e-ISSN: 0975-1556, p-ISSN:2820-2643
Available online on www.ijpcr.com
International Journal of Pharmaceutical and Clinical Research 2024; 16(2); 1707-1711

Original Research Article

Comparison of Dexmedetomine vs Clonidine When Added to Hyperbaric Ropivacaine (0.5%) for Lower Limb Orthopaedic Surgeries under Subarachnoid Block

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Received: 25-12-2023 / Revised: 23-01-2024 / Accepted: 28-02-2024
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Conflict of interest: Nil

Abstract:

Background: The use of adjuvants in spinal anesthesia to improve analgesia has been extensively researched. Dexmedetomidine and clonidine, both alpha-2 adrenergic agonists, are commonly used adjuvants. The aim of the study was to compare the efficacy and safety of dexmedetomidine versus clonidine as adjuvants to hyperbaric ropivacaine in lower limb orthopaedic surgeries conducted under subarachnoid block.

Methods: The study was conducted in which 80 individuals undergoing lower limb surgeries under subarachnoid block. Patients were equally allocated into dexmedetomidine (D) and clonidine (C) groups to receive respective drugs added to hyperbaric ropivacaine 0.5%. Baseline demographics, intraoperative hemodynamic parameters, postoperative pain scores, sedation scores, and adverse events were recorded.

Results: Baseline demographics were similar among groups ($p > 0.05$). Intraoperative hemodynamic parameters didn't differ significantly (MAP: $p = 0.782$, HR: $p = 0.641$, SpO2: $p = 0.517$). Postoperatively, dexmedetomidine (D) group had lower pain scores at 2h ($p = 0.012$), 4h ($p = 0.008$), and 6h ($p = 0.006$) with higher sedation scores at 2h ($p = 0.003$), 4h ($p = 0.007$), and 6h ($p = 0.005$). Adverse events incidence was comparable (hypotension: $p = 0.621$, bradycardia: $p = 0.754$, respiratory depression: $p = 0.891$) with no serious events. Dexmedetomidine group reported better pain control and overall satisfaction.

Conclusion: Dexmedetomidine as an adjuvant to hyperbaric ropivacaine in lower limb orthopaedic surgeries under subarachnoid block offers superior postoperative pain control and patient satisfaction compared to clonidine. The study recommends dexmedetomidine as a preferable adjuvant for enhancing postoperative analgesia in this setting.

Recommendations: Based on the findings, it is recommended considering dexmedetomidine as the adjuvant of choice for lower limb surgeries under subarachnoid block to improve postoperative pain control and enhance patient comfort.

Keywords: Spinal Anesthesia, Dexmedetomidine, Clonidine, Orthopaedic Procedures, Ropivacaine.

Introduction

Anesthesiologists have conducted an extensive amount of study on the use of adjuvants in spinal anaesthesia to enhance the quality of intra-operative and post-operative analgesia, as well as to extend the duration of sensory and motor block. Among the many adjuvants employed, two alpha-2 adrenergic agonists, clonidine and dexmedetomidine, have attracted a lot of interest due to their possible advantages when combined with local anaesthetics for spinal anaesthesia.

When used with local anaesthetics, dexmedetomidine, a highly selective alpha-2 adrenergic receptor agonist, has been demonstrated to increase postoperative analgesia and extend the duration of spinal anaesthesia [1]. It is a promising adjuvant for spinal anaesthesia because of its usage in subarachnoid block, which has been linked to a stable hemodynamic profile, a decreased requirement for intraoperative analgesics, and few adverse effects [2]. However, clonidine has also been employed as an adjuvant in spinal anaesthesia, despite being a less selective alpha-2 adrenergic agonist than dexmedetomidine. Research has indicated that the addition of clonidine to local anaesthetics for spinal anaesthesia enhances postoperative analgesia and lengthens the duration of sensory and motor block [3]. But using it can cause bradycardia and hypotension, which calls for close observation [4].

Research comparing the effects of clonidine and dexmedetomidine as adjuvants to hyperbaric ropivacaine for lower limb procedures under

subarachnoid block has yielded inconsistent findings. Compared to clonidine, dexmedetomidine may provide better analgesia and block duration extension with fewer hemodynamic changes, according to certain studies [5]. Other research, however, shows that there is no appreciable difference in the adverse effects of the two adjuvants and that they both offer comparable advantages in terms of postoperative analgesia, duration of sensory and motor block, and analgesia [6].

The aim of the study was to compare the efficacy and safety of dexmedetomidine versus clonidine as adjuvants to hyperbaric ropivacaine in lower limb orthopaedic surgeries conducted under subarachnoid block.

Methodology

Study Design: This study employed a prospective, randomized, double-blind clinical trial design.

Study Setting: The study was conducted at Civil Hospital, Badal, from July 2021 to November 2023.

Participants: The study comprised 80 individuals who were scheduled for lower limb orthopaedic procedures under subarachnoid block.

Inclusion Criteria:

1. Aged between 18 to 65 years.

2. Undergoing lower limb orthopaedic surgeries.

3. Patients with American Society of Anesthesiologists (ASA) physical status I or II.

Exclusion Criteria:

1. known allergy to dexmedetomidine, clonidine, or ropivacaine.

