ROLE OF INTRATHECAL CLONIDINE AS AN ADJUVANT TO HYPERBARIC BUPIVACAINE IN SPINAL ANAESTHESIA FOR VAGINAL HYSTERECTOMY IN A RURAL HOSPITAL

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Abstract

Background: Spinal anaesthesia using local anaesthetics produces profound sensory and motor blockade by interrupting neural transmission at the spinal level; however, the limited duration of action remains a clinical limitation. To enhance the quality and prolong the duration of spinal anaesthesia, various adjuvant agents have been used intrathecally. Clonidine, an α_2-adrenergic agonist, has been shown to augment neuraxial blockade and extend postoperative analgesia. The present study was undertaken to evaluate the effects of intrathecal clonidine added to 0.5% hyperbaric bupivacaine in patients undergoing vaginal hysterectomy under spinal anaesthesia.

Materials and Methods: This prospective, randomized, double-blind, controlled, single-centre study was conducted at Sree Mookambika Institute of Medical Sciences, Kulasekharam, Tamil Nadu. Forty normotensive patients aged 45–65 years, classified as American Society of Anesthesiologists (ASA) physical status I and II, scheduled for elective vaginal hysterectomy were included. Patients received spinal anaesthesia with 0.5% hyperbaric bupivacaine combined with intrathecal clonidine. The onset and duration of sensory and motor blockade, duration of postoperative analgesia, hemodynamic parameters, visual analogue scale (VAS) scores, requirement of rescue analgesia, and adverse effects were recorded and analysed.

Results: The mean time to achieve peak sensory blockade was 5.45 ± 0.50 minutes, while the onset of motor blockade occurred at 7.05 ± 0.22 minutes. The mean duration of sensory block was 189.80 ± 6.49 minutes and motor block lasted for 247.28 ± 8.42 minutes. The average duration of effective postoperative analgesia was 495.93 ± 22.43 minutes, with most patients requiring three doses of rescue analgesics during the first 24 hours. VAS scores remained at zero for the initial 4 postoperative hours and were below 5 at subsequent assessment intervals up to 24 hours. Hemodynamic parameters remained stable, with bradycardia observed in one patient and hypotension in two patients; all adverse events were mild and managed successfully. The overall incidence of side effects was minimal.

Conclusion: Intrathecal clonidine, when used as an adjuvant to 0.5% hyperbaric bupivacaine, significantly prolongs the duration of spinal anaesthesia and postoperative analgesia with minimal side effects. Its use reduces analgesic requirements and enhances the quality of spinal anaesthesia, making it a valuable adjunct for vaginal hysterectomy procedures.

Keywords: Clonidine; intrathecal adjuvant; hyperbaric bupivacaine; spinal anaesthesia; vaginal hysterectomy

Introduction

Vaginal hysterectomy is a commonly performed gynaecological surgery for various benign uterine conditions such as uterine prolapse, fibroids, and abnormal uterine bleeding. Spinal anaesthesia is widely preferred for vaginal hysterectomy as it provides rapid onset, dense sensory and motor blockade, optimal surgical conditions, and avoids airway manipulation and systemic effects associated with general anaesthesia. Additional advantages include reduced intraoperative blood loss, better postoperative analgesia, early ambulation, and decreased incidence of thromboembolic complications.[1]

Bupivacaine is the most frequently used local anaesthetic agent for subarachnoid block owing to its longer duration of action, profound sensory blockade, and relative cardiovascular stability. Hyperbaric bupivacaine, in particular, allows better control of block height and consistency of anaesthetic effect. However, despite its favorable profile, spinal anaesthesia with bupivacaine alone has a limited duration of analgesia, which may be inadequate for prolonged surgical procedures and postoperative pain control, often necessitating early administration of systemic analgesics.[2]

To overcome this limitation, various pharmacological agents have been investigated as intrathecal adjuvants to local anaesthetics. These include opioids, ketamine, magnesium sulfate, neostigmine, benzodiazepines, and α_2-adrenergic agonists. The ideal intrathecal adjuvant should prolong the duration of sensory and motor blockade, enhance postoperative analgesia, reduce analgesic consumption, and produce minimal side effects. Among these agents, clonidine, a selective α_2-adrenergic receptor agonist, has gained increasing attention due to its analgesic and anaesthetic-potentiating properties.[3]

Clonidine exerts its analgesic action by stimulating α_2-adrenergic receptors in the dorsal horn of the spinal cord, leading to inhibition of nociceptive neurotransmitter release and hyperpolarization of postsynaptic neurons. When administered intrathecally, clonidine enhances the effects of local anaesthetics by prolonging sensory and motor blockade and extending postoperative analgesia. In addition, clonidine produces a degree of sedation and sympatholysis, which may be beneficial during surgery.[4] However, its use is associated with potential adverse effects such as hypotension, bradycardia, and sedation, particularly at higher doses, highlighting the importance of appropriate dose selection.

