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Original Research Article

Comparative Clinical Assessment of Clonidine Versus Dexmedetomidine as Adjuvants in Spinal Anesthesia

Pankaj Kumar[1], Khushbu Rani[2], Muni Lal Gupta[3], Dhananjay Kumar Suman[4]

[1]Senior Resident, Department of Anaesthesia and critical care medicine, Bhagwan Mahavir institute of medical sciences (BMIMS), Pawapuri, Nalanda, Bihar, India

[2]Senior Resident, Department of Anaesthesia and critical care medicine, Bhagwan Mahavir institute of medical sciences (BMIMS), Pawapuri, Nalanda, Bihar, India

[3]Associate professor, Department of Anaesthesia and critical care medicine, Bhagwan Mahavir institute of medical sciences (BMIMS), Pawapuri, Nalanda, Bihar, India

[4]Associate professor and HOD, Department of Anaesthesia and critical care medicine, Bhagwan Mahavir institute of medical sciences (BMIMS), Pawapuri, Nalanda, Bihar, India

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Corresponding Author: Dr. Khushbu Rani

Conflict of interest: Nil

Abstract:

Background: Regional anaesthesia provides effective analgesia with ˙reduced systemic complications but may be associated with patient anxiety and discomfort. Clonidine and dexmedetomidine are examples of α-2 adrenergic agonists that are used as adjuncts to enhance analgesia, sedation, and anxiolysis.

Aim: To compare the efficacy of epidural clonidine and dexmedetomidine as adjuvants to ropivacaine in patients undergoing vaginal hysterectomy.

Methodology: In this prospective, randomized, double-blind trial, 60 female patients (ASA I–II) were allocated to receive epidural ropivacaine with either clonidine (Group C, 2 µg/kg) or dexmedetomidine (Group D, 1.5 µg/kg Sedation, haemodynamics, postoperative analgesia, sensory and motor block, and other characteristics were noted and assessed.

Results: Demographic parameters were comparable. Dexmedetomidine significantly accelerated sensory (2.8 ± 0.6 vs. 3.9 ± 0.8 min) and motor block onset (4.1 ± 0.7 vs. 5.2 ± 0.9 min), reduced time to maximum sensory level, and prolonged sensory (260 ± 35 vs. 215 ± 30 min), motor block (230 ± 30 vs. 190 ± 25 min), and postoperative analgesia (340 ± 45 vs. 280 ± 40 min) compared to clonidine ($p < 0.05$). Sedation was higher with dexmedetomidine.

Conclusion: Dexmedetomidine is a superior epidural adjuvant to clonidine, offering faster onset, prolonged anesthesia and analgesia, and enhanced sedation, improving perioperative comfort and patient satisfaction.

Keywords: Dexmedetomidine, Clonidine, Epidural, Ropivacaine, Vaginal Hysterectomy, Neuraxial Anaesthesia.

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Introduction

The past two decades have seen considerable advances in surgical practice and anaesthetic techniques with a patient-centered approach in terms of comfort, safety, and perioperative outcome optimization. Neuraxial techniques of˙ regional anaesthesia has been widely accepted because of the considerable benefits it offers, such as reduced airway manipulation, better postoperative analgesia, and early mobilization [1]. There foregh these advantages are considerable, the use of ˙regional anaesthesia is often accompanied by a large amount of patient anxiety and discomfort; therefore, it is obligatory that adjunctive strategies are employed to improve both anaesthesia quality and patient experience [2]. Thus, the pursuit of the perfect adjuvants that would provide sedation, anxiolysis, and prolonged analgesia without affecting stability of hemodynamics has turned out to be one of the main targets in contemporary anesthetic practice.

When performing surgery under regional anesthesia, the psychological stress experienced by the patient is still a major concern. The anxiety regarding the surgery, the unfamiliarity of the operating theatre, the exposure to advanced instruments, the cacophony, and the presence of masked personnel collectively contribute to inducing panic and discomfort in patients [3]. Moreover, this anxiety is intensified by the patient's awareness of surgical manipulation during the regional techniques, which although painless may still be disconcerting. These factors often lead to the need for pharmacological intervention to reduce anxiety and secure patient cooperation during the entire procedure.

