A COMPARATIVE STUDY OF DEXMEDETOMIDINE AND MAGNESIUM SULFATE AS ADJUVANTS WITH ROPIVACAINE FOR SPINAL ANAESTHESIA IN INFRAUMBILICAL SURGERIES AND POSTOPERATIVE ANALGESIA

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ABSTRACT :

Background Neuraxial anaesthesia is the most preferred technique for lower abdominal and lower limb surgeries. Dexmedetomidine is an agonist on the α2receptor found in the peripheral and central nervous system. Stimulation of the alpha receptors in the brain and spinal cord inhibits neuronal firing, causing hypotension, bradycardia, sedation, and analgesia
Methods: The study was conducted at mookambika medical college between 2023- 2024. After obtaining Ethical Committee approval ,50 ASA I- II patients undergoing infraumblical surgeries were randomly allotted into two groups. Inclusion criteria are Patients of age 20 to 65 years of either sex,ASA grade I and II,Patients undergoing infraumblical surgeries under spinal anaesthesia. Exclusion criteria are Patient's unwillingness,Patients with clinically significant cardiovascular, respiratory, hepatic, renal, neurological, psychiatric and metabolic diseases**.**
Results: In our study, we compared the effect of intrathecally administered magnesium and dexmedetomidine with ropivacaine in terms of onset, duration and regression of sensory and motor block, hemodynamic profile as well as the side effects .
In our study Group D patients received 3 ml of 0.75% isobaric ropivacaine hydrochloride with 10 μg of dexmedetomidine in 0.5ml NS and Group M patients received 3 ml of 0.75% isobaric ropivacaine hydrochloride with 75 mg of MgSO4 in 0.5 ml NS.
Conclusion: dexmedetomidine seems to be a better adjuvant to intrathecally administered ropivacaine in infraumbilical surgeries when compared with magnesium sulfate with regard to early onset of sensory and motor block, maximum level of sensory block achieved.
Keywords: Dexmedetomidine,Megnesium Sulfate.

INTRODUCTION:

Neuraxial anaesthesia is the most preferred technique for lower abdominal and lower limb surgeries. Spinal anaesthesia is considered superior to general anaesthesia. It minimizes or avoids the problem associated with general anaesthesia such as airway management, inhibits stress hormone release, decreases intraoperative blood loss, provides postoperative analgesia, and lowers the incidence of thromboembolic events.

Use of intrathecal adjuvants prolongs the duration of block, leads to a better success rate and patient satisfaction, and provides adequate pain management. A number of adjuvants have been studied to prolong the effect of spinal anaesthesia such as opioids (morphine, fentanyl, nalbuphine, buprenorphine), sodium bicarbonate, vasoconstrictors (epinephrine), N-methyl- d-aspartate antagonists (ketamine, magnesium sulfate), centrally acting α-2 adrenoceptor agonists (clonidine and dexmedetomidine), and γ-aminobutyric acid receptor agonists (midazolam). Thus, intrathecal additive is a reliable method to prolong the duration of spinal anaesthesia and prolong postoperative analgesia.

Dexmedetomidine is an agonist on the α2receptor found in the peripheral and central nervous system. Stimulation of the alpha receptors in the brain and spinal cord inhibits neuronal firing, causing hypotension, bradycardia, sedation, and analgesia. The analgesic action of the intrathecal α2-adrenoceptor agonist is depressing the release of C fiber transmitters and by hyperpolarization of postsynaptic dorsal horn neurons. This antinociceptive effect may explain the prolongation of sensory block, but the prolongation of the motor block may result from the binding of α2 adrenoceptor agonists to motor neurons in the dorsal horn.

Magnesium sulfate blocks calcium influx and noncompetitively antagonizes N-methyl-d-aspartate receptor channels and prevents central sensitization from peripheral nociceptive stimulation, leading to analgesia. The analgesic action of intrathecal Mg+2 is primarily based on the regulation of calcium influx into the cell, that is natural physiological calcium antagonism.

With this background, this study was designed to compare the efficacy of intrathecal dexmedetomidine and magnesium sulfate (MgSO4) for onset & duration of sensory & motor block, duration of analgesia, post operative pain & to evaluate the side effects, if any.

