, which is clinically and statistically significant.



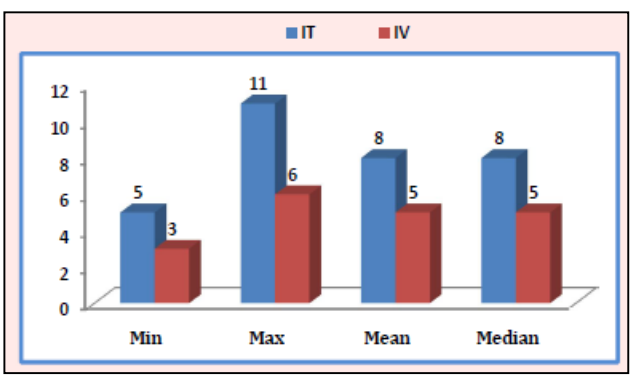
Graph 4. Comparison of Onset of Motor Block in 2 Groups

The mean time for onset of motor block was 4 minutes for group IT and 5 minutes for Group IV with p value of 0.01, which is clinically and statistically significant.



Graph 5. Comparison of Total Duration of Motor Block in 2 Groups

The mean time for total duration of motor block was 381 minutes for group IT and 192 minutes for Group IV with p value of <0.01, which is clinically and statistically significant.



Graph 6. Comparison of First Requirement of Analgesic in 2 Groups

The mean time for first requirement of analgesic is 8 hours for group IT and 5 hours for Group IV with p value of <0.01, which is clinically and statistically significant.

Comparison of Side Effects

Group	Hypotension		Total
	No	Yes	
IT	28	2	30
	93%	7%	100%
IV	25	5	30
	83%	17%	100%
Total	53	7	60
	88%	12%	100%
Chi-square value=1.46 ; p=0.23; NS			

Table 3. Comparison of Hypotension Occurring Between Two Groups

Hypotension occurred in 7% patients in group IT, 17% patients in group IV. This difference is clinically and statistically not significant (p >0.05).

Group	Bradycardia		Total
	No	Yes	
IT	30	0	30
	100%	0%	100%
IV	28	2	30
	93%	7%	100%
Total	58	2	60
	97%	3%	100%
Chi-square value=2.07 ; p=0.15; NS			

Table 4. Comparison of Bradycardia Occurring Between Two Groups

Bradycardia was noted in 7% of patients in group IV, no bradycardia occurred in group IT. This is statistically nonsignificant (p >0.05).

DISCUSSION

In this study, majority of patients were middle aged in both the groups. The sex ratio, ASA grade were also similar in both groups. The types of surgeries performed were also identical in both the groups. These parameters were kept identical in both the groups to avoid variations in intraoperative and postoperative outcome of patients.

Onset of Sensory Block

The mean time for onset of sensory block in Group IT was 2.6±1.2 minutes and in Group IV was 3.23±1.9 minutes, with p value 0.03, which was statistically significant. In comparison to study by Elhakim M. et al,[5] it was found that the onset of sensory blockade was similar and was 4.48±0.6 mins. for dexmedetomidine group compared to 3±0.78 mins. to the control group. This was statistically significant.

Motor Block Grade

In our study, 3% of patients in group IV showed grade 2 motor block. The other 97% of group IV and 100% of group IT showed grade 3 motor block. This was clinically and statistically insignificant p >0.05 in studies done by Brummet C M et al[6] and Abdallah et al, all the cases, which were taken for surgery, after the patient reached Modified Bromage score of 3.

Onset of Motor Block

In this study, time of onset of motor block was 4±1 minutes in group IT and 5±3 minutes in group IV with p value <0.05, which was statistically and clinically significant. In a study done by Ramadhyani[7] et al with 0.3 mcg intrathecal dexmedetomidine as adjuvant in spinal anaesthesia showed onset of motor block at 13.9±6.9 minutes. In their study, the dose of dexmedetomidine was less compared to that of our study.

In a meta-analysis done by Rosenberg P[8] et al, it was 9.33 min. and in study done by Kumkum Gupta et al, the onset of motor block was 11.9±5.2 minutes.

Time to Attain Maximum Height of Sensory Block

The mean time for attaining maximum height of sensory block was 8±4 minutes for group IT and 11±5 minutes for Group IV with p value of 0.02, which was clinically and statistically significant. In the study done by Stevie et al, maximum height of sensory block was observed to be 6.1±1.1 min. In a study done by Sheriff et al, it was 7.7±1.5 min.

Motor Block Total Duration

In this study, total duration of motor block was 381±67 min. in group IT and 192±41 min. in group IV with p value of <0.01, which was statistically and clinically significant. In a study done by Abdulla et al with intrathecal dexmedetomidine 5 mcg, it was found that total duration of motor block was 291 min. In a study done by Palaniswamy A et al,[9] total duration of motor block was 220±16 min., which is similar to our study.

Time of First Analgesia Required

In this study, mean of time of first analgesia required was 8±1 hours in group IT and 5±1 hours in group IV with p value <0.01, which was statistically and clinically significant. In a study by Bogra J et al,[10] it was 4 hours and in study of Nethra et al, it was 7.4 hours.

Haemodynamic Parameters

The difference of fall of blood pressure when compared between both group IV and group IT was not clinically and statistically different p >0.05. This correlates with the study done by Hala E et al and Gupta et al.

Heart rate of <50 beats/minute was considered as bradycardia and was treated with Inj. Atropine 0.6 mg IV. This fall in heart rate in group IV was clinically and statistically significant p <0.05. There was no significant difference in both groups in respiratory rate and oxygen saturation p >0.05.

Side Effects

In our study, bradycardia occurred in 7% of cases of group IV. No patients in group IT developed bradycardia. This was treated with 0.6 mg atropine. In a study by Takano Y et al,[11] 5% developed hypotension and no patient developed bradycardia and in a study Badran et al, 20% developed bradycardia, 9.1% were given atropine for treatment of bradycardia. No patient developed hypotension in their study.

In our study, side effects like nausea, vomiting, pruritus and respiratory depression did not occur in either of the groups. In a study by Kim JE et al,[12] nausea and vomiting occurred in 3.33% of patients and shivering occurred in 6.67% of patients and 3.33% of study group complained of nausea and vomiting.

CONCLUSION

This study reveals that intrathecal dexmedetomidine - 16 mcg with 0.5% heavy bupivacaine and intrathecal 0.5% heavy bupivacaine of 3.2 mL followed by intravenous infusion of dexmedetomidine 1 mcg/kg given over 10 mins. followed by maintenance dose of 0.25 mcg/kg/hr. of infusion of dexmedetomidine till the end of the surgery, both provides adequate anaesthesia for lower abdominal and lower limb surgeries.

Intrathecal dexmedetomidine with bupivacaine provides better haemodynamic stability, faster onset of sensory and motor blockade, provides longer duration of sensory and motor blockade and also adequate postoperative analgesia compared with intravenous infusion of dexmedetomidine in spinal anaesthesia with bupivacaine.

Intrathecal dexmedetomidine also showed less frequency of hypotension and bradycardia compared with intravenous dexmedetomidine group. There was no complaints of postoperative nausea and vomiting, pruritus and respiratory depression in both groups.

Hence, for shorter duration surgeries less than 3 hours duration, both intrathecal and intravenous dexmedetomidine can be used as adjuvant in spinal anaesthesia, but for surgeries longer than 3 hours duration, intrathecal dexmedetomidine is superior over intravenous dexmedetomidine for providing better anaesthesia, analgesia with stable haemodynamics and lesser side effects.

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