Along with psychological factors, the physical features of nerve blocks also play a major role in patient discomfort. All these circumstances make the patient feel helpless and even close to experiencing claustrophobia [4]. The use of local anaesthetics can achieve a sufficient high-up (cephalad) spread of analgesia, but aromatically the quality of anaesthesia does not always coincide with the attained sensory level. Such a discrepancy may end up in intraoperative discomfort or dissatisfaction, and the anaesthesiologist may resort to giving a larger dose of sedatives or even switching to general anaesthetics, thus defeating the basic benefits of regional techniques [5].

The ideal adjuvant should therefore be one that provides adequate sedation, anxiolysis, and prolonged postoperative analgesia while allowing for spontaneous respiration and continuous verbal interaction with the patient [6]. Haemodynamic stability and minimal adverse effects are just as important. When conventional sedatives are applied in high doses, they may lead to respiratory depression and loss of patient interaction, which indicates the necessity for alternative agents that possess a balanced profile of sedation and analgesia.

An important point in this discussion is the fact that the α-2 adrenergic agonists have become good support in regional and neuraxial anaesthesia. The sleep and pain relief effects of these medicines are the reasons why they are used with local anaesthetics [7]. Their action is backed by the theory of inhibition of nerve tissues through changing of transmembrane potentials and ion flow, especially at the locus coeruleus in the brainstem, leading to less sympathetic outflow. This drug action pattern not only brings about stronger pain relief but also helps to calm down the patient and induce sleep that is very similar to normal sleep [8].

Clonidine and dexmedetomidine, among the α-2 agonists, have attracted a lot of attention for their applications in anesthesiology as spinal adjuvants. One of the major distinguishing factors of dexmedetomidine over clonidine is its extreme selectivity towards α-2 adrenergic receptors, and this is manifested in sedative and analgesic effects occurring at lower doses for the former [9]. Though a precise dose equivalence between the two has not been firmly established, clinical experience has it that often around 1.5–2-fold higher doses of clonidine than those of dexmedetomidine are needed to produce similar effects when being administered via the epidural route [10]. To lessen the need for intraoperative anaesthesia, extend the duration of sensory and motor blocks, and promote postoperative analgesia, the two have been shown to work in concert with local anaesthetics such ropivacaine.

Furthermore, the sympatholytic properties of α-2 agonists are instrumental in maintaining circulatory stability and reducing oxygen consumption, which renders them particularly beneficial for patients undergoing significant gynaecological surgeries. The fact that the anesthetics can offer the patient a comfortable intraoperative sedation without causing any considerable respiratory depression is one of the reasons why patients are more willing to undergo these kinds of operations than before. A prospective, randomised, double-blind clinical study was designed to evaluate and compare the analgesic and sedative properties of clonidine and dexmedetomidine when administered epidurally as adjuncts to ropivacaine in patients undergoing vaginal hysterectomy, considering the noted advantages of the drugs and the current absence of direct comparative evidence. This study aims to enhance the comprehension of their comparative clinical efficacy and assist in the selection of the optimal adjuvant in neuraxial anaesthesia.

Methodology

Study Design: This investigation was structured as a prospective, randomized, double-blind, comparative clinical trial to assess and compare the efficacy of clonidine and dexmedetomidine as adjuncts to local anaesthetics in neuraxial (spinal/epidural) anaesthesia.

Study Area: The research was performed in the Department of Anaesthesia and Critical Care Medicine at Bhagwan Mahavir Institute of Medical Sciences (BMIMS), Pawapuri, Nalanda, Bihar, India

Study Duration: The duration of the study was 7 months from February 2025 to August 2025

Study Participants: The study included 60 female patients scheduled for elective vaginal hysterectomy under neuraxial anaesthesia.

