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Anaesthesia Section

Role of Prophylactic Intramuscular Glycopyrrolate in Preventing Hypotension and Bradycardia in Patients Undergoing Elective Lower Limb Surgeries under Spinal Anaesthesia: A Randomised Placebo-controlled Study

SOUVIK CHOUDHURY[1], SUDESHNA BHAR KUNDU[2], MAUSUMI NIYOGI[3]

ABSTRACT

Introduction: Spinal anaesthesia is an extensively used anaesthetic technique for infraumbilical surgeries. Despite its many advantages, hypotension and bradycardia are two common complications. The incidence of bradycardia following spinal anaesthesia is higher in young adults. Although a few previous studies have observed that intramuscular glycopyrrolate is effective in preventing spinal-induced bradycardia and hypotension in elderly and parturient patients, there is a lack of reported studies in the young population.

Aim: To evaluate the role of intramuscular glycopyrrolate in the prevention of bradycardia and hypotension in adult patients undergoing lower limb surgeries.

Materials and Methods: A randomised, parallel-group, double-blind, placebo-controlled study was conducted in the Department of Anaesthesiology at Calcutta National Medical College, Kolkata, West Bengal, India. The duration of the study was 15 months, from July 2021 to September 2022. A total of 60 patients aged 18-45 years, of either sex, with American Society of Anaesthesiologists (ASA) physical status I and II, undergoing elective lower limb surgeries under spinal anaesthesia. The patients were randomised into two groups: group G received intramuscular glycopyrrolate 1 mL (0.2 mg) and group N received intramuscular normal saline 1 mL 15 minutes prior to spinal anaesthesia. Hyperbaric bupivacaine (0.5%) 3 mL and fentanyl (25 mcg) 0.5 mL were injected intrathecally. Haemodynamic parameters were monitored. All data were analysed using appropriate statistical tests. A p-value of <0.05 was considered statistically significant. Changes in Heart Rate (HR) were considered the primary outcome variable. The secondary outcome variables were changes in Mean Arterial Pressure (MAP), incidence of bradycardia and hypotension, phenylephrine requirement, and incidence of dry mouth.

Results: The mean age of the study participants of group G and group N was 34.17 years and 33.63 years. The two groups were comparable in terms of demographic profile. In comparison to group N, patients in group G showed a significantly higher HR throughout the intraoperative period (p<0.001) and at 60 minutes in the postoperative period. The incidence of hypotension was significantly higher in group N (53.33%) compared to group G (3.33%, p<0.001), and the MAP was lower in group N compared to group G in the intraoperative period. The number of patients requiring phenylephrine was also higher in group N (53.33%) compared to those in group G (3.33%).

Conclusion: Prophylactic use of intramuscular glycopyrrolate can maintain stable haemodynamics in patients undergoing lower limb surgeries under spinal anaesthesia. It can maintain a higher HR and reduces the incidence of hypotension following spinal anaesthesia.

Keywords: Haemodynamics, Incidence, Intraoperative period, Young adult

INTRODUCTION

Spinal anaesthesia is a widely used anaesthetic procedure due to its technical simplicity, fast onset, and effective sensory and motor blockade. However, hypotension and bradycardia are two common complications of this technique. Prevention and prompt management of hypotension are of utmost importance to prevent organ ischaemia. Bradycardia is another serious complication, and post-spinal severe bradycardia and cardiac arrest are more common in healthy, young, and vagotonic patients [1,2]. Patients with ASA physical status-1 are at 3.5 times higher risk of developing bradycardia compared to those with ASA physical status-3 and 4 [3]. Therefore, the prevention of bradycardia is of paramount importance, especially in healthy, young individuals undergoing spinal anaesthesia.

Glycopyrrolate is a quaternary amine with an antimuscarinic effect. It can attenuate reflex vagal responses and subsequent bradycardia. Unlike atropine, it does not cross the blood-brain barrier and, therefore, has no effect on the central nervous system [4]. Thus, glycopyrrolate is a potential agent that can be used prophylactically before spinal anaesthesia to reduce the incidence of bradycardia, especially in young patients.

