Original Article

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Comparison of Intubation Conditions of Cisatracurium with and without a Priming Dose in Patients under General Anaesthesia: A Randomised Controlled Trial

Anaesthesia Section

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ABSTRACT

Introduction: Endotracheal intubation is a crucial procedure during general anaesthesia that maintain a patent airway and facilitate mechanical ventilation. Cisatracurium, a benzylisoquinolinium non depolarising neuromuscular blocker, offers advantages such as a predictable duration of action and organ-independent metabolism; however, it has a relatively delayed onset. Priming with a subparalysing dose may expedite the onset and improve intubating conditions.

Aim: To compare the intubating conditions of cisatracurium with and without a priming dose in patients undergoing general anaesthesia.

Materials and Methods: This randomised controlled trial was conducted from July 2023 to July 2025 at Department of Anaesthesia, Jawaharlal Nehru Medical College (JNMC) and Acharya Vinoba Bhave Rural Hospital (AVBRH), Wardha, Maharashtra, India. After obtaining informed consent, 60 American Society of Anaesthesiologists (ASA) physical status I-II patients undergoing elective surgeries were enrolled. Patients were randomised and single-blinded into two groups: Group C (cisatracurium intubating dose of 0.15 mg/kg) and Group CP (a priming dose of one-fifth of 0.15 mg/kg followed by the remaining dose for intubation). The onset of neuromuscular blockade, intubating conditions, haemodynamic parameters, and adverse events were recorded. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 27.0, applying Independent samples t-tests and Chi-square tests, with p-value <0.05 considered statistically significant.

Results: The demographic characteristics of the study population were comparable between Group CP (cisatracurium with priming) and Group C (cisatracurium without priming). There was no significant difference in age distribution between the two groups. Group CP demonstrated a significantly faster onset of neuromuscular blockade (116.8±13.58 seconds) compared to Group C (180.63±13.47 seconds; p-value <0.01). The duration of action was significantly shorter in Group CP (29.87±5.01 minutes) than in Group C (35.60±4.44 minutes; p-value <0.01). Ease of laryngoscopy and favourable vocal cord positioning were significantly better in Group CP (p-value=0.003 and p-value=0.0049, respectively). Haemodynamic stability and the incidence of adverse events were comparable between the groups.

Conclusion: Priming with cisatracurium effectively enhances intubating conditions and shortens the onset time without compromising haemodynamic stability. It represents a safe and reliable modification in anaesthesia practice for achieving smooth and rapid intubation.

Keywords: Airway, Endotracheal intubation, Haemodynamic, Neuromuscular blocking agents

INTRODUCTION

Endotracheal intubation is a critical component of administering general anaesthesia, as it provides airway protection and enables effective mechanical ventilation during surgical procedures [1]. Achieving optimal intubating conditions, characterised by adequate muscle relaxation, minimal patient movement, and reduced airway trauma iis essential for safe and effective laryngoscopy and intubation [2]. Neuromuscular Blocking Agents (NMBAs) play a pivotal role in facilitating these conditions by inducing muscle relaxation and suppressing reflex responses. The selection of an NMBA depends on several factors, including the onset of action, duration of neuromuscular blockade, and haemodynamic stability [3]. Among the available NMBAs, cisatracurium, a benzylisoquinolinium derivative, has gained popularity due to its favourable pharmacokinetic and pharmacodynamic profile. These include a predictable duration of action, organ-independent metabolism via Hofmann elimination, and minimal histamine release, which enhance its safety in patients with renal or hepatic impairment [4].

