ORIGINAL RESEARCH ARTICLE

Intrathecal Labor Analgesia Using Dexmedetomidine: A Viable Alternative to Epidural Analgesia

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Abstract

Aims and objectives: The aims and objectives of the study were to compare the safety and efficacy of single dose intrathecal analgesia using bupivacaine and fentanyl with either dexmedetomidine or morphine on maternal and fetal outcome.

Materials and methods: One-hundred and twenty parturients with uncomplicated pregnancy in spontaneous or induced labor at cervical dilatation 4–6 cm were enrolled for the study. They were randomized into two groups of 60 each. Group I received dexmedetomidine 5 µg (1 mL) and group II received morphine 250 µg (1 mL) along with 0.5% bupivacaine heavy 2.5 mg (0.5 mL) + Fentanyl 25 µg (0.5 mL). Progress of labor, duration of analgesia, and neonatal APGAR score was recorded and compared between the two groups.

Result: The mean rate of cervical dilatation in group I was 1.63 ± 0.135 cm/hour whereas it was 1.54 ± 0.156 cm/hour in group II ($p = 0.001$). The mean total duration of labor in group I was 682.35 ± 60.920 minutes whereas it was 771.63 ± 52.016 minutes ($p = 0.005$). In the group I, 98.3% (59/60) had NVD, 1.7% (1/60) had IVD, and none had cesarean delivery. Similarly 75% (45/60) had NVD, 15% (9/60) had IVD, and 10% (6/60) had cesarean delivery in the group II. This difference was statistically significant ($p = 0.001$). However, duration of the second stage of labor, duration of labor analgesia, maternal satisfaction, and APGAR score did not differ in the two groups.

Conclusion: Single-shot intrathecal labor analgesia using combination of bupivacaine (2.5 mg), fentanyl (25 µg), and dexmedetomidine (5 µg) is a safe, effective, reliable, cheap, and satisfactory method of pain relief for labor and delivery.

Keywords: Dexmedetomidine, Intrathecal analgesia, Labor analgesia.

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Introduction

Labor is a highly complex event.[1] Labor pain is one of the most severe types of pain a woman will experience in her life time. Maternal pain and anxiety cause increase in release of catecholamines which in turn cause uncoordinated uterine contraction, reduced utero-placental blood flow,[2] and may act as tocolytic. Hence effective pain relief with regional analgesia enhances uterine contractions and chances of causing dystocia decrease.[3] There are many different techniques, both regional and nonregional, to provide labor analgesia. Currently, the gold standard obstetric analgesia is epidural anesthesia. But intrathecal labor analgesia is simple, easy, and effective method for painless and safe delivery. This can be used effectively as well as economically in low resource set-up for intrapartum pain relief. When the two drugs are combined, both the local anesthetic and opioid can be administered at low concentrations, resulting in increased maternal satisfaction and, most importantly, a decrease in the incidence of adverse effects such as hypotension and drug toxicity.[2] Dexmedetomidine is a new selective α_2-adrenoreceptor agonist that has sedative and anesthetic properties. It acts by activating proteins in the brain stem which results in the inhibition of norepinephrine release. It provides stable hemodynamic conditions, good quality of intraoperative, and prolonged postoperative analgesia with minimal side effects. Intrathecal DMT has been found to have antinociceptive action for both somatic and visceral pain.[4,5] We therefore conducted study to compare the safety and efficacy of single-dose intrathecal analgesia using bupivacaine, fentanyl, and dexmedetomidine and bupivacaine with fentanyl and morphine on maternal and fetal outcome.

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Aims and Objectives

Aims

To compare the effect of single-dose intrathecal analgesia on maternal and fetal outcome.

Objectives

To assess and compare maternal and fetal outcome after using intrathecal analgesia through

- Mode of delivery: Normal/Instrumental/Cesarean
- Duration of labor
- Average rate of progression of labor
- Effect on ambulation.

Materials and Methods

A prospective, randomized controlled double-blind study was conducted at Kamla Nehru State Hospital for mother and child, Indira Gandhi Medical College (IGMC), to compare the effect of single-dose intrathecal analgesia using bupivacaine, fentanyl and dexmedetomidine, and bupivacaine with fentanyl and morphine on maternal and fetal outcome.