A previous study has concluded that glycopyrrolate may be used as a prophylactic agent to reduce the incidence of bradycardia following spinal anaesthesia in parturient patients [5]. In geriatric patients, prophylactic glycopyrrolate has also been found to be effective in reducing the incidence of bradycardia and hypotension [6,7]. However, there is a lack of reported studies in young adult patients, in whom the incidence of post-spinal bradycardia is high. Therefore, the present study was aimed to evaluate the effect of intramuscular glycopyrrolate on the haemodynamic condition of adult patients receiving spinal anaesthesia. The primary objective was to compare the changes in HR, and the secondary objectives were to compare the changes in MAP, the incidence of bradycardia and hypotension, phenylephrine requirement, and the incidence of dry mouth.

The null hypothesis was that the effect of prophylactic intramuscular glycopyrrolate would be the same as that of placebo in preventing hypotension and bradycardia in patients undergoing elective lower

limb surgeries under spinal anaesthesia. The alternative hypothesis was that prophylactic intramuscular glycopyrrolate would be more effective compared to placebo in preventing hypotension and bradycardia in patients undergoing elective lower limb surgeries under spinal anaesthesia.

MATERIALS AND METHODS

A randomised, parallel-group, double-blind, placebo-controlled study was conducted in the Department of Anaesthesiology at Calcutta National Medical College, Kolkata, West Bengal, India. The duration of the study was 15 months, from July 2021 to September 2022. Institutional Ethics Committee (IEC) approval was obtained, and written informed consent was obtained from all participants.

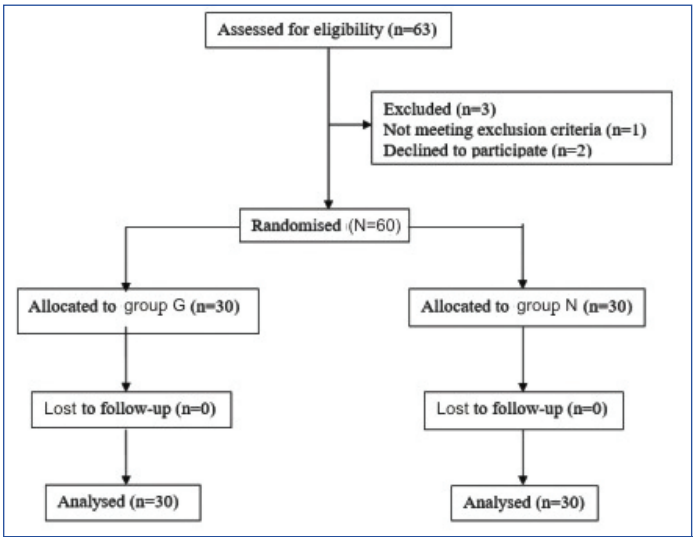
Inclusion criteria: A total of 60 patients aged 18-45 years, of either sex, with ASA physical status I and II, undergoing elective lower limb surgeries under spinal anaesthesia were included in the study.

Exclusion criteria: Patients with contraindications for spinal anaesthesia, Body Mass Index (BMI) >30 kg/m², height <150 cm, known allergy to glycopyrrolate, glaucoma, and those receiving any antihypertensive agents were excluded from the study.

Sample size calculation: The sample size was calculated considering the incidence of hypotension in the two groups as 70% and 27.3% [6], with a study power of 90% and an alpha error of 5%. The estimated total sample size was 54. Therefore, 30 patients were included in each group (total of 60 patients) to compensate for a 10% dropout rate.

Study Procedure

A total of 63 patients were assessed for eligibility. Three patients were excluded: two patients declined to participate, and one patient did not meet the exclusion criteria. Thus, finally, 60 patients were included in the study [Table/Fig-1].



[Table/Fig-1]: Consolidated Standards of Reporting Trials (CONSORT) flow diagram.