Despite these advantages, cisatracurium has a relatively slower onset of action compared to agents such as rocuronium, which may limit its use when rapid intubation is required [5]. The priming technique has been proposed as a strategy to overcome this limitation. This technique involves administering a subparalysing priming dose of the NMBA several minutes before the full intubating dose, with the aim of accelerating the onset of muscle relaxation and improving intubating conditions while maintaining haemodynamic stability. Several studies have investigated the efficacy of cisatracurium priming. Sinha RA et al., demonstrated that priming with 10-15 µg/kg of cisatracurium reduced the onset time without compromising haemodynamic parameters [6]. Lin SP et al., reported that priming with either cisatracurium or rocuronium improved the onset of neuromuscular blockade, although the effect was more pronounced with rocuronium [7]. Additionally, Ahn BR et al., showed that combining low-dose ketamine with cisatracurium priming further expedited blockade onset, suggesting a potential synergistic effect [8].

Nevertheless, the clinical utility and safety of the priming technique with cisatracurium remain subjects of ongoing debate. El-Kasaby AM et al., reinforced cisatracurium's superior haemodynamic stability compared to atracurium, even when priming strategies were employed, supporting its use in patients vulnerable to haemodynamic fluctuations [9]. However, variability in study findings—particularly

regarding the optimal priming dose, timing, and patient population—highlights the need for further research. Although priming shows promise in enhancing intubating conditions and shortening onset time, individual patient factors such as age, co-morbidities, and surgical requirements must guide its application [10].

Therefore, this study aimed to assess and compare the efficacy and safety of cisatracurium with and without a priming dose in achieving rapid onset of neuromuscular blockade, favourable intubating conditions, and stable perioperative haemodynamics in patients undergoing elective surgery under general anaesthesia.

The primary objective was to compare the intubating conditions of cisatracurium with and without a priming dose. The secondary objectives were to compare the onset and duration of action of cisatracurium with and without priming and to evaluate the adverse effects associated with both techniques.

MATERIALS AND METHODS

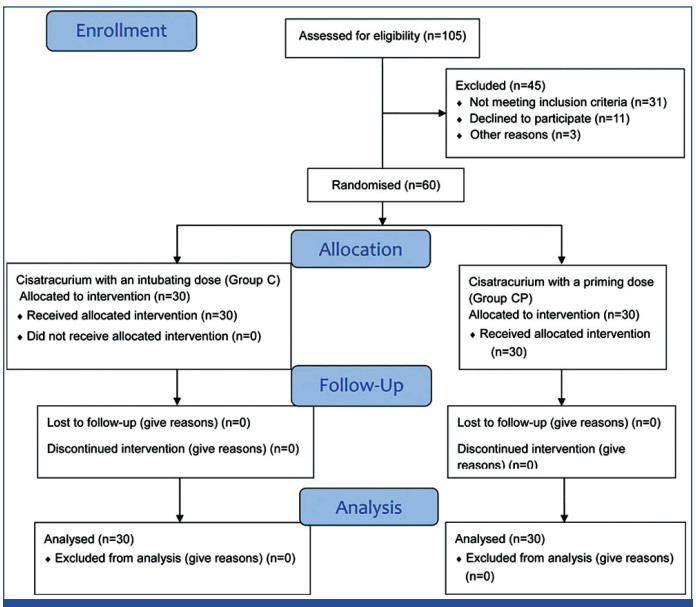
This randomised controlled study was conducted over a two-year period (July 2023 to July 2025) in the Department of Anaesthesiology at Jawaharlal Nehru Medical College (JNMC) and Acharya Vinoba Bhave Rural Hospital (AVBRH), Wardha, Maharashtra, India. The study was approved by the Institutional Ethics Committee (No. DMIHER(DU)/IEC/2023/1083). As this was an institutional academic study without external intervention, CTRI registration was not applicable.

Sample size: A minimum sample size of 60 participants was calculated based on a pilot study effect size of 0.8, with 80% power and a 5% level of significance. Written informed consent was obtained from all participants prior to enrolment, after which patients were equally divided into two groups of 30 each.

Inclusion criteria: ASA physical status I-II, age 18-60 years, both genders, and patients scheduled for elective surgeries under general anaesthesia were included in the study.