2. severe hepatic or renal impairment.

3. history of significant cardiovascular disease.

4. Pregnant or lactating women.

Bias:

To minimize bias, randomization was performed using computer-generated random numbers, and blinding was maintained throughout the study period.

Variables: The independent variables were the administration of either dexmedetomidine or clonidine as adjuvants to hyperbaric ropivacaine. The dependent variables included intraoperative and postoperative hemodynamic parameters, pain scores, sedation scores, and any adverse events.

Data Collection: Baseline demographic data, intraoperative hemodynamic parameters, pain scores, sedation scores, and any adverse events were recorded. Data collection was performed by trained research staff who were blinded to the group assignments.

Procedure:

- **Randomization and Group Allocation:**

- Using computer-generated random numbers, patients were randomised into either the clonidine (C) or the dexmedetomidine (D) group.

- Group allocation was concealed from both patients and investigators throughout the study.

- **Anaesthesia Technique:**

- All patients received standard premedication according to the hospital protocol.

- Using a 25-gauge Quincke needle, a subarachnoid block was done while the patient was seated at the L3-L4 or L4-L5 interspace.

- Patients received hyperbaric ropivacaine (0.5%) 3 ml along with either dexmedetomidine or clonidine depending on group allocation making the total amount of drug given in subarachnoid block to 3.2 ml.

- In the dexmedetomidine (D) group, dexmedetomidine 20 micrograms was added to hyperbaric ropivacaine 0.5%.

- In the clonidine (C) group, clonidine 20 micrograms was added to hyperbaric ropivacaine 0.5%.

- Hemodynamic parameters were observed continuously throughout the surgery.

- **Intraoperative and Postoperative Data Collection:**

- Intraoperative data including hemodynamic parameters and any adverse events were recorded at specified time intervals.

- In the post-anesthesia care unit (PACU), postoperative pain scores were estimated on a regular basis using a standardised pain scale.

- Sedation scores and any adverse events were also documented during the postoperative period.

- **Follow-Up:**

- Patients were followed up until discharge from the hospital.

- Any complications or adverse events occurring during the hospital stay were noted and managed accordingly.

Statistical Analysis: The data was analysed utilizing SPSS version 21.0. The variables were presented as percentages, frequencies, and mean ± standard deviation. The relevant parametric or non-parametric tests were used to compare the groups,

and p-values of less than 0.05 were regarded as statistically significant.

Ethical Considerations: The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

Result

Eighty patients in all who were having lower limb orthopaedic procedures under subarachnoid block were involved in the study. The participants were categorized equally into two groups: one for clonidine (Group C) and the other for dexmedetomidine (Group D).

Table 1 lists the baseline demographic parameters that ensured a balanced participant distribution: age, gender, duration of surgery and ASA physical status were comparable across the two groups.

Table 1: Baseline Demographic Characteristics

Characteristic	Group D	Group C
Total number of patients	40	40
Age (years), mean ± SD	45.2 ± 6.3	43.8 ± 7.1
Surgery duration (mins)	118.6±2.6	116±2.4
Gender, n (%)		
- Male	22 (55%)	20 (50%)
- Female	18 (45%)	20 (50%)
ASA Physical Status, n (%)		
- I	32 (80%)	30 (75%)
- II	8 (20%)	10 (25%)
- III	0	0

During the intraoperative period, no significant variation was observed in mean arterial pressure (MAP), heart rate (HR), and oxygen saturation (SpO2) between the groups. Both groups maintained stable hemodynamic parameters throughout the surgery, indicating similar intraoperative anaesthetic effects (table 2).

Table 2: Intraoperative Hemodynamic Parameters

Parameter (Mean ± SD)	Group D	Group C
Mean Arterial Pressure (mmHg)	85.6 ± 8.4	86.2 ± 7.9
Heart Rate (bpm)	78.5 ± 6.9	79.3 ± 7.5
Oxygen Saturation (%)	98.2 ± 1.1	97.8 ± 1.4

Numeric rating scale (NRS) was used to evaluate postoperative pain, and the results displayed significant disparities among the two groups. At 2, 4, and 6 hours postoperatively, the patients in group D showed substantially lower pain scores ($p < 0.05$) than the group C. Patients in group C reported higher mean pain levels at the corresponding time points of 3.5 ± 0.9, 4.0 ± 0.8, and 4.2 ± 0.7, while those in the group D reported mean pain scores of 2.5 ± 0.8 at 2 hours, 3.0 ± 0.7 at 4 hours, and 3.2 ± 0.6 at 6 hours. (table 3)

Table 3: Post-operative Pain scores

Time (hours after surgery)	Group D	Group C	P value
2	2.5 ± 0.8	3.5 ± 0.9	0.012
4	3.0 ± 0.7	4.0 ± 0.8	0.008
6	3.2 ± 0.6	4.2 ± 0.7	0.006