Standard fasting guidelines were followed, and clear fluids were allowed upto two hours preoperatively. All patients received an infusion of Ringer's lactate 15 mL/kg as a co-load. Routine monitors, including pulse oximetry, Non Invasive Blood Pressure (NIBP), and Electrocardiogram (ECG), were attached, and baseline parameters were recorded. The patients were randomised into two groups, group G and group N, using a computer-generated random number list with a 1:1 allocation ratio. Patients in group G received intramuscular glycopyrrolate 1 mL (0.2 mg), and those in group N received intramuscular normal saline 1 mL, 15 minutes prior to spinal anaesthesia [6]. The intramuscular injection was administered in the deltoid muscle under strict aseptic conditions. One anaesthesiologist, who was not clinically involved in the study, prepared the study drug using the sealed envelope technique. Both drugs were prepared in 2 mL syringes with identical appearances. All patients and healthcare providers, including anaesthesiologists and nurses, were kept blinded to the group allocation.

Patients were placed in the sitting position. Lumbar puncture was performed under strict aseptic conditions at the L3-L4 or L4-L5 vertebral interspace with a 25G Quincke needle. Hyperbaric bupivacaine (0.5%) 3 mL and fentanyl (25 mcg) 0.5 mL were injected intrathecally. Heart rate and NIBP were recorded at three minute intervals until 15 minutes and at five minute intervals thereafter. Hypotension was defined as a fall in mean arterial pressure of more than 20% from the baseline value [6]. Hypotension was treated with a bolus dose of phenylephrine 100 mcg Intravenously (i.v.). Bradycardia was defined as a HR of less than 50 Beats Per Minute (BPM),. Patients received atropine 0.6 mg i.v. when the heart rate was less than 40 BPM [6]. Fluid management was left to the discretion of the anaesthesiologist with atleast five years of experience. The height of the sensory block was assessed by loss of cold sensation using an alcohol swab 15 minutes after the intrathecal injection. In the postoperative period, HR and NIBP were recorded at intervals of 30 minutes upto 180 minutes. Any side effects, such as nausea, vomiting, and dry mouth, were also noted.

STATISTICAL ANALYSIS

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 12.0 software (SPSS Inc., Chicago, IL, USA). Categorical variables were expressed as numbers and percentages and compared using Pearson's Chi-square test or Fisher's-exact test as appropriate. Continuous variables were expressed as mean and Standard Deviation (SD) and compared across groups using Student's t-test for parametric data and Mann-Whitney U test for non parametric data. Between group haemodynamic variables over time were analysed using repeated measures Analysis of Variance (ANOVA). A p-value of <0.05 was considered statistically significant.

RESULTS

The two groups were comparable in terms of demographic profile and baseline haemodynamic parameters [Table/Fig-2]. One patient (3.33%) in group G developed bradycardia, whereas 5 (16.66%) patients in group N experienced bradycardia [Table/Fig-3]. However, the difference was not statistically significant (p=0.197). No patient required atropine intraoperatively as the HR was more than 40 BPM in all patients. The incidence of hypotension was significantly lower in group G compared to group N (3.33% vs 53.33% with p<0.001) [Table/Fig-3].

Parameters	Group G (n=30) n (%)	Group N (n=30) n (%)	p-value
Age (in years)	34.17 (2.82)	33.63 (3.00)	0.416
Sex (male:female)	18:12	18:12	1.000
Weight (kg)	63.8 (7.55)	65.93 (10.54)	0.579
Height (cm)	161.67 (7.92)	162.07 (8.88)	0.935
ASA I:II	29:1	29:1	1.000
Baseline heart rate (per minute)	83.56 (9.15)	82.75 (7.81)	0.627
Baseline MAP (mmHg)	98.92 (8.68)	100.23 (9.34)	0.705

[Table/Fig-2]: Demographic profile and the baseline haemodynamic parameters. Chi-square test used for sex and American Society of Anaesthesiologists (ASA) status, Student's t-test used for other parameters MAP: Mean arterial pressure

Parameters	Group G (n=30) n (%)	Group N (n=30) n (%)	p-value
Incidence of bradycardia	1 (3.33)	5 (16.66)	0.197
Incidence of hypotension	1 (3.33)	16 (53.33)	<0.001

[Table/Fig-3]: Incidence of bradycardia and hypotension. *p-value <0.001 for incidence of hypotension- highly significant, Chi-square test used

[Table/Fig-4,5] shows that the HR was significantly higher in group G compared to group N throughout the intraoperative period (p<0.001) and at 60 minutes in the postoperative period (p=0.009).