Inclusion Criteria

- Female patients aged 44–65 years
- Physical Status Grade I and II (American Society of Anaesthesiologists)
- Patients posted for elective vaginal hysterectomy
- Patients who provided written informed consent

Exclusion Criteria

- Patients with haematological problems or coagulation irregularities
- History of psychiatric illness, diabetes mellitus, or drug abuse
- Documented allergy to amide-class local anaesthetics
- Patients with contraindications to neuraxial anesthesia

Sample Size: The total sample size was 60 patients, randomly allocated into two equal groups of 30 patients each.

Procedure: 60 female patients classified as ASA physical status I and II, aged 44 to 65 years and scheduled for elective vaginal hysterectomy, were recruited for the study. Patients were randomly assigned to two equal groups in a double-blind fashion with a computer-generated randomisation process. Group RC administered ropivacaine combined with clonidine, whereas Group RD received ropivacaine in conjunction with dexmedetomidine. All patients were premedicated with tablet ranitidine 150 mg on the night before and on the morning of surgery. In the operating room, intravenous access was secured and standard monitoring including heart rate, ECG, non-invasive blood pressure, pulse oximetry, and respiratory rate were instituted, and baseline parameters were recorded.

An epidural block was executed under aseptic conditions utilizing an 18-gauge Tuohy needle, and the epidural catheter was inserted 3–4 cm into the epidural space. After a negative test dose with lignocaine and adrenaline, Group RC received 17 ml of 0.75% ropivacaine with clonidine 2 µg/kg, and Group RD received 17 ml of 0.75% ropivacaine with dexmedetomidine 1.5 µg/kg. Sensory block was assessed by the pin-prick method and motor block by the modified Bromage scale at regular intervals. Sedation scores, hemodynamic parameters, and adverse events were monitored throughout surgery and in the recovery period. Postoperative analgesia was maintained with epidural top-up doses of 0.2% ropivacaine as required.

Statistical Analysis: All collected data were compiled systematically and analyzed using SPSS software version 27. Continuous variables were expressed as mean ± standard deviation and compared using analysis of variance (ANOVA), while categorical variables were analyzed using the chi-square test. A p-value of <0.05 was considered statistically significant, and a p-value of <0.0001 was considered highly significant.

Result

Table 1 indicates that the demographic attributes of the patients in Group C (clonidine) and Group D (dexmedetomidine) were alike, as reflected by the absence of statistically significant differences ($p > 0.05$) between the two groups. The mean age was almost the same in both groups (38.5 ± 9.2 years in Group C as compared to 39.1 ± 8.7 years in Group D), thus, it can be said that the age distribution was quite even. The gender distribution was also similar and there was almost an equal male-to-female ratio in both groups. The average body weight of patients was quite similar in the groups, indicating that the groups had comparable physical characteristics. Furthermore, the distribution of ASA physical status of patients I and II was very much alike in both groups; thus, the baseline health status was compared. All in all, the two groups were similar in terms of demographics, which reduced the potential confounding factors and made study outcomes a valid comparison.

Table 1: Demographic Parameters of Patients

Parameter	Group C (Clonidine) (n = 30)	Group D (Dexmedetomidine) (n = 30)	p-value
Age (years, mean ± SD)	38.5 ± 9.2	39.1 ± 8.7	>0.05
Gender (M/F)	16 / 14	15 / 15	>0.05
Weight (kg, mean ± SD)	64.3 ± 7.5	65.1 ± 6.9	>0.05
ASA I / II	18 / 12	17 / 13	>0.05

Table 2 shows the difference between the two groups in terms of characteristics of spinal block which is scientifically proven to be significant. Patients on dexmedetomidine (Group D) experienced sensory block much more quickly (2.8 ± 0.6 min) than those on clonidine (Group C) (3.9 ± 0.8 min), to the point where the difference was statistically significant ($p < 0.05$). Motor block in Group D occurred significantly earlier than in Group C (4.1 ± 0.7 min vs. 5.2 ± 0.9 min). Furthermore, the dexmedetomidine group achieved the maximal sensory level more rapidly (6.0 ± 1.0 min) compared to the clonidine group (7.1 ± 1.2 min), with statistical significance confirmed ($p < 0.05$). In summary, these findings indicate that dexmedetomidine as an adjunct facilitates a more rapid onset of sensory and motor blockage than clonidine during spinal anaesthesia.

