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Efficacy of Intrathecal Dexmedetomidine and Fentanyl as Adjuvants to Bupivacaine for Postoperative Analgesia

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Abstract

***Background**: Adjuvants are added with hyperbaric bupivacaine in a single syringe before injecting the drugs intrathecally this reduces the dose of bupivacaine to produce the same degree of analgesia in addition it tends to prolong postoperative analgesia. The present study was aimed to determine the efficacy of dexmedetomidine and fentanyl with hyperbaric bupivacaine to produce postoperative analgesia. **Methods:** Based on the inclusion and exclusion criteria n=80 cases were divided into two groups. Group I (Dexmedetomidine) group receiving 0.5% hyperbaric bupivacaine 2.5 ml + 5 µgm Dexmedetomidine in 0.5 ml normal saline intrathecally. Group II (Fentanyl) received 0.5% hyperbaric bupivacaine 2.5 ml + 25 µgm fentanyl intrathecally. **Results:** The mean duration of onset of sensory analgesia in seconds in group I was 116.55 ± 10.5 sec and in group II it was 128.65 ± 12.5 seconds the difference between the onset of sensory analgesia was significantly faster in group I as compared to group II. The regression time to modified Bromage score 0 was slower in group I compared with group II; with a total mean duration of motor block in group I was 270.3 ± 19.45 min; in the group, II was 250.11 ± 9.2 min. The incidence of post-operative complications reveals the overall complications were slightly lesser in group I as compared to group II. **Conclusion**: This present study within its limitations concludes that the addition of dexmedetomidine as an adjuvant to hyperbaric bupivacaine has a very potent role in rapid onset of block and prolonging the duration of the block. It enhances the duration of the block almost doubles the duration as with plain hyperbaric bupivacaine. It also exclusively reduces the post-operative requirement of first analgesics and lesser analgesia is required in the postoperative period with minimal or no side effects and good postoperative analgesia as compared to fentanyl.*

***Keywords**: Dexmedetomidine, Fentanyl, hyperbaric bupivacaine, spinal anesthesia, adjuvants*

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Introduction

The subarachnoid block is a simple technique that provides a deep and fast surgical block through the injection of small doses of local anesthetic solution in the subarachnoid space. The subarachnoid block is a widely used method providing a fast onset and effective sensory and motor blockade. Administrating the combinations of other classes of analgesics with local anesthetics has been used to increase the duration and reduce the side effects of analgesia. [1] Several drugs have been used as adjuvants in spinal anesthesia to prolong intraoperative and postoperative analgesia. [2, 3] Including opioids, α2 agonists, neostigmine, vasoconstrictors, etc. Clonidine and dexmedetomidine are two α2 agonists affecting pre-synaptic and post-synaptic α2 receptors. [4] Dexmedetomidine has been widely used for anesthesia and analgesia purposes. This drug has sedative, anti-anxiety, analgesic, neuroprotective, and anesthetic-sparing effects. [5] Dexmedetomidine along with other drugs has been used to increase the duration of analgesia in subarachnoid, epidural,

and caudal blocks. [6, 7] Fentanyl is a synthetic opioid with central action, which is used widely for pain control. Intrathecal fentanyl is usually added to other local anesthetics to increase anesthesia and analgesia. It has improved spinal anesthesia and reduced the anesthetic drug-related side effects including pruritus, nausea, and vomiting. [8] The potentiating effect of short-acting lipophilic opioid fentanyl to hyperbaric bupivacaine improves the quality of intraoperative and early postoperative subarachnoid block. The addition of opioids to local anesthetic solutions has disadvantages, such as pruritus and respiratory depression. With this background, the current study aimed to determine the efficacy of intrathecal dexmedetomidine and fentanyl to bupivacaine on the duration of onset, duration of the block, hemodynamic stability, and postoperative analgesia.

Materials and Methods

The present study was conducted in the Department of Anesthesia, Prathima Institute of Medical Sciences, Naganoor, Karimnagar. Institutional Ethical Committee permission was obtained for the study. Written consent was obtained from all the participants of the study.