Time point (in minutes)	Group G (n=30) Mean±SD	Group N (n=30) Mean±SD	p-value
0	84.63±9.08	82.20±11.45	0.491
3	107.60±4.54	84.40±9.66	<0.001
6	104.67±4.16	81.27±7.18	<0.001
9	104.47±4.15	84.80±7.46	<0.001
12	102.63±3.75	79.30±9.65	<0.001
15	100.63±9.31	81.87±8.51	<0.001
20	101.20±8.95	84.50±8.04	<0.001
25	95.87±7.61	83.10±7.02	<0.001
30	95.17±11.64	83.60±8.75	<0.001
35	92.53±6.59	83.43±8.58	<0.001
40	92.20±7.53	81.12±8.57	<0.001
45	92.13±7.23	80.10±9.32	<0.001
50	92.67±6.17	80.27±8.63	<0.001
55	90.93±6.76	81.27±8.64	<0.001
60	94.27±5.69	82.93±9.01	<0.001

[Table/Fig-4]: Comparison of intraoperative heart rate between groups.
*p-value <0.001- highly significant, using Student's t-test

Time point (in minutes)	Group G (n=30) Mean±SD	Group N (n=30) Mean±SD	p-value
30	82.08±7.85	79.74±11.90	0.195
60	81.07±10.22	74.10±10.33	0.009
90	78.70±11.37	82.27±7.31	0.124
120	86.83±0.38	85.87±0.43	0.490
150	84.33±8.74	86.37±11.68	0.178
180	83.87±10.64	85.43±5.62	0.254

[Table/Fig-5]: Comparison of postoperative heart rate between two groups.
*p-value <0.05 at 60 min- significant, using student's t-test

Intraoperative MAP was higher in group G compared to group N at 3, 6, 12, 15, 25, 40, and 45 minutes [Table/Fig-6].

[Table/Fig-7] showed that the two groups were comparable in terms of the height of the sensory block 15 minutes after the intrathecal injection. A significantly higher number of patients in group N required phenylephrine intraoperatively compared to those in group G (53.33% vs 3.33%, p<0.001). The requirement of phenylephrine and i.v. fluid was also higher in group N compared to group G, but the difference was not statistically significant. [Table/Fig-8] showed that there was no significant difference in the incidence of postoperative dry mouth between the two groups (11 patients in group G vs 9 patients in group N, p=0.784). The incidence of nausea and vomiting was also not statistically significant between the two groups (p=0.667).

Time point (in minutes)	Group G (n=30) Mean±SD	Group N (n=30) Mean±SD	p-value
0	99.67±9.14	101.17±8.09	0.694
3	97.87±10.02	87.73±6.33	< 0.001
6	98.67±7.25	94.93±6.13	0.021
9	96.97±6.35	99.40±6.29	0.211
12	100.00±4.56	94.37±6.57	0.001
15	97.93±6.37	94.87±6.28	0.024
20	98.23±6.04	97.17±6.51	0.563
25	99.00±5.90	94.83±6.47	0.003
30	101.23±6.88	94.57±7.34	0.067
35	97.37±5.67	96.97±6.75	0.905
40	98.97±7.65	93.27±9.09	0.013
45	99.33±5.19	94.33±8.25	0.020
50	93.13±5.77	93.13±5.77	1.00
55	99.10±6.36	99.07±6.49	0.959
60	97.30±6.65	98.83±6.03	0.305