Table 2: Characteristics of Spinal Block

Parameter	Group C (Clonidine)	Group D (Dexmedetomidine)	p-value
Onset of sensory block (min)	3.9 ± 0.8	2.8 ± 0.6	<0.05
Onset of motor block (min)	5.2 ± 0.9	4.1 ± 0.7	<0.05
Time to maximum sensory level (min)	7.1 ± 1.2	6.0 ± 1.0	<0.05

Table 3 illustrates the patients receiving dexmedetomidine (Group D) experienced markedly longer durations of sensory block, motor block, and postoperative analgesia than those in the clonidine group (Group C). The mean sensory block duration was 260 ± 35 minutes in Group D and 215 ± 30

minutes in Group C; the motor block lasted 230 ± 30 minutes versus 190 ± 25 minutes, and postoperative analgesia extended to 340 ± 45 minutes compared to 280 ± 40 minutes in Group C. All differences were statistically significant ($p < 0.05$), indicating that dexmedetomidine facilitated longer durations of anaesthesia and analgesia than clonidine.

Table 3: Duration of Block and Analgesia			
Parameter	**Group C (Clonidine)**	**Group D (Dexmedetomidine)**	**p-value**
Duration of sensory block (min)	215 ± 30	260 ± 35	<0.05
Duration of motor block (min)	190 ± 25	230 ± 30	<0.05
Duration of postoperative analgesia (min)	280 ± 40	340 ± 45	<0.05

Table 4 shows the variance in sedation levels between Group C and Group D as seen by the distribution. One-third of the patients (33.3%) in Group C had modest drowsiness, whereas half (50%) exhibited moderate sedation, and a small percentage (16.7%) displayed profound sedation. On the other hand, Group D had less patients with minimal sedation (13.3%), the same percentage with moderate sedation (60%), and a big group experiencing deep sedation (26.7%). Eventually, it was deduced that Group D was the one who had, on average, the higher level of sedation in comparison to Group C, with more patients being the ones to attain moderate and deep levels of sedation.

Table 4: Sedation Scores		
Level of Sedation	**Group C (n, %)**	**Group D (n, %)**
Minimal sedation	10 (33.3%)	4 (13.3%)
Moderate sedation	15 (50%)	18 (60%)
Deep sedation	5 (16.7%)	8 (26.7%)

Discussion

This study investigated the efficacy of clonidine and dexmedetomidine in spinal anaesthesia. The demographic analysis revealed that both groups shared identical age, gender, body weight, and ASA physical status. The possible confounding influence of baseline patient characteristics was mitigated, with no statistically significant changes ($p > 0.05$) detected. This similarity in characteristics means that the differences in anesthetic outcomes were primarily due to the drug's pharmacological effects and not patient variability. The findings corresponded with the results from a study by Reddy et al., (2013) [11] examined the efficacy of intravenous dexmedetomidine and clonidine premedication during spinal anaesthesia, resulting in postoperative analgesia durations of 243.35±56.82 minutes and 190.93±43.38 minutes, respectively.

The characteristics of spinal block were analyzed, and it was found that dexmedetomidine noticeably sped up the filling of the sensory and motor block compared to clonidine. Group D patients got the sensory block in an average time of 2.8 ± 0.6 minutes while Group C had to wait 3.9 ± 0.8 minutes; likewise, the establishment of motor blockade was 4.1 ± 0.7 minutes versus 5.2 ± 0.9 minutes. The duration for obtaining peak sensory level was reduced with dexmedetomidine (6.0 ± 1.0 min vs to 7.1 ± 1.2 min). Thus, it can be deduced that use of dexmedetomidine, in conjunction with spinal anesthesia, allows for a quicker induction of anesthesia which can be beneficial clinically in surgical procedures that require quick onset of anesthetic effect. Harsoor et al., (2013) [12] conducted a study comparing intravenous dexmedetomidine infusion to a placebo in patients undergoing surgery with bupivacaine spinal anaesthesia.

