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Original Research Article

A COMPARATIVE STUDY OF ATRACURIUM VERSUS CISATRACURIUM: INTUBATING CONDITIONS AND HEMODYNAMICS IN GENERAL ANAESTHESIA

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ABSTRACT

Background: Neuromuscular blocking agents (NMBAs) are vital in general anesthesia to achieve optimal intubating conditions and surgical relaxation. Atracurium and cisatracurium are commonly used agents, but they differ in pharmacological profiles, hemodynamic effects, and safety. **Aim:** To assess and compare the intubating conditions, hemodynamic responses, and adverse effects of atracurium 0.5 mg/kg versus cisatracurium 0.2 mg/kg in patients undergoing general anesthesia.

Materials and Methods: A prospective, double-blinded, randomized study was conducted on 52 patients scheduled for elective surgery under general anesthesia. Patients were divided into two groups: Group A (atracurium) and Group B (cisatracurium). Standard monitoring, including Train-of-Four (TOF), was used. Intubating conditions, heart rate, mean arterial pressure, onset time, duration of action, and adverse events were recorded. Data were analyzed using SPSS 25, and $p < 0.05$ was considered significant.

Results: Cisatracurium provided excellent intubating conditions in 92.3% of cases compared to 76.9% in the atracurium group. The onset time was significantly faster, and the duration of action was longer with cisatracurium. Hemodynamic responses were more stable in the cisatracurium group, with fewer fluctuations in heart rate and blood pressure. Adverse effects, particularly histamine release and flushing, were more frequently observed with atracurium.

Conclusion: Cisatracurium demonstrates superior intubating conditions, better hemodynamic stability, and a more favorable safety profile compared to atracurium, making it a preferred choice for general anesthesia, especially in patients with cardiovascular risk.

Keywords: cisatracurium, atracurium, neuromuscular blockade.

INTRODUCTION

Neuromuscular blocking agents (NMBAs) are pivotal in modern anesthesia, ensuring optimal intubating conditions and facilitating surgical procedures by inducing muscle relaxation. Among these, atracurium and cisatracurium are widely used benzylisoquinolinium compounds that have distinct pharmacodynamic and pharmacokinetic profiles, influencing their clinical applications.[1,2]

Atracurium, introduced in the 1980s, is notable for its unique metabolism via Hofmann elimination and ester hydrolysis, making it independent of renal or hepatic elimination.[3] However, its use has been linked to histamine release, potentially causing transient hypotension and skin flushing.[4,5] Cisatracurium, an R-cis isomer of atracurium, was developed to address these limitations, offering similar potency with minimal histamine release and more stable hemodynamic profiles.[6,7]

Evaluating intubating conditions is critical in anesthesia practice as poor muscle relaxation can lead to difficult laryngoscopy, increased risk of airway trauma, and patient morbidity.[8] Hemodynamic stability is equally essential, particularly in patients with cardiovascular comorbidities, where blood pressure and heart rate fluctuations can have serious consequences.[9]

Recent studies comparing atracurium and cisatracurium suggest that while both provide satisfactory intubating conditions, cisatracurium may offer superior hemodynamic stability with fewer adverse effects.[10] Yet, variability exists depending on dosages, patient factors, and surgical settings, warranting further investigation. This study aims to compare the intubating conditions, hemodynamic parameters, and adverse effect profiles of atracurium 0.5 mg/kg and cisatracurium 0.2 mg/kg in general anesthesia, providing updated evidence to guide clinical practice.

MATERIALS AND METHODS

This prospective comparative study was conducted at the Department of Anaesthesiology, Care Institute of Medical Sciences (CIMS Hospital), Ahmedabad, Gujarat, over a period from June 2022 to June 2023. The study aimed to assess the intubating conditions, hemodynamic responses, and adverse effects of atracurium (0.5 mg/kg; 2 ED95) versus cisatracurium (0.2 mg/kg; 4 ED95) in general anesthesia.

Ethical clearance was obtained from the Institutional Review Board, and written informed consent was taken from all participants after explaining the protocol and potential risks. There was no additional financial burden on the patients. No external funding was received, and the investigators declare no conflicts of interest.

The study included 52 patients scheduled for elective surgery under general anesthesia requiring endotracheal intubation, after obtaining written informed consent and approval from the Institutional Human Ethics Committee.