Inclusion criteria

1. ASA I and II grades
2. Elective lower limb and abdominal surgeries under spinal anesthesia
3. Aged 20 – 50 years
4. Males and females

Exclusion criteria

1. Patients with coagulation disorders
2. Significant comorbidities
3. Spinal deformities
4. On therapy with ACE inhibitors
5. Conversion to general anesthesia because of inadequate analgesia

Based on the inclusion and exclusion criteria n=80 cases were divided into two groups. Group I (Dexmedetomidine) group receiving 0.5% hyperbaric bupivacaine 2.5 ml + 5 µgm Dexmedetomidine in 0.5 ml normal saline intrathecally. Group II (Fentanyl) received 0.5% hyperbaric bupivacaine 2.5 ml + 25 µgm fentanyl intrathecally. The patients were randomly allotted to two groups. The selected cases underwent pre-anesthetic checkup and detailed history, physical examination, and systemic examination was carried out. The laboratory investigations were CBP, Hb%, ESR, BT and CT, FBS, Blood urea, serum creatinine, urine analysis, Chest X-ray ECG, HIV, and HbsAg. Patients were kept NBM overnight and shifted to the operating room, IV of ringer's lactate solution 500 ml was infused. The monitors were connected to patients to record non-invasive BP, Pulse oximeter and ECG, PR, SpO2, and RR. Lumbar puncture was done in left lateral position by sing disposable Quincke spinal needle (26 G) at L3-L4 intervertebral space after obtaining free flow of CSF. The patients were then placed as per the surgical procedure and all the vital parameters were monitored After spinal anesthesia, Oxygen (4L/min) by venture mask was given. Fluid therapy was maintained with lactated Ringer's solution (10mL/kg/hr). The assessment of sensory and motor blockade was done using the hypodermic pinprick method along the midaxillary line and modified Bromage scale respectively. Patients were observed for sedation, and it was recorded by 6 points modified Ramsay sedation scale score. Postoperative analgesia assessment was done every 4th hour for 24 hours. Rescue analgesic in the form of inj diclofenac sodium 75 mg i.m will be given if VAS score is >4. The total amount of analgesic administered after operation, time to first analgesic dose, and the occurrence of any intra or postoperative adverse events such as nausea, vomiting, itching, respiratory depression (RR<12/min), postural puncture headache, or any adverse events will be documented. All the available data was uploaded on an MS Excel spreadsheet and analyzed by SPSS version 19 in windows format. Continuous variables were expressed as mean and standard deviation and categorical variables were expressed by chi-square test and Fisher's exact test ($p<0.05$ was considered as significant).

Results

Out of n=40 cases of group I n=26(65%) were males and n=14(35%) were females for group II n=23(57.5%) were males and n=17(42.5%) were females. Based on the ASA category in group I ASA grade 1 was 80% and ASA grade 2

was 20%. In group II the ASA grade 1 was 77.8% and ASA grade II was 47.5%.

Table 1: The physical parameters of the cases included in the study

Parameter	*Group I (Dexmedetomidine)*	*Group II (Fentanyl)*	*p-value*
Age in years	38.56 ± 3.54	37.28 ± 2.98	0.215
Height in centimeters	162.2 ± 5.5	161.5 ± 3.5	0.335
Weight in Kgs	60.2 ± 4.21	59.32 ± 3.95	0.143

All the patients in this study were electively posted for lower limb and lower abdominal surgeries were in the age group 20 – 50 years. The youngest patient was a 20-year-old male and the eldest was a 50-year-old male. The mean age of group I was 38.56 years and group II was 37.28 years the differences were statistically not significant depicted in table 1. In Group I, the mean duration of surgery (in mins) was 101.46 ± 20.1 minutes In Group II, 115.21 ± 18.98 minutes respectively. Statistically, there was a highly significant difference between the three study groups about the mean duration of surgery as P<0.04.

Table 2: Comparison of sensory blockade in both groups of cases

	Group I (Dexmedetomidine)	*Group II (Fentanyl)*	*p-value*
Level of sensory blockade			
T6	32 (80.0%)	26 (65.0%)	0.0251*
T8	08 (20.0%)	14 (35.0%)	
Degree of Motor Blockade			
Bromage Grade	3.0 ± 0.0	3.0 ± 0.0	---

The mean duration of onset of sensory analgesia in seconds in group I was 116.55 ± 10.5 sec and in group II it was 128.65 ± 12.5 seconds the difference between the onset of sensory analgesia was significantly faster in group I as compared to group II. The regression time to modified Bromage score 0 was slower in group I compared with group II; with a total mean duration of motor block in group I was 270.3 ± 19.45 min; in the group, II was 250.11 ± 9.2 min.

The requirement of postoperative analgesia Diclofenac sodium IM per 24 hours showed out of n=40 cases of group I n=38(95%) cases required only 2 doses of analgesic on the comparison with the group II out of n=40 cases n=35(87.5%) cases required 3 doses of analgesic the p values were <0.05 hence considered significant. The incidence of postoperative complications is depicted in table 4 which reveals the overall complications were slightly lesser in group I as compared to group II however, the values were not significant.