AIM AND OBJECTIVES OF THE STUDY:

To evaluate and compare the efficacy of intrathecally administered dexmedetomidine and magnesium sulphate along with ropivacaine in patients undergoing infraumbilical surgeries.

Comparative study of dexmedetomidine and magnesium sulphate as adjuvants with intrathecal ropivacaine in infraumbilical surgeries with respect to :Time to onset of analgesia at T10. Maximum sensory level achieved.Time to achieve the maximum sensory level. Mean time to regression to L1 dermatome.Time to onset of motor block. Maximum Bromage scale achieved. Total duration of motor block.Hemodynamic parameters.

MATERIALS AND METHODS:

The study was conducted at mookambika medical college between 2023- 2024. After obtaining Ethical Committee approval ,50 ASA I- II patients undergoing infraumblical surgeries were randomly allotted into two groups.

Inclusion criteria are Patients of age 20 to 65 years of either sex,ASA grade I and II,Patients undergoing infraumblical surgeries under spinal anaesthesia. Exclusion criteria are Patient’s

unwillingness,Patients with clinically significant cardiovascular, respiratory, hepatic, renal, neurological, psychiatric and metabolic diseases.Patients with coagulation disorders, any life-threatening disease, signs of sepsis, previous injury, deformity or previous surgery of spine, anticipated difficulty in regional anesthesia,Allergy to study drugs , pregnancy, and lactation. Thorough preanesthetic checkup of all patients including all routine investigations was done. The procedure was explained to the patient and written informed consent was taken. Pain visual analog scale (VAS) scores were explained to all patients.

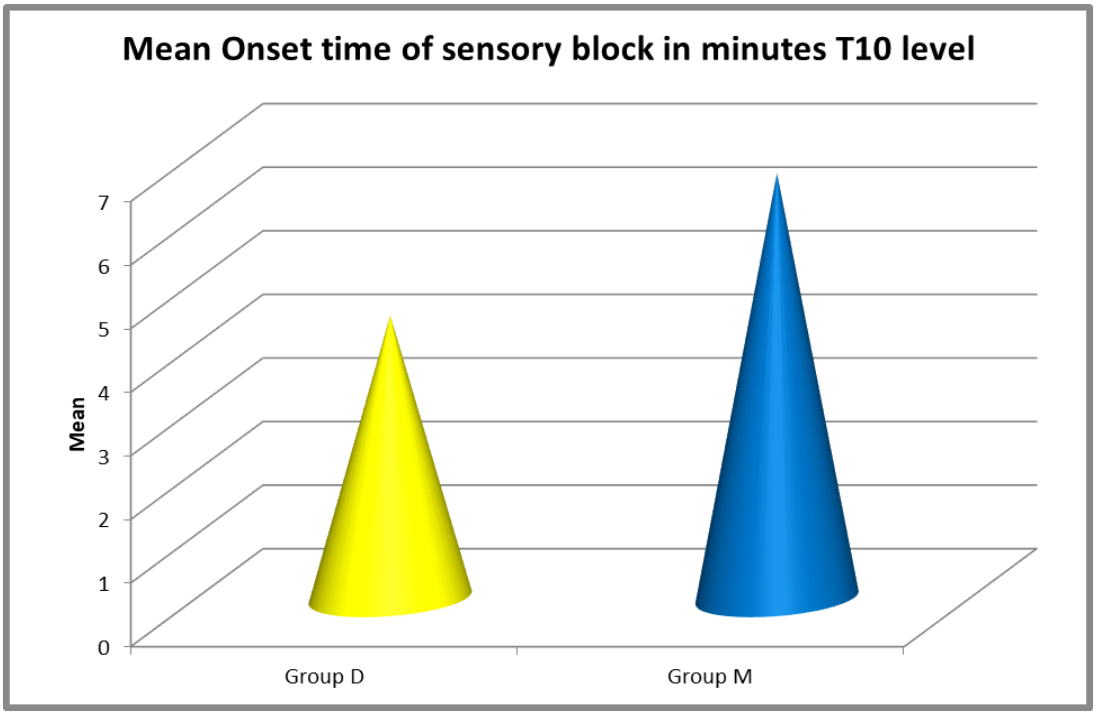
Premedication was given as tablet alprazolam 0.25 mg a night before surgery, injection glycopyrrolate 0.2 mg, and injection midazolam 0.04 mg/kg body weight by intravenous route just before the procedure in the preop room.Preoperatively, pulse rate and noninvasive systolic and diastolic blood pressure of the patients were recorded. In the operation theater, intravenous line was secured with 18-gauge intricate, and all the patients were preloaded with 10 ml/kg body weight of Ringer lactate solution over 15 to 20 min. Multipara monitors were connected, and baseline pulse rate, noninvasive systolic and
diastolic blood pressure, oxygen saturation (SpO_2), and electrocardiogram (ECG) were recorded. also. Oxygen was routinely administered through oxygen mask at the rate of 5 L/min.