[Table/Fig-6]: Comparison of intraoperative Mean Arterial Pressure (MAP) between two groups.
*p-value <0.05 at 3, 6, 12, 15, 25, 40 and 45 minutes- significant, using Student's t-test

Parameters		Group G (n=30) n (%)	Group N (n=30) n (%)	p-value
Height of sensory block	T6	2 (6.67)	3 (10)	0.062
	T10	11 (36.67)	19 (63.33)	
	T12	17 (56.67)	8 (26.67)	
Number of patients requiring phenylephrine		1 (3.33)	16 (53.33)	<0.001
Mean amount of phenylephrine used (mcg)		100 (0)	181.25 (40.31)	0.071
Mean volume of i.v. fluid used (mL)		1428.33 (130.31)	1573.91 (118.42)	0.631

[Table/Fig-7]: Comparison of height of sensory block, phenylephrine and fluid requirement in the intraoperative period.
*p-value <0.001 for number of patients requiring phenylephrine- highly significant, Chi-square test was used for height of sensory block and number of patients requiring phenylephrine, Mann-Whitney U test was used for other parameters

Parameters	Group G (n=30) n (%)	Group N (n=30) n (%)	p-value
Incidence of dry mouth	11 (36.67)	9 (30)	0.784
Incidence of nausea and vomiting	2 (6.66)	4 (13.33)	0.667

[Table/Fig-8]: Comparison of incidence of dry mouth and nausea and vomiting.
Chi-square test was used

DISCUSSION

Hypotension and bradycardia are two common complications of spinal anaesthesia. Spinal anaesthesia induces systemic vasodilation and sympathetic blockade, leading to venous pooling of blood and a decrease in cardiac output. It also results in a decrease in systemic vascular resistance, leading to hypotension [8]. Various management strategies, including preloading with i.v. fluids and the use of vasopressors like phenylephrine and ephedrine, have been attempted to reduce the incidence of post-spinal hypotension. However, preloading may not always be effective and can be detrimental in patients with compromised cardiac conditions [9]. The use of prophylactic vasopressors can lead to reactive hypertension and changes in HR, which may be harmful to patients [10]. Bradycardia is another serious complication of spinal anaesthesia. It occurs when the cardiac accelerator fibers (T1-T4) are affected. Decreased venous return and increased inotropy of the left ventricle are potential contributing factors to bradycardia. The role of the Bezold-Jarisch reflex has also been postulated [3].

In the present study, HR was significantly higher in group G compared to group N throughout the intraoperative period and at 60 minutes postoperatively. Similar findings have been observed in previous studies [Table/Fig-9] [6,11-17]. Glycopyrrolate is an anticholinergic drug that reversibly binds to muscarinic cholinergic receptors, preventing the binding of acetylcholine. This results in an increased HR due to the antagonism of acetylcholine's action on the heart [4]. The lower heart rate in group N may also be attributed to the higher consumption of phenylephrine to manage hypotension. Therefore, prophylactic glycopyrrolate can help maintain a higher heart rate and reduce the requirement for phenylephrine, thus preventing further bradycardia.

Intravenous administration of glycopyrrolate may cause an abrupt rise in heart rate, which could be detrimental to patients [4]. Therefore, intramuscular glycopyrrolate was used in the present study to avoid sudden tachycardia. The incidence of hypotension was significantly lower in group G compared to group N (p<0.001).