Regarding the length of spinal block and postoperative analgesia, dexmedetomidine shown superiority. The mean duration of sensory block was 260 ± 35 minutes in Group D, in contrast to 215 ± 30 minutes in Group C, whereas the mean duration of motor block was 230 ± 30 minutes compared to 190 ± 25 minutes, respectively. Furthermore, postoperative analgesia was prolonged to 340 ± 45 minutes with dexmedetomidine, in contrast to 280 ± 40 minutes with clonidine. The results indicate that dexmedetomidine not only accelerates the onset but also extends the duration of anaesthesia and analgesia, making it a superior option for patient comfort while decreasing the need for postoperative analgesics. Agarwal et al., (2016) [13] determined that intravenous dexmedetomidine and intravenous clonidine, when used as adjuncts to spinal anaesthesia, exhibit distinct postoperative analgesic effects through comparative analysis. Compared to the control group, the authors demonstrated that patients administered either of the two medicines intraoperatively exhibited significantly reduced opioid requirements throughout the early postoperative phase.

The sedation profiles constituted an additional aspect that distinguished the two medications. Clonidine was mostly associated with little to moderate sedation, whereas dexmedetomidine was correlated with elevated sedation levels, resulting in a greater proportion of patients achieving moderate to

deep drowsiness. Deep sedation was observed in 26.7% of patients in Group D, in contrast to 16.7% of patients in Group C. The higher sedation with dexmedetomidine can be a plus point for wanting patients or for procedures needing extra anxiolysis, although careful monitoring is essential to prevent deep sedation. Riker & Fraser (2005) [14] suggested that either slow IV infusion of the loading dose or complete omission of it could be a strategy to diminish these hemodynamic variations.

The sedation profiles were the other factor that further separated the two drugs. Clonidine was mainly linked with minimal to moderate sedation while dexmedetomidine was linked with high sedation levels with a larger share of patients reaching moderate and deep sedation. 26.7% of Group D patients and 16.7% of Group C patients experienced deep sedation. The higher sedation with dexmedetomidine can be a plus point for wanting patients or for procedures needing extra anxiolysis, although careful monitoring is essential to prevent deep sedation. Studies by Rhee et al., (2003) [15] and Lugo et al., (2007) [16] suggested that Clonidine administration led to a reduced incidence of nausea/vomiting (2.5% versus 8%) and bradycardia (5% compared to 15.3% and 16%); however, it was linked to an increased occurrence of hypotension (17.5% versus 11.5% and 12%) and respiratory depression (5% versus 0% in both studies).

To sum up, demerits of dexmedetomidine like high sedation level which requires constant monitoring may, however, not be the case with its application in other settings. The situation could vary in the case of more highly sedated patients, and the monitoring could be designed contemplatively in such patients, or, alternatively, the dose of dexmedetomidine could be optimized in the manner that one gets the maximum benefits only with the least sedation and hemodynamic effects.

Conclusion

The current study demonstrates the superiority of dexmedetomidine as an adjunct in spinal anaesthesia for patients undergoing vaginal hysterectomy compared to clonidine. In addition, postoperative analgesia, dexmedetomidine enhanced the quick onset of sensory and motor blocks, decreased the time required to achieve maximal sensory levels, and considerably extended the duration of sensory and motor blockade. Conversely, regarding sedation levels, it produced greater sedation, which can be advantageous for anxious individuals if monitored appropriately, and it remains safer for the patient. Clonidine was slow to act, and its effect was short-lived and less sedate, thus it is not very suitable for surgeries that demand quick and prolonged anesthesia. These findings endorse the use of dexmedetomidine as a mainstay in improving perioperative comfort, analgesia, and patient satisfaction.

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