Statistical analysis was done using the statistical package for social sciences (SPSS).Different statistical methods were used as appropriate. Mean ± SD was determined for quantitative data and frequency for categorical variables. The independent t- test was performed on all continuous variables. The normal distribution data was checked before any t-test. The Chi-Square test was used to analyze group difference for categorical variables. A p- value < 0.05 was considered significant.

RESULTS:

The statistical analyses were performed using SPSS version 21. Data were presented as mean with Standard deviation for normal distribution (Age, Heart rate, blood pressure and various time durations). Data were presented as frequency with proportion (%) for categorical data (Type of surgery, maximum sensory level etc.,). Unpaired 't' test was used to compare the means following between dexmedetomidine and MgSO4 group. Chi Square test (Fisher's exact test)was used to compare the categorical variables between the groups. $p<0.05$ and $p<0.0001$ were considered statistically significant.

COMPARISON OF MEAN ONSET TIME OF SENSORY BLOCK IN MINUTES TO T10 LEVEL

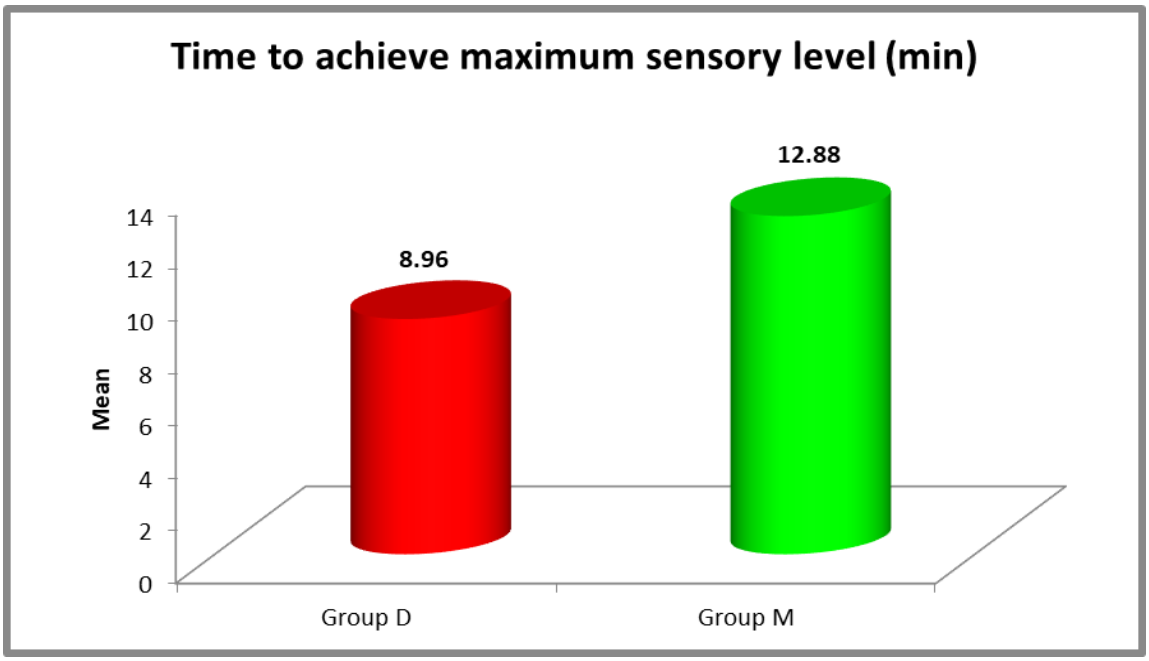


COMPARISON OF TIME TAKEN (MINS) TO ACHIEVE MAXIMUM SENSORY LEVEL

Parameter	Group D(N=25)	Group M (N=25)	P value
Time to achieve maximum sensory level (min)	8.960±0.78	12.880±0.72	**<0.001**

There was a statistical significant association in time to achieve maximum sensory level in group D with P value < 0.001.