Exclusion criteria: Known allergy to study drugs, history of neuromuscular disease, hepatic or renal dysfunction, pregnancy, or anticipated difficult airway were excluded from the study.

Randomisation and blinding: As shown in [Table/Fig-1], participants were randomly allocated into two groups: Group C and Group CP. The random allocation sequence was generated by an anaesthesiologist not involved in participant recruitment or outcome assessment using a computer-generated random number table. Participants were enrolled by the principal investigator after confirming eligibility based on the inclusion and exclusion criteria.



[Table/Fig-1]: CONSORT 2010 flow diagram.

Group assignment was performed by a designated research nurse who opened sequentially numbered, sealed, opaque envelopes containing the group allocation. The nurse prepared the study drug according to the assigned group, ensuring that both the anaesthesiologist performing the intubation and the outcome assessor were blinded to group allocation.

Study Procedure

Intubation difficulty was graded as easy, mild resistance, or difficult using the Modified Intubation Difficulty Scale (IDS) [11]. A total of 60 ASA I,II patients scheduled for elective surgeries under general anaesthesia were enrolled. Patients were randomly divided into 2 groups of 30 each. Group C received cisatracurium 0.15 mg/kg as the intubating dose. Group CP received a priming dose of cisatracurium equivalent to one-fifth ($1/5^{th}$) of the total intubating dose (0.15 mg/kg), administered three minutes before induction, followed by the remaining four-fifths ($4/5^{th}$) dose for intubation along with propofol and fentanyl [12]. All patients underwent a thorough preoperative assessment, including routine laboratory investigations, and were premedicated according to standard protocols. Preoxygenation was performed for three minutes before induction of anaesthesia.

Neuromuscular monitoring was performed using the TOF-Watch® SX. Intubating conditions were graded using a standardised four-point scale (Excellent, Good, Poor, Inadequate) [13]. Haemodynamic parameters {Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), SpO_2, and $EtCO_2$} were recorded at baseline, before induction, and up to 10 minutes post-intubation.

STATISTICAL ANALYSIS

Descriptive and inferential statistical analyses were employed. The Independent samples t-test was used to compare continuous variables, including age, height, weight, Body Mass Index (BMI), HR, blood pressure, MAP, SpO_2, and $EtCO_2$ between Group-C and Group-CP. The Chi-square test was applied to analyse categorical variables such as age groups, BMI categories, vocal cord position, ease of laryngoscopy, reaction to intubation, and side-effects. Statistical analysis was performed using SPSS version 27.0. Continuous variables were expressed as mean±SD. A p-value <0.05 was considered statistically significant.

RESULTS

The demographic characteristics of the study population were comparable between Group C (cisatracurium without priming) and Group CP (cisatracurium with priming). Age distribution did not differ significantly between the groups (p-value=0.574). Both groups had similar mean ages, indicating appropriate age matching, as shown in [Table/Fig-2].

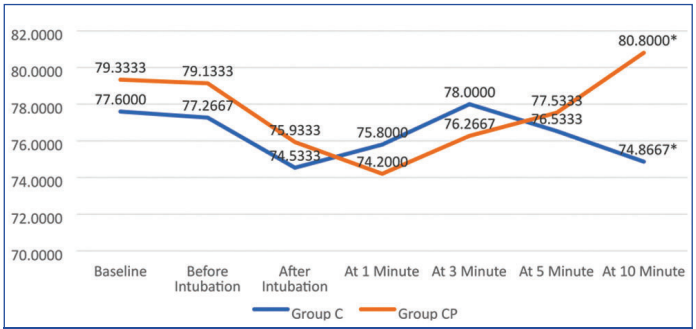
Age group (years)	Group C n (%)	Group CP n (%)	Total n (%)	χ^2	p-value
20-35	9 (30.0)	6 (20.0)	15 (25.0)	1.992	0.574
36-50	12 (40.0)	15 (50.0)	27 (45.0)		
51-65	9 (30.0)	8 (26.7)	17 (28.3)		
66-80	0	1 (3.3)	1 (1.7)		
Total	30 (100)	30 (100)	60 (100)		

[Table/Fig-2]: Frequency distribution of age groups between Group C and Group CP.