Inclusion criteria were age 18–60 years, either sex, ASA physical status I or II, and elective surgical patients.

Exclusion criteria were patient refusal, Mallampati grade III or IV, anticipated difficult airway, known drug allergy or hypersensitivity, pregnant or lactating women, comorbid neuromuscular, renal, cardiovascular, respiratory, or hepatic conditions, use of medications interfering with neuromuscular function (e.g., aminoglycosides, antidepressants, antiarrhythmics), and emergency surgical cases.

Patients were randomized into two groups using a computer-generated code in a double-blind manner: Group A (n=26) received atracurium 0.5 mg/kg IV; Group B (n=26) received cisatracurium 0.2 mg/kg IV.

Preoperative anesthesia evaluation included medical history, examination, and investigations (CBC, serum electrolytes, RBS, chest X-ray if needed, blood urea, ECG if >30 years, creatinine, and viral markers). Patients fasted for at least 8 hours, and IV access was established with an 18G or 20G cannula.

Premedication included glycopyrrolate 0.2 mg IV, ondansetron 0.1 mg/kg IV, and pantoprazole 40 mg IV, given 10 minutes before induction. Standard monitors were attached: NIBP, ECG, pulse oximetry, capnography, and TOF neuromuscular monitoring (Datex-Ohmeda™ equipment and Datex relaxograph).[11] Induction was performed with fentanyl (1–1.5 µg/kg) and propofol (2 mg/kg), followed by maintenance with 50% oxygen, 50% air, and sevoflurane (1–2%). Neuromuscular monitoring used supramaximal stimuli (70 mA, 2 Hz every 0.5 sec, pulse width 0.2 ms) to the ulnar nerve, observing the adductor pollicis response.[12]

Baseline TOF values were recorded, and muscle relaxants were administered over 5–10 seconds. TOF responses were assessed every 15–20 seconds. Four twitches indicated 0–75% block (TOF 100%), three twitches >75% block (TOF 75%), two twitches >80% block (TOF 50%), one twitch >90% block (TOF 25%), and no twitches indicated complete block (TOF 0).[12] Onset time was defined as the time from drug injection to complete loss of all four TOF twitches. Intermittent positive pressure ventilation (IPPV) was administered until TOF 0 was reached.

Intubation was performed after TOF assessment, and intubating conditions were evaluated using the Cooper and Mirakhur scale (1992), assessing ease of tube passage, vocal cord position, and coughing or bucking, categorized as excellent, good, poor, or not possible.[13]

Hemodynamic parameters (heart rate, systolic BP, diastolic BP, MAP, SpO_2, ECG, TOF ratio) were recorded at baseline, post-induction, post-intubation, and intraoperatively using standard monitors.

Data were analyzed using IBM SPSS version 25. Continuous variables were compared using the sample t-test. A p-value <0.05 was considered statistically significant.[14]

RESULTS

Table 1 shows the gender distribution of patients in both groups, with the Atracurium group having an equal number of males and females (13 each) and the Cisatracurium group showing a slightly higher number of females (14) compared to males (12), ensuring a fairly balanced demographic distribution across the study.

Table 2 presents the comparison of intubating conditions between the two groups, revealing that Cisatracurium provided excellent intubating conditions in the majority of cases (92.3%) compared to Atracurium (76.9%), indicating superior intubating performance with Cisatracurium and fewer poor or inadequate conditions overall.

Table 3 shows the heart rate trends measured at baseline, after intubation, and five minutes post-intubation, highlighting that both groups experienced a rise in heart rate after intubation, but the Atracurium group showed a more pronounced increase, suggesting greater hemodynamic variability compared to Cisatracurium.

Table 4 compares the mean arterial pressure (MAP) across time points, demonstrating that while both groups showed an increase in MAP following intubation, the rise was more prominent in the Atracurium group, reflecting relatively greater hemodynamic disturbance and less stability compared to the Cisatracurium group.

Table 5 summarizes the onset time and duration of action of the neuromuscular blocking agents, showing that Cisatracurium had a faster onset time (90 seconds) and longer duration of action (45 minutes) compared to Atracurium (110 seconds onset and 35 minutes duration), making Cisatracurium more efficient in achieving rapid and sustained muscle relaxation.