COMPARISON OF TIME TAKEN (MINS) TO ACHIEVE MAXIMUM SENSORY LEVEL

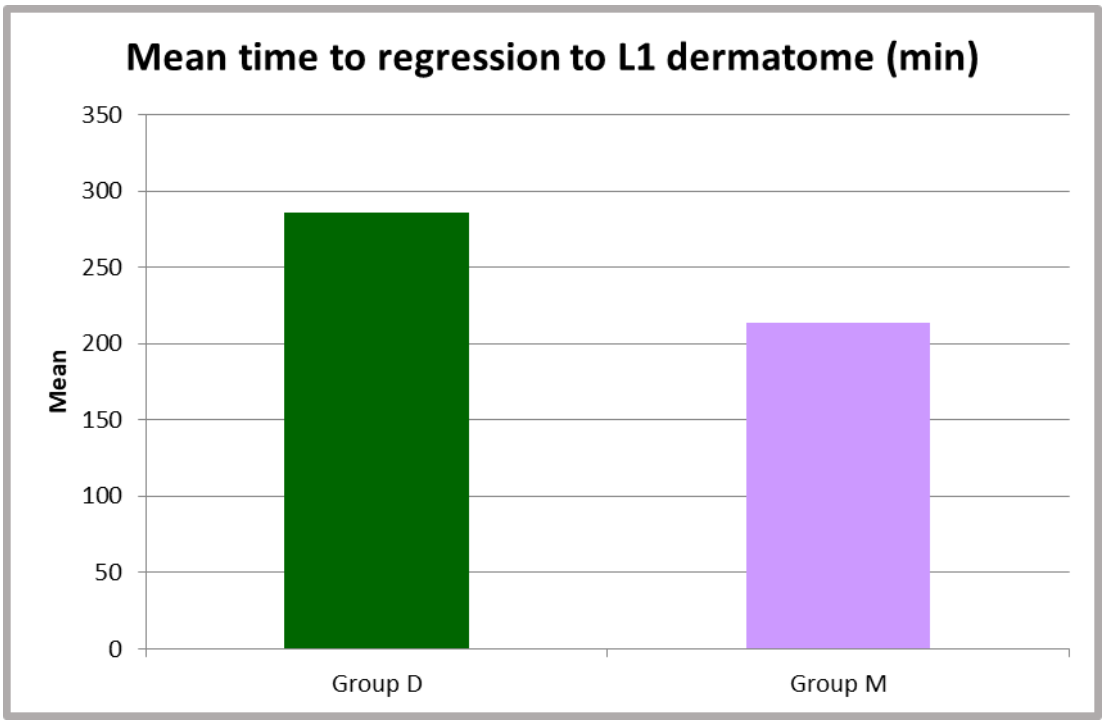


COMPARISON OF MEAN TIME (MINS) TO REGRESSION TO L1 DERMATOME

Parameter	Group D(N=25)	Group M (N=25)	P value
Mean time to regression to L1 dermatome (min)	286.0±23.97	213.30±55.31	**0.001**

There was a statistical significant association mean time to regression to L1 dermatome in group D with P value < 0.001.

COMPARISON OF MEAN TIME (MINS) TO REGRESSION TO L1 DERMATOME



COMPARISON OF MEAN ONSET TIME OF MOTOR BLOCK BETWEEN THE GROUPS IN THE STUDY POPULATION. (UNPAIRED 'T' TEST) :

S. No	Parameter	Group D (N= 25) (Mean±SD)	Group M(N=25) (Mean ±SD)	P value	Statistical test
1	Mean Onset time of motor block	8.40 ± 0.645	12.92 ± 1.350	0.001	Unpaired 't' test

The mean time for motor block was 8.40 ± 0.645 (minutes) in group D and12.92 ± 1.35 (minutes) in group M. There was a statistically significant association among two groups in time for complete motor block with p<0.00.

