Abstract

Background: Dexmedetomidine has been used as an effective adjuvant to local anesthetics in peripheral nerve blocks and at the incision site. Aims: We compared the postoperative analgesic effect of bupivacaine alone and in addition of dexmedetomidine to bupivacaine in wound instillation during lumbar laminectomy. Setting and Design: This was a prospective, double-blind, randomized control trial. Subjects and Methods: Sixty adults of the American Society of Anesthesiologists Grade I–II scheduled for elective lumbar laminectomy under general anesthesia were randomly allocated into two groups. Group B (control group) patients received wound instillation with 20 mL of 0.25% bupivacaine at the end of surgery and Group D patients received 2 µg.kg⁻¹ dexmedetomidine diluted in 20 mL 0.25% bupivacaine as instillation over the incision site. If the NRS exceeded “4” at any point of time, rescue analgesia with injection diclofenac 75 mg deep intramuscular was administered. Postoperative pain score, duration of analgesia, total rescue analgesic required in the first 24 h, and side effects were compared between the groups. Results: Demographic data were comparable in both the groups. Duration of analgesia (19.93 ± 3.2 in Group D vs. 12.13 ± 1.8 in Group B) was significantly more in Group D, number of analgesic demands were less in group D as compared to Group B, and total rescue analgesic required (62.51 ± 39.13 vs. 95.68 ± 33.5) was significantly less in Group D as compared to Group B. Conclusions: We conclude that dexmedetomidine 2 µg.kg⁻¹ is an effective adjuvant to bupivacaine for wound instillation in terms of quality and duration of postoperative analgesia following lumbar laminectomy.

Keywords: Analgesia, bupivacaine, dexmedetomidine, lumbar laminectomy, wound instillation

Introduction

Lumbar laminectomy is a commonly performed procedure in neurosurgical and orthopedic practice.[1] Postoperative pain relief helps in early mobilization, initiation of physiotherapy, provides satisfaction to the patients, preventing the development of chronic pain, and plays an important role in reducing morbidity and mortality.[3] Currently, several postoperative analgesic modalities like intravenous (i.v.) nonsteroidal anti-inflammatory drugs or opioids, intrathecal opioids and local anesthetics, wound infiltration and wound instillation have been evaluated. A simple technique of instillation of wound with local anesthetics has shown better postoperative pain management in various surgical procedures.[3-8]

As a significant proportion of surgical pain originates from the surgical wound, it is meaningful or effective to use local anesthetics at the site of surgery to manage perioperative pain.[7] Wound instillation technique acts by blocking the transmission of pain from nociceptive afferents directly from the wound surface and also decreases the local inflammatory response to injury.[9] A single shot wound instillation with long-acting local anesthetics provides analgesia for up to 8–12 h. Various adjuvants when added with local anesthetics such as opioids, nonopioids, vasoconstrictors, N-methyl D-aspartate antagonists, α₂ agonists, and neostigmine can prolong postoperative analgesic effect.[9] α₂ adrenergic...
agonists have both analgesic and sedative properties and lack respiratory depression.\[^{10,11}\] The peripheral analgesic effects of \(\alpha_2\) adrenergic agonists potentiate the action of local anesthetics, which is mediated by binding to \(\alpha_2\) adrenergic receptor.\[^{11}\]

Dexmedetomidine has been used as an adjuvant to local anesthetics in various surgical procedures.\[^{12-16}\] We aim to compare the duration and analgesic efficacy of bupivacaine alone and in addition to dexmedetomidine in wound instillation after lumbar laminectomy.

**Subjects and Methods**

This is a prospective, randomized, double-blind study performed over a period of 1-year in a tertiary care hospital. The study was approved by Institutional Ethics Review Committee. The clinical trial was registered with Clinical Trial Registry of India (CTRI No: 2018/08/015463). Written and informed consent was obtained from all patients.

Patients of physical status American Society of Anesthesiologists Classes I and II, aged 18–60 years of either sex, scheduled for lumbar laminectomy who planned to have single-level lumbar disc surgery under general anesthesia were enrolled for this trial. Exclusion criteria included patients with spinal stenosis, who underwent prior lumbar disc surgery, prior neurological deficits, preoperative opioid use or history of any substance abuse or on steroids, had known local anesthetics allergy, intraoperative cerebrospinal fluid leak, or those requiring placement of a drain. Patients were randomly allocated to two groups of thirty each using sequentially sealed opaque envelopes. A trained nurse not involved in the study generated the random allocation sequence, enrolled participants, and assigned participants to interventions. Group B (control group) received wound site instillation with 20 mL of 0.25% bupivacaine \(n = 30\). Group D (study group) received wound site instillation with 2 \(\mu\)g.kg\(^{-1}\) dexmedetomidine diluted in 20 mL 0.25% bupivacaine \(n = 30\). Neither the patients nor the assessor knew which group they were allotted to. Preparation of drug and instillation was done by doctors not involved in the final assessment or data collection.