Similarly, height (Group C: 165.33±5.61 cm; Group CP: 163.80±5.83 cm), weight (Group C: 61.90±4.97 kg; Group CP: 60.80±5.29 kg), and Body Mass Index (BMI) (approximately 22.59±0.81 kg/m^2 in both groups) were comparable, with no statistically significant differences. These findings confirmed that baseline demographic characteristics were well matched between the study groups, minimising potential confounding factors.

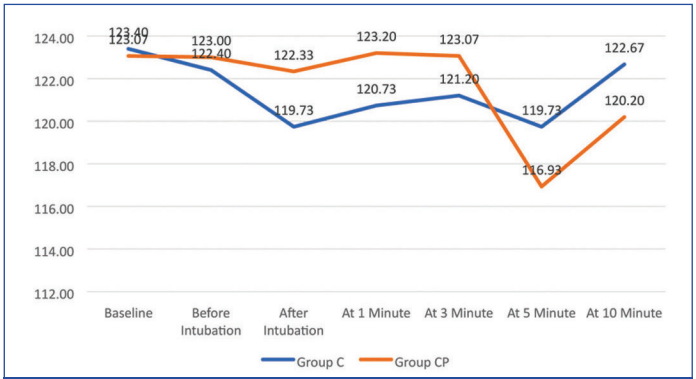
At various intervals during the perintubation period, haemodynamic parameters such as HR, SBP, DBP, MAP, SpO_2, and $EtCO_2$ were

recorded. As shown in [Table/Fig-3], HR values between Group C and Group CP remained statistically comparable from baseline (77.60±8.51 vs 79.33±6.24; p-value=0.372) to five minutes post-intubation (76.53±7.43 vs 77.53±8.86; p-value=0.637). However, at 10 minutes post-intubation, Group CP demonstrated a significantly higher HR (80.80±7.64) compared to Group C (74.87±5.79; p-value=0.001), indicating a delayed tachycardic response.

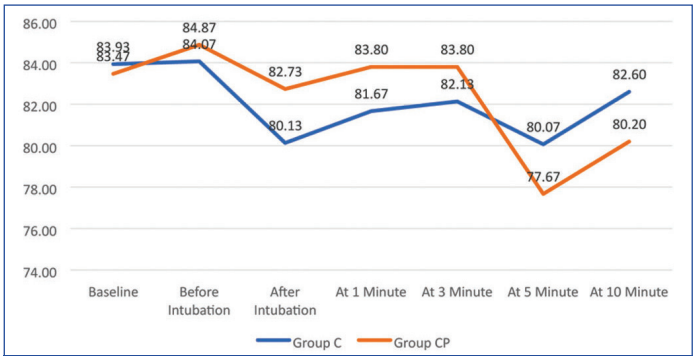


[Table/Fig-3]: Comparison of Heart Rate (HR) between Group C and Group CP at different time points.

No significant differences were observed in SBP, DBP, MAP, or SpO_2 between the groups at any time point, indicating preserved cardiovascular and respiratory stability, as shown in [Table/Fig-4-7]. A statistically significant but clinically acceptable increase in $EtCO_2$ was observed at one minute post-intubation in Group CP (33.23±3.07 mmHg) compared to Group C (30.83±2.53 mmHg; p-value=0.002), as depicted in [Table/Fig-8].