Several clinical studies have demonstrated that low-dose intrathecal clonidine, when combined with bupivacaine, significantly prolongs the duration of spinal anaesthesia and postoperative analgesia without producing clinically significant side effects. Systematic reviews and randomized controlled trials have reported reduced postoperative analgesic requirements and improved patient comfort with the addition of clonidine to intrathecal local anaesthetics.[5,6] These benefits make clonidine an attractive adjuvant in gynaecological surgeries, including vaginal hysterectomy, where prolonged analgesia and hemodynamic stability are desirable.

Despite existing evidence, variations in patient characteristics, clonidine dosage, and study settings necessitate further evaluation to establish its efficacy and safety profile in specific populations. Therefore, the present study was conducted at a tertiary care centre to assess the effects of intrathecal clonidine as an adjuvant to 0.5% hyperbaric bupivacaine in patients undergoing vaginal hysterectomy under spinal anaesthesia, with emphasis on block characteristics, postoperative analgesia, hemodynamic changes, and associated side effects.

Aim:

To evaluate the effects of intrathecal clonidine as an adjuvant to 0.5% hyperbaric bupivacaine on the quality and duration of spinal anaesthesia in patients undergoing vaginal hysterectomy.

Objectives

To assess the onset time and duration of sensory blockade following intrathecal administration of clonidine with hyperbaric bupivacaine.To evaluate the onset time and duration of motor blockade produced by the study drug combination.

Materials and Methods

This prospective, randomized, double-blind, controlled, single-centre study was carried out in the Department of Anaesthesiology at Sree Mookambika Institute of Medical Sciences and Hospital, Kulasekharam, Tamil Nadu, India, during the period from October 2024 to June 2025, after obtaining approval from the Institutional Ethics Committee. All participants were provided with detailed information about the study in their local language, and written informed consent was obtained prior to inclusion.

A total of 40 patients scheduled for vaginal hysterectomy under spinal anaesthesia were enrolled in the study. Women aged 45–65 years, who were normotensive and classified as American Society of Anesthesiologists (ASA) physical status I or II, were included. Patients with ASA physical status III or IV, significant cardiovascular, renal, or hepatic disease, known allergy to clonidine or bupivacaine, morbid obesity, or any contraindication to spinal anaesthesia were excluded.

All patients underwent a detailed pre-anaesthetic evaluation one day before surgery. Baseline vital parameters including heart rate, blood pressure, respiratory rate, and oxygen saturation were recorded. Routine preoperative investigations such as haemoglobin concentration, platelet count, bleeding time, clotting time, blood glucose levels, renal and liver function tests, serum electrolytes, serum proteins, urine routine examination and microscopy, electrocardiogram, chest radiograph, and prothrombin time with international normalized ratio (PT/INR) were performed in all patients to confirm suitability for surgery and spinal anaesthesia.

On the day of surgery, standard fasting guidelines were ensured, and patients were transferred to the operating theatre. After instituting standard monitoring, spinal anaesthesia was administered as per the study protocol, with intrathecal clonidine added as an adjuvant to 0.5% hyperbaric bupivacaine in the study group. Intraoperative and postoperative parameters were monitored and documented according to predefined study outcomes.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using the Statistical Package for the Social Sciences (SPSS) software, version ___. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Normality of data distribution was assessed using the Shapiro–Wilk test. Continuous variables were analysed using the Student's t-test for normally distributed data, and categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate. A p-value < 0.05 was considered statistically significant, and all statistical tests were two-tailed.

Result:

In this study 40 patients who underwent vaginal hysterectomy under spinal anaesthesia were enrolled. In present study, mean age was 54.23 ± 6.175 years, mean weight was 56.63 ± 4.63 kg, mean Height was 154.48 ± 6.50 cm & mean duration of surgery was 96.30 ± 4.08 minutes.

Table 1: General characteristics

Characteristics	**Mean ± SD**
Mean age (years)	54.23 ± 6.175
Mean Weight (kg)	56.63 ± 4.63
Mean Height (cm)	154.48 ± 6.50
Mean duration of surgery	96.30 ± 4.08

Hemodynamic variables (Pulse rate, systolic blood pressure & diastolic blood pressure) were studied. Mean pulse rate at various points as pre operative, after spinal block at 5 min, 15 min, 30 min, 45 min, 60 min, 90 min & 120 min was stable with subarachnoid block with 0.5% Hyperbaric bupivacaine 3ml (15 mg) + 30mcg Clonidine (as an adjuvant).