Table 3 Comparison of Study Group For

Study parameter	Group I	Group II	P-Value
The onset of sensory block(sec)	166.55 ± 10.5	118.65 ± 12.5	0.0125 *
Time to cephalic spread(min)	11.65 ± 1.62	9.92 ± 0.68	0.1220
Two segment regressions (min)	140.73 ± 11.5	115.5 ± 9.94	0.0471 *
The onset of motor block(sec)	542 ± 60.85	472 ± 49.16	0.001 *
Duration of motor block(min)	270.3 ± 19.45	250.11 ± 9.2	0.325
Duration of surgery (min)	116.55 ± 10.5	128.65 ± 12.5	0.387
Post operative analgesia(min)	330.67 ± 25.43	240.83 ± 24.0	0.000 *

***** Significant

Table 4 Comparison of Overall Incidence of Side Effects and Complications

Complication	Group I	Group II
Bradycardia	2(5.0%)	1 (2.5%)
Hypotension	2 (5.0%)	2 (5.0%)
Nausea and vomiting	1(2.5%)	1 (2.5%)
Pruritus	0 (0.0%)	1 (2.5%)
Total	5(12.5%)	5(12.5%)

Discussion

The addition of dexmedetomidine to hyperbaric bupivacaine produced a predictable and adjustable level of blockade. [9] Similarly, the addition of low dose bupivacaine to intrathecal fentanyl augments intrathecal fentanyl duration and quality of analgesia and speeds onset of analgesia. [10] The mean duration of onset of sensory analgesia in seconds in group I (dexmedetomidine) was 116.55 ± 10.5 sec and in group II it was 128.65 ± 12.5 seconds the difference between the onset of sensory analgesia was significantly faster in group I as compared to group II (Fentanyl). Al Mustafa et al., [11] studying the addition of 5 micrograms of dexmedetomidine or 25 micrograms fentanyl intrathecal to hyperbaric bupivacaine produces a prolonged subarachnoid block. The efficacy was noted in a dose-dependent manner. The mean duration of sensory and motor block in this study of group I cases was greater than group II given in table 3. Al Ghanem et al., [12] in a similar study found 10 isobaric bupivacaine in

hysterectomy found dexmedetomidine produces more prolonged motor and sensory block as compared to fentanyl. The highest level of sensory block T6 in our study was found in group I 32 (80.0%) and 26 (65.0%) in group II. Desai et al., [13] in their comparative study found that the time to reach the highest level of the block was less when morphine or fentanyl was administered sequentially with hyperbaric bupivacaine. The prolongation of a motor block of spinal anesthetics is a result of the binding of α_2 adrenoreceptor agonists to the motor neurons in the dorsal horn. Dexmedetomidine appears to be eight times more specific and highly selective for α_2 adrenoreceptor thereby making it a useful adjunct to spinal anesthesia. [14] Some studies have found that the dose of 3, 5, and 10 micrograms of intrathecal dexmedetomidine produces good results without affecting the hemodynamic stability and lack of sedation. [11, 12, 15] Some studies have found that the dose of 3, 5, and 10 micrograms of intrathecal dexmedetomidine produces good results without affecting the hemodynamic stability and lack of sedation. [11, 12, 15] The regression time to modifed Bromage score 0 was slower in group I compared with group II. None of the cases required analgesics during the surgery. Bromage 3 occurred in all patients before the operations. Reduced need for analgesics in the post-operative period was seen in group I as compared to group II. The longer duration of sensory and motor block for dexmedetomidine have been reported in the previous studies comparing this drug with other drugs clonidine, fentanyl, and sufentanil. [16, 17] The side effects of drugs were observed there were no significant differences in the rate of hypotension, bradycardia, nausea, and vomiting between the two groups. Previous studies have reported different rates of side effects. Ravipati et al., [18] observed pruritus only in the fentanyl group while no significant difference between the groups. One study has shown a higher rate of hemodynamic side effects in the dexmedetomidine group. [17]

Conclusion

This present study within its limitations concludes that the addition of dexmedetomidine as an adjuvant to hyperbaric bupivacaine has a very potent role in rapid onset of block and prolonging the duration of the block. It enhances the duration of the block almost doubles the duration as with plain hyperbaric bupivacaine. It also exclusively reduces the post-operative requirement of first analgesics and lesser analgesia is required in postoperative period with minimal or no side effects and good postoperative analgesia as compared to fentanyl.

***Conflict of Interest*: None**
***Source of support*: Nil**
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