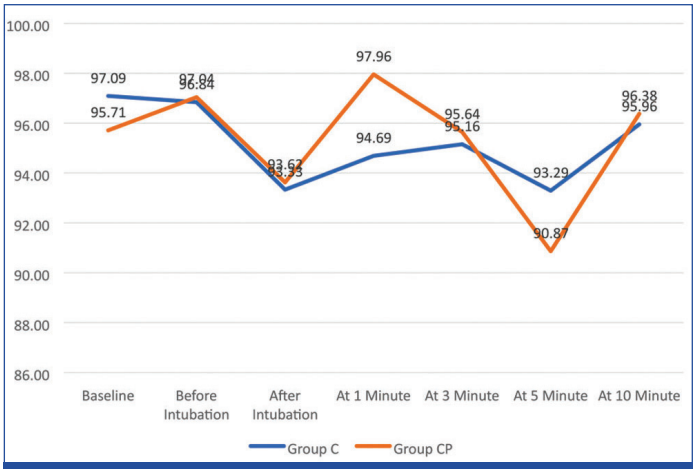


[Table/Fig-4]: Comparison of SBP between Group C and Group CP at different time points.

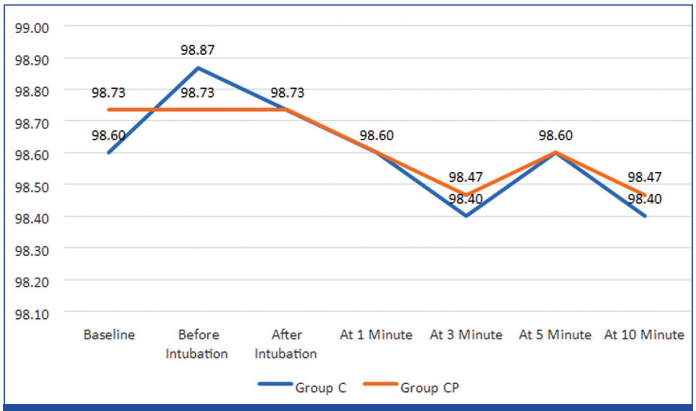


[Table/Fig-5]: Comparison of DBP between Group C and Group CP at different time points.

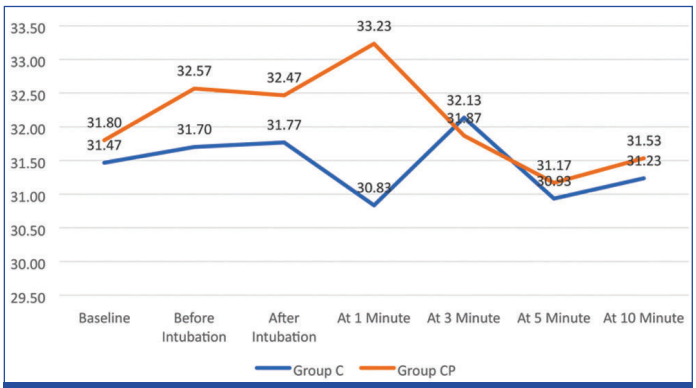
The neuromuscular blockade profile revealed that the time to disappearance of the TOF response was significantly shorter in the primed group (Group CP: 116.80±13.58 seconds) compared to the control group (Group C: 180.63±13.47 seconds; p-value <0.01), as shown in [Table/Fig-9]. Additionally, the duration of action was significantly reduced in Group CP (29.87±5.01 minutes) compared to Group C (35.60±4.44 minutes; p-value <0.01), as shown in [Table/Fig-10]. These findings confirm the effectiveness of the priming technique in accelerating the onset of neuromuscular blockade without prolonging drug action.



[Table/Fig-6]: Comparison of MAP between Group C and Group CP at different time points.



[Table/Fig-7]: Comparison of SpO_2 between Group C and Group CP at different time points.



[Table/Fig-8]: Comparison of $EtCO_2$ between Group C and Group CP at different time points.

		M±SD	t-test	p-value
Time of disappearance of Tof (in sec)	Group C	180.63±13.47	18.281	<0.01
	Group CP	116.80±13.58		

[Table/Fig-9]: Comparison of time of disappearance of Tof between Group C and Group CP.