One-hundred and twenty laboring primigravida patients of age 20–35 years with singleton pregnancy at term with vertex presentation, scheduled for normal vaginal delivery and having cervical dilatation of 4–6 cm, desiring for labor analgesia, were recruited (between June 1, 2019 and December 31, 2019) after obtaining informed written consent and clearance from the institute ethics and research committee.

A thorough general physical examination was done. Per abdominal examination was done to confirm lie, presentation, and position. Duration, intensity, and frequency of uterine contractions were noted. Fetal heart sound was auscultated and noted. Per vaginal examination was done and cervical dilation, effacement, position, and station of the presenting part were noted. Pelvic assessment was done to rule out cephalopelvic disproportion (CPD). Artificial rupture of membranes (ARM) was done at ≥4 cm cervical dilatation and after confirming clear liquor case was selected for study. All parturients were subjected for basic investigations (HB, ABORh, TSH, HIV, HBsAg, STS, 75 g OGTT) if not already done.

Computerized randomization software was used to divide cases who matched inclusion criteria into two groups. Selected parturients were randomly allocated into two groups. The study solutions were prepared by the anesthesiologist not involved in the study. The parturients of the two groups were given coded drugs. Code was broken after data assimilation. Maternal numerical pain rating score (NPRS) was recorded by the anesthetist.

Under all aseptic precautions parturients back were painted and draped. L3–L4 interspace was identified and overlying skin was infiltrated with 2 mL of 1% lignocaine. 26G spinal needle was introduced via median/para median approach. Correct placement of spinal needle in subarachnoid space was confirmed by free flow of cerebrospinal fluid and coded drugs were injected.

Parturients were kept in supine position for 10 minutes and then allowed to ambulate with assistance. Onset of analgesia was noted, which was taken as time in minutes needed to decrease in NPRS score during labor pain by 2. Failure to achieve this was regarded as "Failed Block" and alternate measures of analgesia were administered and parturients were noted and dropped from further study.

In both the groups the following data were obtained every 5 minutes for first 30 minutes, then every 30 minutes until delivery:

- Maternal blood pressure
- Heart rate, respiratory rate
- Maternal NPRS score
- Effect on ambulation
- Other side effects like maternal nausea, vomiting, drowsiness, palpitations and pruritis

Group I: received single shot of intrathecal	*Group II: received single shot of intrathecal*
0.5 mL of 0.5% bupivacaine heavy (2.5 mg) with	0.5 mL of 0.5% bupivacaine 0.5% heavy (2.5 mg) with
0.5 mL fentanyl (25 µg) and	0.5 mL fentanyl (25 µg) and
1 mL of dexmedetomidine (5 µg)	1 mL morphine (250 µg)
Total: 2 mL	Total: 2 mL

Fetal heart rate was monitored continuously using electronic fetal monitoring. The labor was monitored partographically. The third stage of labor was managed actively.

At delivery time, NPRS score and type of delivery were recorded. The indication for instrumental delivery (ventouse/forceps) or caesarean section was noted. Postdelivery maternal satisfaction was noted.

Neonatal assessment was done by assessing APGAR score at 1 and 5 minutes and needed resuscitation and NICU admissions.

Observation and Results

Demographic data like age, gestation, and mean cervical dilatation were statistically similar in both the groups. Mean cervical dilatation rate was found to be faster than normal pregnancy rate; being quicker in dexmedetomidine group. In our study we had only one instrumental vaginal delivery in dexmedetomidine group whereas there were nine instrumental vaginal deliveries in morphine group; on the other hand group I had no caesarean sections as compared to six in group II. These results were statistically significant. There was no difference in fetal outcome between both the groups.

Results are given in tabulated form (Tables 1 to 4).

Discussion

Intrathecal route of providing labor analgesia has seen a resurrection in recent times. Most frequently used drugs are bupivacaine and fentanyl either alone or in combination. Though useful, this provides either inadequate duration of analgesia (bupivacaine in low dose and concentration) or has prominent side effects (motor blockade leading to higher number of instrumental/operative deliveries). Thus, there is continuous research in novel adjuvants to be given alongside bupivacaine and fentanyl to have long duration analgesia without any motor blockade or other side effects. There is a paucity of literature on the studies comparing intrathecal dexmedetomidine and morphine in labor analgesia. Both these agents have been safely and successfully used intrathecally as well as in pregnant patients for operative deliveries. Therefore we