S. No.	Author's name, year of the study	Place of study	Sample size (age group)	Name of study drugs compared	Parameters assessed	Conclusion
1	Hwang J et al., 2014 [6]	Seoul National University Hospital, Seoul	A total of 66 patients above 60 years of age scheduled for elective surgery under spinal anaesthesia	Glycopyrrolate 0.2 mg vs normal saline given IM 15 minute before spinal anaesthesia	Incidence of hypotension and bradycardia, ephedrine use, mean arterial pressure, heart rate, and the incidence of nausea and vomiting	Reduced incidence and severity of hypotension, ephedrine use and the incidence of nausea and vomiting in elderly patients receiving prophylactic intramuscular glycopyrrolate
2	Deshar R et al., 2022 [11]	University Hospital of BP Koirala Institute of Health Sciences, Dharan, Nepal	A total of 258 patients undergoing non-elective caesarean section for category 2 and 3 under spinal anaesthesia	Glycopyrrolate 0.2 mg vs normal saline administered i.v. before the patient was placed in sitting position for spinal anaesthesia	Intraoperative requirement of phenylephrine, incidences of hypotension, reactive hypertension, bradycardia, use for atropine, tachycardia, intraoperative nausea and vomiting, shivering, pruritus, dry mouth and dizziness	Prophylactic glycopyrrolate does not reduce the vasopressor requirements to prevent postspinal hypotension. Mean SBP and the incidence of tachycardia were higher in glycopyrrolate group. Other parameters were comparable
3	Patel SD et al., 2017 [12]	St. Luke's-Roosevelt Hospital, New York, USA	Meta-analysis of 5 RCT, included 311 patients undergoing caesarean section under spinal anaesthesia	A total of 153 patients received glycopyrrolate and 158 patients received placebo	Intraoperative hypotension, use of vasopressor, heart rate, nausea and vomiting, dry mouth	Prophylactic glycopyrrolate increases maternal heart rate, reduces vasopressor requirements but does not decrease the incidence of spinal-induced hypotension
4	Mukati R et al., 2021 [13]	Jabalpur, Madhya Pradesh, India	A total of 104 patients of ASA I and II, undergoing total abdominal hysterectomy under spinal anaesthesia	Glycopyrrolate 4 mcg/kg made upto 2 mL with 0.9% sodium chloride vs placebo administered i.v. prior to intrathecal injection	Heart rate, blood pressure, respiratory rate, oxygen saturation, vasopressor requirement and any side-effect	Prophylactic i.v. glycopyrrolate can attenuate hypotension and bradycardia following spinal anaesthesia with decreased vasopressor requirement
5	Prasopsuk K et al., 2020 [14]	Sawanpracharak Hospital, Thailand	A total of 62 elderly patients undergoing TURP under spinal anaesthesia	IM glycopyrrolate 0.2 mg vs normal saline 15 minutes before spinal anaesthesia	Heart rate, blood pressure, total ephedrine dosage, total i.v. fluid requirement and estimated blood loss	Intramuscular glycopyrrolate can prevent postspinal hypotension without any significant change in the heart rate in elderly patients
6	Piya R et al., 2021 [15]	Patan Hospital, Nepal	A total of 82 pregnant women, ASA I and II scheduled for elective Caesarean Section under spinal anaesthesia	Glycopyrrolate 0.2 mg i.v. vs normal saline	Heart rate, blood pressure, total dose of ephedrine, incidence of nausea, vomiting, and dry mouth	Prophylactic glycopyrrolate reduces the incidence of hypotension and vasopressor requirement
7	Jain R and Sharma R, 2015 [16]	Santosh Medical and Dental College and Hospital, Uttar Pradesh, India	A total of 66 parturient ASA I and II undergoing elective lower segment caesarean section under spinal anaesthesia	Ondansetron 4 mg (2 mL) vs glycopyrrolate 0.2 mg diluted to 2 mL with normal saline slow i.v. prior to intrathecal block	Incidence of emesis, episodes of hypotension, bradycardia and postoperative pain	In comparison to ondansetron, glycopyrrolate has comparable effect on nausea and vomiting during caesarean section. It has no significant effect on hypotension. But the incidence of bradycardia was lower and the incidence of dry mouth was higher in glycopyrrolate group
8	Manem A and Krishnamurthy D, 2019 [17]	Sri Devaraj Urs Medical College, Karnataka, India	A total of 60 parturient scheduled for elective Caesarean section under spinal anaesthesia	Glycopyrrolate 0.2 mg vs normal saline given IM 15 minute before spinal anaesthesia	Incidence and severity of hypotension, heart rate and blood pressure changes, incidence of nausea and vomiting	Prophylactic intramuscular glycopyrrolate decreases the incidence and severity of spinal-induced hypotension in parturients
9	Present study	Calcutta National Medical College, Kolkata	A total of 60 patients of 18-45 years, either sex, ASA physical Status-I and II, undergoing elective lower limb surgeries under spinal anaesthesia	Glycopyrrolate 0.2 mg vs normal saline given IM 15 minute before spinal anaesthesia	Changes in the heart rate, changes in MAP, incidence of bradycardia and hypotension, phenylephrine requirement and incidence of dry mouth	Prophylactic intramuscular glycopyrrolate can maintain higher heart rate and reduces the incidence of hypotension following spinal anaesthesia