Group	Mean±SD (Duration of action) (mins)	t-test	p-value
C	35.60±4.44	4.693	<0.01
CP	29.87±5.01		

[Table/Fig-10]: Comparison of duration of action between Group C and Group CP.

Intubating conditions were significantly improved in the primed group. Group CP had a higher proportion of easy laryngoscopy (86.7%) compared to Group CP (46.7%; p-value=0.003), as shown in [Table/Fig-11]. Vocal cord position was more favourable in Group CP, with 83.3% of patients exhibiting open (abducted) cords compared to 43.3% in Group C (p-value=0.0049; [Table/Fig-12]). Furthermore, 80% of patients in Group CP exhibited no reaction to

tracheal tube insertion and cuff inflation, compared to 40% in Group C (p-value=0.0006), as demonstrated in [Table/Fig-13].

Laryngoscope ease	Group C	Group CP	Total	χ^2	p-value
Difficult	4 (13.3%)	0	4 (6.67%)	11.6	0.003
Easy	14 (46.7%)	26 (86.7%)	40 (66.67%)		
Slight resistance	12 (40.0%)	4 (13.3%)	16 (26.67%)		
Total	30 (100.0%)	30 (100.0%)	60 (100%)		

[Table/Fig-11]: Frequency distribution of laryngoscope group comparison between Group C and CP.

Vocal cord position	Group C	Group CP	Total	χ^2	p-value
Closed (adducted)	6 (20.0%)	1 (3.3%)	7 (11.66%)	10.628	0.0049
Moving/partially open	11 (36.7%)	4 (13.3%)	15 (25%)		
Open (abducted)	13 (43.3%)	25 (83.3%)	38 (63.33%)		
Total	30 (100.0%)	30 (100.0%)	60 (100%)		

[Table/Fig-12]: Frequency distribution of vocal cord position comparison between Group C and CP.

Reaction to Insertion of tracheal tube and cuff inflation	Group C	Group CP	Total	χ^2	p-value
No movement	12 (40.0%)	24 (80.0%)	36 (60%)	10.222	0.006
Severe coughing	5 (16.7%)	1 (3.3%)	6 (10%)		
Slight movement	13 (43.3%)	5 (16.7%)	18 (30%)		
Total	30 (100.0%)	30 (100.0%)	60 (100%)		

[Table/Fig-13]: Frequency distribution of reaction to tracheal tube insertion and cuff inflation comparison between Group C and CP.

Adverse effects were generally mild and infrequent, with no statistically significant difference between the two groups [Table/Fig-14], confirming the safety of the priming technique.

Adverse effect	C	CP	Total	χ^2	p-value
Bradycardia (HR <60 bpm)	1 (3.3%)	1 (3.3%)	2	8.238	0.2150
Dizziness/Light headedness	1 (3.3%)	4 (13.3%)	5		
Hypotension (SBP drop >20%)	2 (6.7%)	1 (3.3%)	3		
Nausea/vomiting	2 (6.7%)	2 (6.7%)	4		
No adverse effect	24 (80.0%)	17 (56.7%)	41		
Odynophagia/ throat discomfort	0	2 (6.7%)	2		
Transient diplopia / blurred vision	0	3 (10.0%)	3		
Total	30 (100.0%)	30 (100.0%)	60		

[Table/Fig-14]: Frequency distribution of adverse effect comparison between Group C and CP.

DISCUSSION

The finding of an accelerated onset of neuromuscular blockade and superior intubating conditions with priming is consistent with several earlier reports. Lin SP et al., observed faster onset times and improved laryngoscopic conditions with priming or adjunctive strategies [7]. Ahn BR et al., similarly reported enhanced intubating conditions following priming with cisatracurium [8]. Recent investigations published within the last five years have also demonstrated that low-dose priming or modified dosing regimens of non depolarising neuromuscular blocking agents can reduce onset time and improve laryngeal relaxation [14]. Although rocuronium often produces a faster absolute onset than cisatracurium, the present study showed that priming with cisatracurium narrows this gap and yields clinically acceptable intubating conditions comparable to those reported in contemporary comparative trials [15].