Table 2: Preoperative to intraoperative pulse rate

Pulse rate at	**Mean**	**SD**
Pre operative	77.35	6.43
5 min	76.55	5.28
15 min	75.43	4.82
30 min	73.65	4.90
45 min	73.15	3.45
60 min	73.00	2.72
90 min	73.55	4.31
120 min	73.10	2.56

In present study, after subarachnoid block with 0.5% Hyperbaric bupivacaine 3ml (15 mg) + 30mcg Clonidine (as an adjuvant) mean systolic blood pressure at various points as pre operative, after spinal block at 5 min, 15 min, 30 min, 45 min, 60 min, 90 min & 120 min was stable & no major fluctuations were noted.

Table 3: Preoperative to intraoperative mean systolic blood pressure

Systolic blood pressure	**Mean**	**SD**
Pre operative	121.15	5.58
5 min	112.60	5.75

15 min	114.75	5.61
30 min	116.85	4.15
45 min	118.50	2.39
60 min	119.45	2.60
90 min	119.85	2.37
120 min	119.90	2.48

In present study, after subarachnoid block with 0.5% Hyperbaric bupivacaine 3ml (15 mg) + 30mcg Clonidine (as an adjuvant) mean diastolic blood pressure at various points as pre operative, after spinal block at 5 min, 15 min, 30 min, 45 min, 60 min, 90 min & 120 min was stable & no major fluctuations were noted.

Table 4: Preoperative to intraoperative mean diastolic blood pressure

Diastolic blood pressure	**Mean**	**SD**
Pre operative	78.70	3.96
5 min	76.40	4.06
15 min	76.05	4.16
30 min	77.20	3.62
45 min	78.70	2.42
60 min	78.75	2.38
90 min	79.35	1.72
120 min	79.50	2.11

In present study, we noted that duration of onset to peak sensory block was 5.45 ± 0.50 min, duration of onset to motor block was 7.05 ± 0.22 min, duration of sensory block was 189.80 ± 6.49 min, duration of motor block was 247.28 ± 8.42 min & mean duration of post- operative analgesia was 495.93 ± 22.43 min. Number of analgesic injections required were 3 in majority patients.

Table 5: Anaesthesia characteristics

Characteristic	**In minutes (mean ± SD)**
Onset to peak sensory block	5.45 ± 0.50
Onset to motor block (grade IV)	7.05 ± 0.22
Duration of sensory block	189.80 ± 6.49
Duration of motor block	247.28 ± 8.42
Mean duration of post-operative analgesia	495.93 ± 22.43
Number of analgesic injections required	3

Visual analogue scale score was 0 at 1 hr., 2 hr., 3 hr. & 4 hr. while at 6 hr., 8 hr., 10 hr., 12 hr., 18 hr. & 24 hrs. median VAS was < 5.

Table 6: Mean visual analogue scale

VAS at	**Min**	**Max**	**Median**
1 hr.	0	0	0
2 hr.	0	0	0
3 hr.	0	0	0
4 hr.	0	0	0
6 hr.	1	5	2
8 hr.	0	6	5
10 hr.	1	2	1
12 hr.	2	5	2
18 hr.	2	6	5
24 hr.	2	6	2

In present study, mean Ramsay sedation score of 2 was noted at at 1 hr., 2 hr., 3 hr., 4 hr., 6 hr., 8 hr., 10 hr., 12 hr., 18 hr. & 24 hrs.

Table 7: Mean Ramsay sedation score

RSS at	Min	Max	Median
1hr	2	2	2
2hr	2	2	2
3hr	2	2	2
4hr	2	2	2
6hr	2	2	2
8hr	2	2	2
10hr	2	2	2
12hr	2	2	2
18hr	2	2	2
24hr	2	2	2

Bradycardia was noted in one patient and hypotension occurred in two patients, which were managed effectively. Overall incidence of side effects was low.

Table 8: Side effects

Side effects	Number (%)
Bradycardia	1 (2.5 %)
Hypotension	2 (5 %)

Discussion

Spinal anaesthesia remains the technique of choice for vaginal hysterectomy owing to its rapid onset, dense sensory and motor blockade, minimal airway manipulation, and reduced perioperative morbidity. However, the limited duration of action of local anaesthetics when used alone often necessitates early postoperative analgesic supplementation. The present study was undertaken to evaluate the effects of intrathecal clonidine as an adjuvant to 0.5% hyperbaric

bupivacaine with respect to haemodynamic stability, block characteristics, postoperative analgesia, sedation, and adverse effects in patients undergoing vaginal hysterectomy.