POST OPERATIVE PARAMETERS :

Parameters	Group D(N=25)	Group M (N=25)	P value
Total duration of Analgesia(mins)	381.60±30.09	223.00±18.20	**<0.001**

Total doses of tramadol in 24 hours	1.240±0.435	2.640±0.489	<**0.001**

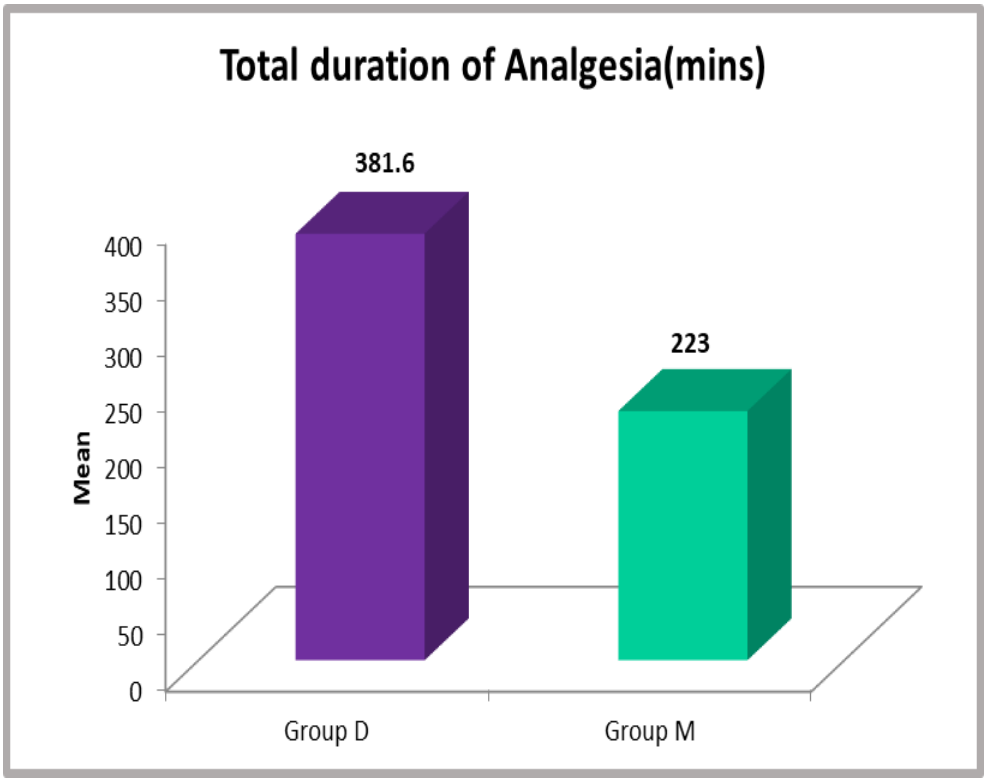
There was a statistical significant association in the total duration of analgesia and total doses of tramadol in 24 hours in group D with P value < 0.001.

COMPARISON OF TOTAL DURATION OF ANALGESIA (MINS)

Parameter	**Group D(N=25)**	**Group M (N=25)**	**P value**
Total duration of Analgesia(mins)	381.60±30.09	223.00±18.20	<**0.001**

There was a statistical significant association in the total duration of analgesia in group D with P value < 0.001

COMPARISON OF TOTAL DURATION OF ANALGESIA (MINS)



DISCUSSION:

Spinal anaesthesia is simple to perform, uses small dose of drugs, offers rapid onset of action, reliable surgical anaesthesia with good muscle relaxation. These advantages are sometimes offset by a relatively short duration of action and complaints of postoperative pain when effect wears off. Spinal anaesthesia with ropivacaine hydrochloride is increasingly being used these days owing to its lack of cardiotoxicity and neurotoxicity. The efficacy of local anaesthetics can be enhanced using adjuvants such as opioids, α2 agonists, magnesium, neostigmine, ketamine. Prolongation of the duration of spinal block is desirable both for long procedures and for postoperative pain relief.