The modestly shorter clinical duration observed in the primed group was consistent with pharmacological expectations, wherein an earlier onset is associated with a proportionally earlier offset at a fixed total dose. Similar findings have been reported in earlier cisatracurium priming studies [13,15]. The incidence of adverse events in this study—namely bradycardia, dizziness, transient diplopia, and throat discomfort—was low and did not differ significantly between groups, corroborating earlier safety data reported by El-Kasaby AM et al., and others [9,15-17]. Recent safety analyses and meta-analyses have also shown no significant increase in clinically relevant adverse events with low-dose priming strategies when patients are appropriately selected and monitored [18].

In the present study, priming with cisatracurium significantly reduced the onset time of neuromuscular blockade (Group CP: 116.80±13.58 seconds vs Group C: 180.63±13.47 seconds; p-value <0.01) and improved intubating conditions (easy laryngoscopy: 86.7% in Group CP vs 46.7% in Group C; p-value=0.003). Additionally, the primed group demonstrated a shorter clinical duration of action (29.87±5.01 minutes vs 35.60±4.44 minutes; p-value <0.01), while haemodynamic parameters remained comparable between the two groups. These findings indicate that priming with one-fifth of the intubating dose of cisatracurium enhances laryngeal conditions and accelerates onset in a clinically meaningful manner without compromising peri-intubation cardiovascular stability.

Throughout the study period, HR, SBP, DBP, MAP, SpO_2, and $EtCO_2$ remained stable at most time points. Transient differences—such as a higher HR at 10 minutes in Group CP—were not clinically significant. These observations align with previous reports indicating that cisatracurium is haemodynamically well tolerated and that low-dose priming does not substantially increase cardiovascular adverse events [9,15,17]. These findings support the pragmatic use of low-dose cisatracurium priming to enhance intubating conditions in elective surgical cases, particularly in situations where rocuronium may be undesirable due to concerns related to organ dysfunction. However, this study was limited by its single-centre design and modest sample size, which may reduce generalisability of the results to higher-risk populations and emergency settings. Larger multicentre randomised trials and pooled analyses --including direct comparisons with rocuronium and studies involving elderly or comorbid patient populations --are recommended to define optimal priming doses, timing, and patient selection criteria. Furthermore, additional pharmacodynamic studies employing laryngeal muscle monitoring could provide deeper insights into differential onset profiles and help refine clinical protocols [19]. Recent cohort studies and randomised trials published over the past five years have similarly concluded that careful priming with benzylisoquinolinium neuromuscular blockers maintains haemodynamic stability in ASA I-II patients [20]. Therefore, priming appears to be a safe strategy for routine elective procedures when appropriate monitoring is employed.

Limitation(s)

This study was conducted at a single centre, which may limit the generalisability of the findings. Additionally, onset and recovery times were evaluated only in elective surgical settings; therefore, the results may not be directly applicable to emergency procedures or patients with significant systemic diseases.

CONCLUSION(S)

The present study demonstrates that priming with cisatracurium significantly enhances intubating conditions by providing a faster onset of neuromuscular blockade and improved ease of laryngoscopy, without prolonging the duration of action. Patients in the priming group exhibited superior vocal cord positioning and better suppression of airway reflexes, facilitating smoother intubation with minimal patient movement. Adverse effects were

mild, infrequent, and comparable between the groups, confirming the safety of the priming strategy. Overall, this study supports the use of cisatracurium priming as an effective and safe approach to optimise intubating conditions and reduce onset time in patients undergoing general anaesthesia.

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- Manual Googling: Dec 08, 2025
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ETYMOLOGY: Author Origin

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