Table 1: Baseline data

Parameters	*Group I*	*Group II*	*p value*
Age (in years)	25.48 ± 3.601	25.82 ± 3.703	0.618
Period of gestation (weeks ± days)	39.08 ± 1.046	39.08 ± 1.154	1.000
Mean cervical dilatation at time of labor analgesia administration (cm)	4.83 ± 0.717	4.98 ± 0.770	0.936

Table 2: Maternal outcomes

Parameters	*Group I*	*Group II*	*p value*
Mean cervical dilatation rate (cm/hour)	1.63 ± 0.135	1.54 ± 0.156	0.001
Mean duration of first stage of labor (minute)	635.25 ± 61.376	664.47 ± 50.691	0.005
Mean duration of second stage of labor (minute)	48.77 ± 11.951	50.82 ± 14.100	0.392
Mean total duration of labor (minute)	682.35 ± 60.920	771.63 ± 52.016	0.005
Mean duration of labor analgesia (minute)	254.42 ± 13.054	253.50 ± 13.254	0.703

Table 3: Mode of delivery

Type of delivery	*Group I (N = 60)*	*Percentage(%)*	*Group II (N = 60)*	*Percentage(%)*	*p value*
NVD	59	98.3	45	75	0.001
IVD	1	1.7	9	15	
NRFHR with poor maternal efforts	1	1.7	8	13.33	
Prolonged second stage	0	0	1	1.66	
Cesarean	0	0	6	10	
Fetal bradycardia	0	0	2	3	
Fetal tachycardia	0	0	1	2	
Non progress of labor	0	0	3	5	

Table 4: Fetal outcome

Neonatal parameter	*Group I (N = 60)*	*Group II (N = 60)*	*p value*
APGAR score at 1 minute	7.10 ± 0.440	7.17 ± 0.587	0.483
APGAR score at 5 minutes	8.83 ± 0.376	8.82 ± 0.390	0.812
Neonatal resuscitation	No	No	—
NICU admissions	No	No	—

intended to use and study these drugs in intrathecal dosage for labor analgesia in view of maternal and neonatal outcomes.

The mean cervical dilatation rate in the present study in group I was 1.63 ± 0.135 cm/hour and in group II was 1.54 ± 0.156 cm/hour, which interestingly is faster than normal. Other studies also support the fact that intrathecal analgesia may provide for quicker cervical dilatation, thus giving it another advantage. In a study Gehan et al.[6] while evaluating the effect of intrathecal dexmedetomidine on quality of CSE analgesia on labor outcome, the rate of cervical dilatation was found to be at least 1.6 ± 0.2 cm/hour. The same was substantiated by Hess et al.[7] in their study of spinal labor analgesia using bupivacaine/fentanyl/morphine (BFM). It may be due to the fact that it leads to muscle relaxation.

The mean duration of second stage of labor was 48.77 ± 11.951 minutes in group I and 50.82 ± 14.1 minutes in group II, respectively. Duration of second stage of labor in the study conducted by Viitanen et al.[8] was 9.6 ± 10.7 minutes, and it could be attributed to difference in parity. In a study conducted by Mathur et al.,[2] it was significantly less compared to the present study. The intrathecal analgesia protocol was a bit different in that study. Although bupivacaine and fentanyl were given in similar doses, injection morphine or dexmedetomidine was not administered for intrathecal labor analgesia. Moreover, the baseline parturients characteristics and the neonatal birth weight details are not available in that study and these parameters also affect the duration of labor.

In the present study the mean total duration of labor in group I was 682.35 ± 60.92 minutes and 711.63 ± 52.016 minutes in group II. Similar to our study, the study by Dostbil et al.[9] on the effects of adding morphine to bupivacaine for labor analgesia found that the duration of labor was more in group bupivacaine/fentanyl/morphine (BFM) (852.86 ± 342.2 minutes) as compared to group BF (758.07 ± 382.1 minutes). Results of this study are more comparable to the study conducted by Hess et al.[7] to assess the effect of small dose of spinal bupivacaine/fentanyl alone or in combination with a small dose of morphine (125 µg) as labor analgesia. The duration of labor was 322 ± 139 minutes, in group BF and 432 ± 272 minutes, in group BFM. The study by Yeh et al.[10] to determine the effect of addition of morphine (150 µg) to the intrathecal combination of fentanyl (25 µg) and bupivacaine (2.5 mg) on duration of labor analgesia found that the mean duration of labor was 9.46 ± 4.5 hour in group BF and it was 9.96 ± 5.8 hour in group BFM.