In the present study, the demographic characteristics such as age, weight, height, and duration of surgery were comparable and fell within a narrow range, indicating a relatively homogenous study population. The mean age of patients was 54.23 ± 6.17 years, which is consistent with the age group commonly undergoing vaginal hysterectomy for benign gynaecological conditions. Similar demographic profiles have been reported in earlier studies evaluating intrathecal clonidine in gynaecological surgeries, supporting the external validity of the present findings.[7]

Haemodynamic stability is a critical concern when α_2-adrenergic agonists such as clonidine are administered intrathecally. In this study, pulse rate and blood pressure remained largely stable throughout the intraoperative period. Although a mild reduction in heart rate and blood pressure was observed following the subarachnoid block, these changes were not clinically significant and did not require aggressive intervention in most cases. Bradycardia occurred in one patient (2.5%) and hypotension in two patients (5%), all of which were managed effectively with standard treatment measures. These findings are consistent with previous studies that have demonstrated that low-dose intrathecal clonidine produces minimal haemodynamic disturbances while providing effective analgesia.[8,9] The sympatholytic effect of clonidine, mediated through central α_2-receptor activation, likely accounts for the modest reductions in heart rate and blood pressure observed.

The onset of sensory and motor blockade is an important determinant of operating room efficiency and patient comfort. In the present study, the mean time to peak sensory block was 5.45 ± 0.50 minutes, and the onset of complete motor blockade occurred at 7.05 ± 0.22 minutes. These findings indicate a rapid establishment of spinal anaesthesia with the clonidine–bupivacaine combination. Previous studies have reported similar onset times when clonidine is added intrathecally, suggesting that clonidine does not significantly delay the onset of spinal block while enhancing its duration.[10]

A key finding of this study was the prolonged duration of sensory and motor blockade. The mean duration of sensory block was 189.80 ± 6.49 minutes, while motor block lasted for 247.28 ± 8.42 minutes. The prolongation of block duration can be attributed to the synergistic action of clonidine with bupivacaine at the spinal cord level. Clonidine enhances local anaesthetic action by reducing neuronal firing and inhibiting the release of nociceptive neurotransmitters in the dorsal horn. These results are in agreement with earlier randomized controlled trials that have demonstrated a significant extension of both sensory and motor blockade with intrathecal clonidine.[11,12]

Postoperative analgesia is one of the most important advantages of adding clonidine to spinal anaesthesia. In the present study, the mean duration of postoperative analgesia was 495.93 ± 22.43 minutes, which is considerably longer than that typically observed with bupivacaine alone. Most patients required only three doses of rescue analgesics within the first 24 postoperative

hours, indicating effective and sustained pain relief. Prolonged analgesia reduces opioid consumption, minimizes opioid-related adverse effects, and improves overall patient satisfaction. Similar findings have been reported by Dobrydnjov et al. and Elia et al., who observed significant prolongation of postoperative analgesia with intrathecal clonidine.[13,14]

Pain assessment using the visual analogue scale further supported the analgesic efficacy of intrathecal clonidine. VAS scores remained at zero during the first four postoperative hours, reflecting excellent early postoperative pain control. Although VAS scores increased gradually at later time intervals, the median values remained below 5 throughout the 24-hour postoperative period, indicating acceptable pain levels. These findings highlight the ability of clonidine to provide extended analgesia beyond the immediate postoperative phase, which is particularly beneficial in gynaecological surgeries where postoperative pain can be significant.[15]

Sedation is another pharmacological effect of clonidine that may influence perioperative patient comfort. In the present study, the Ramsay sedation score remained consistently at 2 throughout the observation period, indicating that patients were calm, cooperative, and easily arousable. Importantly, no excessive sedation or respiratory depression was observed. Mild sedation may be advantageous by reducing anxiety without compromising airway reflexes or respiratory function. These findings are in accordance with previous studies that have described mild, clinically acceptable sedation with intrathecal clonidine.[16]

The overall incidence of adverse effects in the present study was low. The limited occurrence of bradycardia and hypotension suggests that the dose of clonidine used was appropriate and safe for the studied population. This supports the growing consensus that low-dose intrathecal clonidine can be safely used as an adjuvant to bupivacaine, provided patients are carefully selected and monitored.[17]

Despite its strengths, the present study has certain limitations. The absence of a comparative control group receiving bupivacaine alone limits the ability to quantify the exact magnitude of benefit attributable to clonidine. Additionally, long-term outcomes such as chronic pain and patient satisfaction were not evaluated. Future studies with larger sample sizes and comparative designs are warranted to further establish the optimal dose and safety profile of intrathecal clonidine in various surgical populations.

In conclusion, the findings of this study demonstrate that intrathecal clonidine, when added to 0.5% hyperbaric bupivacaine, provides rapid onset, prolonged sensory and motor blockade, extended postoperative analgesia, stable haemodynamics, and minimal side effects in patients undergoing vaginal hysterectomy under spinal anaesthesia.

Conclusion

Intrathecal clonidine (30 µg) as an adjuvant to 0.5% hyperbaric bupivacaine in vaginal hysterectomy under spinal anaesthesia provided stable hemodynamics, rapid onset, prolonged sensory and motor blockade, extended postoperative analgesia, minimal sedation, and a low incidence of manageable side effects, making it an effective and safe adjunct.

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