Furthermore, sedation scores, evaluated using a standardized sedation scale, differed among the two groups during the post-operative period. Patients in group D exhibited higher sedation scores compared to the group C at 2, 4, and 6 hours postoperatively. The mean sedation scores in group D were 2.8 ± 0.6, 2.5 ± 0.4, and 2.3 ± 0.5 at the respective time points, while those in the group C were 1.5 ± 0.3, 1.7 ± 0.4, and 1.8 ± 0.4.(Table 4)

Table 4: Post-operative Sedation scores

Time (hours after surgery)	Group D	Group C	P value
2	2.8 ± 0.6	1.5 ± 0.3	0.003
4	2.5 ± 0.4	1.7 ± 0.4	0.007
6	2.3 ± 0.5	1.8 ± 0.4	0.005

The incidence of complications such as hypotension, bradycardia, and respiratory depression was comparable between the dexmedetomidine and clonidine groups. No serious adverse events requiring intervention were reported in either group, indicating the safety profile of both adjuvants in the context of lower limb surgeries under subarachnoid block.

In terms of patient satisfaction, a higher proportion of patients in the group D reported being satisfied with their postoperative pain control and overall anaesthesia experience compared to those in the group C. The superior pain control and sedative effects observed with dexmedetomidine contribute to its potential as a preferable adjuvant to hyperbaric ropivacaine for lower limb surgeries under subarachnoid block, offering improved post-operative analgesia and patient satisfaction.

Discussion

Eighty patients in all were divided equally between the two groups in the current research. A balanced distribution of participants was ensured by baseline parameters, such as age, gender, and ASA physical status, being similar between the groups. Similar intraoperative anaesthetic effects were seen in the dexmedetomidine and clonidine groups, as seen by the lack of significant variations in mean arterial pressure, heart rate, or oxygen saturation during the intraoperative time.

However, postoperatively, patients receiving dexmedetomidine exhibited significantly lower pain scores and higher sedation scores compared to those receiving clonidine at 2, 4, and 6 hours postoperatively. Adverse events were comparable between the two groups, with no serious events reported, highlighting the safety of both adjuvants.

Moreover, a higher proportion of patients in the dexmedetomidine group reported satisfaction with their postoperative pain control and overall anesthesia experience, suggesting the potential superiority of dexmedetomidine in providing improved analgesia and patient satisfaction in lower limb orthopaedic surgeries under subarachnoid block. These findings underscore the promising role of dexmedetomidine as a preferable adjuvant in enhancing postoperative outcomes and patient comfort in this surgical setting.

Several studies have explored the efficacy of dexmedetomidine and clonidine as adjuvants to hyperbaric ropivacaine in subarachnoid block for lower limb surgeries. A study highlighted a significant variation in the duration of sensory and motor block between dexmedetomidine and clonidine groups, indicating the potential for tailored anesthesia approaches [7]. Further research compared the adjunctive use of these agents with ropivacaine for postoperative analgesia, finding notable differences in analgesia onset and duration, suggesting dexmedetomidine's superiority for prolonged analgesia [8].

Another study focused on the hemodynamic changes following spinal anesthesia with ropivacaine, cautioning the use of dexmedetomidine in older adults due to potential arterial pressure lowering [9]. Additionally, a study compared dexmedetomidine with MgSO4 as adjuvants, finding dexmedetomidine to have a faster onset and longer duration of action, enhancing its appeal for lower limb orthopedic surgeries [10].

Furthermore, a study concluded that intravenous dexmedetomidine provides better prolongation of sensory and motor blockade than clonidine, further supporting its use in orthopaedic surgeries [11]. Collectively, these studies underscore the nuanced benefits and considerations of using dexmedetomidine and clonidine with ropivacaine, contributing to the optimization of anesthesia protocols for lower limb surgeries.

Conclusion

The study comparing dexmedetomidine versus clonidine as adjuvants to hyperbaric ropivacaine for lower limb surgeries under subarachnoid block demonstrates that dexmedetomidine provides superior postoperative pain control and sedation compared to clonidine. Despite comparable intraoperative hemodynamic profiles and safety outcomes, dexmedetomidine emerges as a more favorable option due to its enhanced analgesic efficacy and patient satisfaction. These findings support the consideration of dexmedetomidine as the preferred adjuvant in this surgical context, potentially leading to improved perioperative outcomes and enhanced patient comfort.

Limitations: The limitations of this study include a small sample population who were included in this study. The findings of this study cannot be generalized for a larger sample population. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

Recommendation: Based on the findings, it is recommendred considering dexmedetomidine as the adjuvant of choice for lower limb surgeries under subarachnoid block to improve postoperative pain control and enhance patient comfort.

Acknowledgement: We are thankful to the patients; without them the study could not have been done. We are thankful to the supporting staff of our hospital who were involved in patient care of the study group.

List of abbreviations:

1. ASA: American Society of Anesthesiologists
2. SD: Standard Deviation
3. MAP: Mean Arterial Pressure
4. HR: Heart Rate
5. SpO2: Oxygen Saturation
6. PACU: Post-Anesthesia Care Unit

Source of funding: No funding received.

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