In our study, we compared the effect of intrathecally administered magnesium and dexmedetomidine with ropivacaine in terms of onset, duration and regression of sensory and motor block, hemodynamic profile as well as the side effects .
In our study Group D patients received 3 ml of 0.75% isobaric ropivacaine hydrochloride with 10 μg of dexmedetomidine in 0.5ml NS and Group M patients received 3 ml of 0.75% isobaric ropivacaine hydrochloride with 75 mg of $MgSO_4$ in 0.5 ml NS.

The patients in both groups did not show any statistically significant difference with respect to age, gender, ASA classification and type of surgery.In our study, we found out that onset of sensory block was earlier in Group D in comparison to Group M which was statistically significant. The mean onset time of sensory block at T10 level in Goup D is 4.440±0.50 min and in Group M is 4.440±0.50 min which is statistically significant with P<0.001.
This result correlated with following studies ,in the study conducted by Mahesh Kumar Mahala et al [15] , the addition of dexmedetomidine with ropivacaine provided early onset of sensory block at T10 level . The mean time to achieve T10 sensory level (onset of sensory block) of group dexmed was 4.85 min, while that of group magnesium sulfate was 6.52 min. This difference was statistically significant.Deepika Shukla et al[18] concluded that, the mean time of onset of analgesia at T10 in group dexmedetomidine was 2.27 ± 1.09 min which was faster than group magnesium sulfate 6.46 ± 1.33. Sunil et al'[22] concluded that the time to reach sensory block at T10 in group plain bupivacaine was 4.15±1.14 min, in group magnesium sulfate was 6.46±1.32 min, in group dexmedetomidine was 3.27±0.86 min ($p < 0.05$) which was statistically significant.Srinivasan et al[25] conducted a study using dexmedetomidine as adjuvant with intrathecal ropivacaine in which, the onset of sensory block at T10 level was rapid in group dexmedetomidine 5.58±3.56 min when compared with plain ropivacaine group which was 8.0±1.8 min (P<0.0001).

In our study time to achieve maximum sensory level in Group D was 8.960±0.78 min and in Group M was 12.880±0.72 min which was statistically significant with P value < 0.001. Similar results were observed in, in a study conducted by Ravi Prakash et al[19] while comparing dexmedetomidine and magnesium sulfate as adjuvants with bupivacaine, the time to taken to reach maximum sensory level in Group D (Dexmedetomidine) was 6.8 ± 2.27 min while in Group M (magnesium sulfate) 9.73 ± 1.8 ,which was statistically significant with P value< 0.001. Kavitha jain et al[21] also concluded that the highest level of sensory block achieved was significantly earlier in Group D (Dexmedetomidine) 9.98 ± 0.54 min as compared to Group M (Magnesium sulfate) 17.35 ± 0.52 min with P value < 0.001.

In our study maximum sensory level achieved in Group D was T5 and Group M was T6 (p value 0.675) which was statistically insignificant between the two groups. Similar results were

observed in the following studies ,Farooq et al[23] conducted a study in which maximum sensory level achieved in group dexmedetomidine was T5 while in group magnesium sulfate was T6. Kavitha jain et al[21] concluded that the maximum sensory level achieved in group dexmedetomidine was T6 and in group magnesium sulfate was also T6 which were statistically insignificant.

In our study the mean time to regression to L1 dermatome (min) in Group D was 286.0±23.97 min while in group M was 235.30±55.31 min with P value < 0.001.These results correlated with Sunil et al's study [22] in which time for regression to L1 in group B (plain bupivacaine) was 160.5±21.9 min ,in group M (magnesium sulfate) was 236.6+34.5 min, in group D (dexmedetomidine) was 345.2±43.5 min with P value <0.001.

And also Raviprakash et al[19] in their study observed that the mean duration to S2 segment regression was significantly higher in group Dexmedetomidine 323.27 ± 21.38 min and group Magnesium sulfate 269.53 ±12.18 min than group Bupivacaine 203.1± 12.13 min which was statistically significant. Srinivasan et al[25] also observed that the time for regression to S2 dermatome was 243.1±20.2 min while adding dexmedetomidine with ropivacaine and 297.9±25.3 min while plain ropivacaine was used (P <0.0001) in inguinal hernia cases.