[Table/Fig-9]: Findings of the previously published studies [6,11-17].
MAP: Mean arterial pressure; SBP: Systolic blood pressure

The MAP was found to be significantly lower in group N compared to group G at 3, 6, 12, 15, 25, 40, and 45 minutes intraoperatively. Previous studies have also documented less hypotension in patients receiving prophylactic glycopyrrolate [6,13,14]. Sympathetic blockade and unopposed parasympathetic action, resulting in peripheral vasodilation, are the main causes of hypotension in the control group. Acetylcholine, through its action on M3 receptors on endothelial cells, induces vasodilation by stimulating nitric oxide release [18]. Glycopyrrolate, as an antimuscarinic agent, may prevent this vasodilation and help maintain stable blood pressure intraoperatively.

More patients in group N required vasopressors in the intraoperative period compared to group G ($p<0.001$). This can be attributed to the higher incidence of hypotension in the control group. The height of the block did not contribute to lower blood pressure in group N as the sensory block height was comparable between the two groups. Glycopyrrolate is an antisialagogue and can cause dry mouth as a side effect. Some previous studies have also observed a higher incidence of dry mouth in patients receiving prophylactic glycopyrrolate [15,16]. However, in the present study, no significant difference was found in the incidence of dry mouth between the two groups (36.67% in group G vs 30% in group N, $p=0.784$). A study conducted by Manem A and Krishnamurthy D also did not find dry mouth in any of the patients in their study [17]. The incidence of nausea and vomiting was comparable between the two groups ($p=0.667$). Similar results were obtained in previous studies [6,12].

Limitation(s)

The study has several limitations, including the non availability of various invasive and non invasive methods of haemodynamic monitoring. The fluid management was left to the discretion of the anaesthesiologist with atleast five years of experience, which could introduce variability in the results. The use of phenylephrine for managing hypotension, which can lead to reflex bradycardia, may also be a confounding factor in the present study. For future studies, it would be beneficial to include different age groups of patients

and explore other routes and doses of glycopyrrolate. Additionally, investigating the various other side effects of glycopyrrolate would provide a more comprehensive understanding of its effects.

CONCLUSION(S)

The prophylactic use of intramuscular glycopyrrolate is effective in preventing hypotension and bradycardia in patients undergoing elective lower limb surgeries under spinal anaesthesia. It can maintain a higher HR compared to placebo, thus rejecting the null hypothesis and favouring the alternative hypothesis. Additionally, patients receiving glycopyrrolate require fewer vasopressor agents as there is less of a decrease in intraoperative mean arterial pressure. The drug is well-tolerated without significant adverse effects such as nausea, vomiting, or dry mouth. Therefore, prophylactic intramuscular glycopyrrolate can be effectively used to maintain stable haemodynamics following spinal anaesthesia and improve patient safety.

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PARTICULARS OF CONTRIBUTORS:

1. Senior Registrar, Department of Anaesthesiology, Medica Superspeciality Hospital, Kolkata, West Bengal, India.
2. Associate Professor, Department of Anaesthesiology, Calcutta National Medical College, Kolkata, West Bengal, India.
3. Professor, Department of Anaesthesiology, Calcutta National Medical College, Kolkata, West Bengal, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Sudeshna Bhar Kundu,
68D, Raja Dinendra Street, Kolkata-700006, West Bengal, India.
E-mail: sudeshna04cmc@yahoo.co.in

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