All patients were instructed the day before surgery on how to rate the intensity of pain using numerical rating scale (NRS), a scale of 0 to 10, where 0 = no pain and 10 = worst pain. All patients received ranitidine 150 mg and alprazolam 0.25 mg a night before and at 6:00 am in the morning of the surgery. The vital parameters (heart rate [HR], systolic and diastolic blood pressure, \(\text{SpO}_2\), and respiratory rate) were checked in the preoperative room. Ringer lactate infusion was started at 5–10 mL.kg\(^{-1}\). Monitoring of noninvasive blood pressure (mmHg), electrocardiography, pulse oximetry, and capnography (after intubation) was started and carried out throughout the intraoperative and postoperative period. All patients were premedicated with i.v. glycopyrrolate (0.2 mg), fentanyl (2 \(\mu\)g.kg\(^{-1}\)), and midazolam (0.25 mg.kg\(^{-1}\)). After 3 min of preoxygenation, anesthesia was induced with propofol 2 mg.kg\(^{-1}\), and tracheal intubation was facilitated with vecuronium 0.1 mg.kg\(^{-1}\). Maintenance of anesthesia was carried out using 67% N\(_2\)O, 33% O\(_2\), and inspired isoflurane 1% using controlled ventilation. No further opioid supplementation was given intraoperatively. HR and mean arterial pressure (MAP) were maintained within 20% of the preoperative value. Hypotension (reduction in MAP by 20% of baseline or 60 mmHg) was treated with infusion of normal saline and if required injection mephentermine 3–6 mg i.v. boluses. Bradycardia (HR \(\leq 50\) beats/min) was treated with atropine bolus. All patients received i.v. paracetamol 15 mg.kg\(^{-1}\) and ondansetron 0.1 mg.kg\(^{-1}\) half an hour before completion of the surgery.

In the end, when hemostasis was achieved at incision site, patients in Group B received wound site instillation of 20 mL bupivacaine (0.25%) and Group D received instillation of 2 \(\mu\)g.kg\(^{-1}\) dexmedetomidine diluted in 20 mL 0.25% bupivacaine under aseptic conditions and were allowed to remain in the wound for a dwell time of 60 s. Wound was closed in layers without mopping or suctioning. At the end of the surgery, residual neuromuscular blockade was reversed with neostigmine 0.05 mg.kg\(^{-1}\) and glycopyrrolate 0.01 mg.kg\(^{-1}\) i.v. Tracheal extubation was performed on meeting the standard criteria for extubation. Postoperative pain was assessed by an independent observer blinded to the study by a numerical rating scale (NRS), first at 0 h, i.e., after extubation when the patient was able to follow commands and then at every 1 h up to first 8 h and then at every 6 h till 24 h.

The duration of analgesia was considered from the time the study drugs were instilled to the time for the first demand of rescue analgesia. Rescue analgesia was given with injection diclofenac 1.5 mg.kg\(^{-1}\) deep intramuscular on demand or whenever NRS pain score was \(\geq 4\). Duration of analgesia, total rescue analgesic requirement, and pain score in 24 h were recorded. The level of sedation was assessed using four-point sedation scale (0–3, 0 = awake and oriented, 1 = drowsy but responding to the command, 2 = sleepy but easy to arouse (by loud command or glabellar tap), 3 = deep sleep, difficult to arouse). The incidence and severity of nausea was assessed by four-point categorical scale (0 = none, 1 = mild, 2 = moderate, and 3 = severe). Metoclopramide 10 mg was given i.v. for severe nausea or vomiting. Any other adverse events such as hypotension and bradycardia were also noted. Surgical site-related untoward effects such as hematoma, infection, and wound dehiscence were observed clinically till the patient was discharged.

**Statistical analysis**

The sample size was calculated on the basis of a pilot study done in both groups with a difference in total duration of analgesia of 4 h, using the power of the study 80%, confidence interval 95%, and \(\alpha\) error of 0.05. The statistical analysis of data was performed using Statistical Package for the Social Science evaluation version 20 (IBM, Armonk, NY, USA). The statistical analysis of quantitative data (mean ± standard deviation) between the groups was done by Student’s t-test. To find the significant difference between the bivariate samples in independent groups, the Mann–Whitney U-test was used. To find the significance in categorical data, Chi-square test
was used. In all the above statistical tools, the \( P < 0.05 \) was considered as significant. To obtain a composite value for the pain score distributed over a period of 24 h, an area under the curve (AUC) for the pain score of both groups was determined.