In our study the mean onset time of motor block in Group D was 8.40 ± 0.645 min while in Group M was 12.92 ± 1.350 min with P <0.001.Similar results were observed in in a study conducted by Mahesh Kumar et al[15] in which the mean time to onset of motor block in group A (isobaric ropivacaine with dexmed) was 9.93 min, while in group B (isobaric ropivacaine with magnesium sulfate) was 12.11 min. This difference was statistically significant (p<0.001).Rawada et al[20] conducted a study in which they concluded that the onset time of motor block in group S (plain Bupivacaine) was 5.50±0.61 min, in group DXM (Bupivacaine with Dexmedetomidine) was 3.95±1.47 min and in group Mg (Bupivacaine with Magnesium sulfate) was 5.80±1.47 min. Raviprakash et al[19] also concluded that, the mean time to onset of motor block was rapid in Group D (5.92 ± 1.48 min) and delayed in Group M (8.8 ± 1.54 min) in comparison with the control Group B (6.33 ± 1.37 min).

Similar result was observed in the study conducted by Kavitha jain et al[21]
where the mean time for onset of motor block in Group Dexmedetomidine was 3.73 ± 0.43 min and in Group Magnesium sulphate was 7.72 ± 0.48 min where there was faster onset of motor block by adding dexmedetomidine with hyperbaric bupivacaine.

In our study the maximum bromage scale achieved was 3 in both the groups , which was statistically insignificant.Similar results were observed in studies conducted by Mahesh Kumar et al [15], Vani et al[16] , Deepika et al[18] and Sunil et al[22] .In our study the total duration of motor block was 223.60±17.29 min in Group D and 168.20±18.30 min in Group M with P<0.001.
Similar results were observed in, the study conducted by Mahesh Kumar et al[15] , the mean duration of motor block in group A was 226.03 min ,while in group B was 171.17 min which was statistically significant(p<0.001).Vani et al[16] also concluded that adding dexmedetomidine to isobaric ropivacaine prolonged the total duration of motor block , the total duration of motor block in Group R was 104 ± 12.1 min and in Group D was 182.9 ± 18.4 min, addition of dexmedetomidine prolongs the duration of motor block about 80 min.
Similar results were observed in the study conducted by Deepika Shukla et al [18] , that the regression time of motor block, was prolonged in the group Dexmed (331 ± 35 min). Kavitha jain et al[21] observed that the duration motor block were significantly prolonged in Group

Dexmedetomidine (314.38 ± 14.93 min) when compared to Group Magnesium sulfate (228.81 ± 11.01 min) ($P < 0.05$).Similar results were observed in studies conducted by sunil et al where addition of dexmedetomidine with hyperbaric bupivacaine prolonged the duration of motor blockade.

In our study the total duration of analgesia in Group D was 381.60±30.09 min and in Group M was 223.00±18.20 min with P value < 0.001. In our study the total number of doses of tramadol required in Group D was 1.240±0.435 and in Group M was 2.640±0.489 with $P < 0.001$.
The total number of doses of rescue analgesics required was less in Group D.
Similar results were observed in the studies conducted by Rawadaa et al[20] and Srinivasan et al[25] where there was lesser requirements of rescue analgesics in 24 hrs ,while using dexmedetomidine as an adjuvant .

There was no much difference between the two groups in terms of heart rate , systolic BP and Diastolic BP. The heart rate variation between two groups were significant at 45 min and 75 min but were comparable. The systolic BP variation between two groups was not statistically significant, P value >0.05.The diastolic BP variation between two groups was statistically significant at 45 min and is comparable. Significant hypotension and bradycardia were not observed and hemodynamic stability was maintained in both the groups and, which correlated with the studies conducted by Alka shah et al[24] and Deepika Shukla et al[19].

CONCLUSION:

To conclude, dexmedetomidine seems to be a better adjuvant to intrathecally administered ropivacaine in infraumbilical surgeries when compared with magnesium sulfate with regard to early onset of sensory and motor block, maximum level of sensory block achieved, faster onset of highest level of sensory block with better hemodymanic stability and also prolonging the total duration of analgesia with minimal side effects.

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