The mean duration of analgesia in the present study in group I was 254.42 ± 13.054 minutes and 253.50 ± 13.254 minutes in group II. It was longer as compared to the studies conducted by Owen et al.[11] (90 ± 21 minutes), Nelson et al.[12] (79 ± 34 minutes), Viitanen et al.[8] (101 ± 34 minutes), and Mathur et al.[2] (108 ± 20 minutes). The difference can be attributed to the administration of morphine and dexmedetomidine in addition to bupivacaine and fentanyl in the present study whereas the intrathecal labor analgesia comprised only bupivacaine and fentanyl in the rest of the studies.

Results of our study are similar to the study conducted by Yeh et al.,[10] where they found that addition of morphine to bupivacaine and fentanyl combination increases the duration significantly (252 ± 63 vs 148 ± 44 minutes).

The result of our study was in accordance with Minty et al.,[13] who in a clinical review based on 33 articles including 14 studies, 1 meta-analysis, and 2 systemic reviews, all providing level I evidence concluded that a combination of 2.5 mg bupivacaine, 25 µg fentanyl, and 250 µg of morphine intrathecally provides a 4 hour window of acceptable analgesia.

Thus it is evident from the above studies that intrathecal morphine/dexmedetomidine in addition to their own analgesic action have the synergistic effect on bupivacaine and fentanyl which results in prolongation of analgesia with lowest possible doses.

In the present study group I had 98.3% (59/60) NVD, 1.7% (1/60) IVD, and none had cesarean delivery. Similarly in group II, 75% (45/60) had NVD, 15% (9/60) had IVD, and 10% (6/60) had cesarean delivery. The cumulative results are in line with normal accepted obstetric parameters. Overall caesarean rate in the present study was 10% among the parturients receiving single-shot intrathecal labor analgesia as morphine (group II), which was similar to the study by Hess et al.[7] to assess the effect small dose of spinal bupivacaine/fentanyl alone or in combination with a small dose of morphine (125 µg) as labor analgesia in which rate of cesarean delivery was 14%. In the study conducted by Nelson et al.[12] 55% delivered vaginally, 21% had IVD and the remaining 24% underwent caesarean section. In another study by Gehan et al.[6] on the effect of intrathecal dexmedetomidine on the quality of combined spinal epidural analgesia observed that 10% patients had instrumental delivery and 6.7% had cesarean delivery and 84.3% patients had

normal vaginal delivery. In the study done by Madishetti et al.,[14] 75% patients delivered vaginally, 12.5% had assisted vaginal delivery, and 12.5% delivered by LSCS. Similarly in study done by Shah et al.,[15] 12% had IVD,64% had NVD and 24% had cesarean delivery.

In the present study, none of the parturients in either group had any significant side effects which is supported by other studies using similar doses.[4,16–22]

The mean APGAR scores in group I at 1 and 5 minutes were 7.10 ± 0.440 and 8.83 ± 0.376, respectively, and the mean APGAR scores in group II at 1 and 5 minutes were 7.17 ± 0.587 and 8.82 ± 0.390, respectively. None of the neonates required NICU admission in the two groups. The insignificant effect of our intrathecal analgesia protocol on neonate is also substantiated by other studies using similar dosage.[4,17,19,23–26]

Conclusion

The present study shows that the single-shot intrathecal labor analgesia using the combination of bupivacaine (2.5 mg), fentanyl (25 µg), and morphine (250 µg) or dexmedetomidine (5 µg) is a viable method of pain relief in labor and delivery. The reliability of spinal block, in terms of achieving satisfactory analgesia within a reasonable time limit and providing adequate analgesia till the end of delivery, is the most important issue to address. Single-shot spinal analgesia provides a 3–4 hours window of pain relief in labor and delivery. Therefore, it may provide an adequate analgesia to parturients till delivery when administered in the active phase of labor.

Single-shot intrathecal labor analgesia using the combination of bupivacaine (2.5 mg), fentanyl (25 µg), and dexmedetomidine (5 µg) is a safe, effective, reliable, cheap, and satisfactory method of pain relief for labor and delivery. Moreover, it is devoid of side effects on mother and fetus. It is also associated with rapid cervical dilatation.

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