**RESULTS**

A total of 60 patients were recruited for the study and none were excluded as shown in consort chart [Figure 1]. Both the groups were comparable in terms of age, height, weight, sex, duration of surgery, and intraoperative analgesic supplementation [Table 1]. The mean pain scores as depicted by AUC for NRS were less in the study group when compared with the control group [Figures 2 and 3]. The analgesic requirement was less in Group D in initial hours compared to Group B [Figure 4]. The duration of analgesia was significantly higher in Group D; number of analgesic demands and total rescue analgesic required were significantly higher in Group B [Tables 2 and 3]. HRs, MAPs, and respiratory rates were comparable in both the groups [Figures 5-7].

**DISCUSSION**

The study demonstrated an overall significant analgesic efficacy of dexmedetomidine given in instillation with bupivacaine in lumbar spine surgery. On analyzing the duration of analgesia postoperatively for 24 h, it was observed to be significantly increased \( (P < 0.05) \) in the study group as compared to the control group. Our results are in accordance with other studies using dexmedetomidine as an adjuvant with local anesthetics at the incision site.\(^{[14-17]}\) A recent study by Deshwal et al. compared the postoperative pain relief by adding dexmedetomidine as an adjuvant to ropivacaine for wound infiltration in

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**Table 1: Demographic profile of patients and duration of surgery in two groups \((n=30)\)**

| Variables          | Mean±SD  | \( P \) |
|--------------------|----------|---------|
| Age (years)        | 38.5±10.06 | 37.45±7.53 | 0.71 |
| Height (cm)        | 166.7±9.11  | 164.4±9.49  | 0.44 |
| Weight (kg)        | 68.5±10.29  | 65.75±12.37  | 0.45 |
| Sex (male/female)  | 22/8      | 23/7      | 1.00 |
| Duration of surgery (min) | 106.55±9.38 | 105.15±10.03 | 0.65 |

\( n= \) Number of patients in each group, SD=Standard deviation

**Table 2: Duration of analgesia and total analgesic requirement \((n=30)\)**

| Variables                        | Mean±SD  | \( Z \) | \( P \) |
|----------------------------------|----------|---------|---------|
| Duration of analgesia (h)        | 12.13±1.8 | 19.93±3.2 | 6.405 | <0.0001* |
| Total consumption of analgesic (mg) | 95.68±33.5 | 62.51±39.13 | 2.486 | 0.0127* |

*Significant. \( n= \) Number of patients in each group, SD=Standard deviation

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**Figure 1: Consort flow diagram**
patients undergoing microdiscectomy. They concluded that dexmedetomidine infiltration is a promising and safe adjunct for postoperative pain control in spine surgeries with preserved hemodynamic stability and lack of sedation.[14] Singh and Prasad studied the effect of adding dexmedetomidine with bupivacaine in wound infiltration in abdominal hysterectomy

and found that dexmedetomidine in a dose of 1.0 µg.kg⁻¹ provided superior pain relief and decreased analgesic demand in postoperative period compared to wound infiltration with bupivacaine alone.[16] Similarly, Jyothi et al. compared the postoperative analgesic efficacy of levobupivacaine (L) alone and its combination with clonidine (C) or dexmedetomidine (D) in wound infiltration technique for abdominal surgeries and they found that the total duration of analgesia in LD group was 23.4 h when compared to LC group (20.9 h) and L group (11.65 h) (P = 0.0001) with excellent to good quality of analgesia in adjuvant group (P < 0.001) and incidence of minimal side effects such as sedation, nausea, and vomiting.[17] Oza et al. compared the analgesic effect of intraperitoneal instillation of dexmedetomidine with bupivacaine with that with bupivacaine alone in patients undergoing laparoscopic surgeries and concluded that dexmedetomidine seems to be an

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**Table 3: Number of demands of rescue analgesic in both the groups (n=30)**

| Number of demands | Group B | Group D | Chi-square with yates correction | Df, P |
|-------------------|---------|---------|----------------------------------|-------|
| 0                 | 0       | 8       | 6.67                             | 1, 0.0098* |
| 1                 | 20      | 22      |                                  |       |
| 2                 | 10      | 0       |                                  |       |

*Significant. n=Number of patients in each group, Df=Degree of freedom
Conclusions

The patients who received bupivacaine with dexmedetomidine wound instillation had better pain control at all-time interval as compared to the patients who received bupivacaine alone. The total amount of analgesic agents used in 24 h was significantly lower in the study group as compared to the control group.

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Conflicts of interest

There are no conflicts of interest.

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