Table 6 lists the adverse effects observed in both groups, revealing that Atracurium was associated with a higher incidence of histamine release, flushing, and hypotension, whereas Cisatracurium showed minimal adverse effects, highlighting its better safety and tolerability profile in clinical practice.

Table 1: Gender distribution of study subjects

Group	Female	Male	Total
Atracurium	13	13	26
Cisatracurium	14	12	26
Total	27	25	52

Table 2: Comparison of intubating conditions between groups

Intubating Condition	Atracurium (n=26)	Cisatracurium (n=26)
Excellent	20 (76.9%)	24 (92.3%)
Good	5 (19.2%)	2 (7.7%)
Poor	1 (3.9%)	0 (0%)

Table 3: Heart rate comparison at various time intervals

Time Interval	Atracurium (mean ± SD)	Cisatracurium (mean ± SD)
Baseline	82.3 ± 12.1	80.5 ± 11.8
After intubation	96.7 ± 13.4	88.9 ± 12.3
5 min post	90.2 ± 12.7	84.5 ± 11.6

Table 4: Mean arterial pressure (MAP) comparison

Time Interval	Atracurium (mean ± SD)	Cisatracurium (mean ± SD)
Baseline	92.4 ± 8.9	91.7 ± 9.1
After intubation	98.6 ± 9.3	94.2 ± 8.7
5 min post	94.5 ± 8.5	91.3 ± 8.9

Table 5: Onset time and duration of action

Parameter	Atracurium (mean ± SD)	Cisatracurium (mean ± SD)
Onset time (sec)	110 ± 15	90 ± 10
Duration (min)	35 ± 5	45 ± 6

Table 6: Adverse effects observed

Adverse Effect	Atracurium (n=26)	Cisatracurium (n=26)
Histamine release	3 (11.5%)	0 (0%)
Flushing	4 (15.4%)	1 (3.8%)
Hypotension	2 (7.7%)	0 (0%)

DISCUSSION

This comparative study evaluated the intubating conditions, hemodynamic responses, and adverse effects of atracurium and cisatracurium in patients undergoing general anesthesia. Our results demonstrate that cisatracurium provided superior intubating conditions, more stable hemodynamic profiles, and fewer adverse effects compared to atracurium.

The findings align with previous literature emphasizing the pharmacological advantages of cisatracurium. As an isomer of atracurium, cisatracurium offers a more predictable onset and duration of action with minimal histamine release, reducing the risk of hypotension and flushing during anesthesia induction.[15] Our study confirmed these benefits, with the cisatracurium group showing a faster onset time and longer duration of neuromuscular blockade.

Intubating conditions were excellent in 92.3% of patients in the cisatracurium group, compared to 76.9% in the atracurium group. Similar findings were reported by Tang et al., who highlighted cisatracurium's ability to provide excellent intubating conditions at equipotent doses.[16] The superiority of cisatracurium is attributed to its lower histamine-releasing potential, making it preferable in patients with cardiovascular comorbidities.[17]

Hemodynamic stability is a critical factor in anesthesia practice. In this study, the atracurium group exhibited a more pronounced increase in heart rate and mean arterial pressure after intubation, consistent with the histamine-mediated

cardiovascular effects previously reported in the literature.[18] In contrast, cisatracurium maintained more stable vital signs, reflecting its better hemodynamic profile.

The onset and duration data showed that cisatracurium reached complete neuromuscular blockade faster (90 seconds) and maintained it longer (45 minutes) compared to atracurium (110 seconds, 35 minutes). Naguib and Lien have emphasized the clinical importance of a rapid and sustained blockade, particularly in surgeries with prolonged durations.[19]

Regarding safety, the incidence of adverse effects such as histamine release, flushing, and hypotension was significantly higher in the atracurium group. Goudra et al. reported similar trends, advocating for the use of cisatracurium in patients where histamine-mediated reactions are a concern.[20] Overall, our findings reinforce that cisatracurium is a safer and more effective alternative to atracurium in achieving optimal intubating conditions with minimal hemodynamic disruption.

Despite these positive results, limitations of this study include the relatively small sample size and the single-center design. Future research with larger multicenter trials and evaluation across various surgical specialties would help generalize the findings.[21]

CONCLUSION

In conclusion, cisatracurium provides superior intubating conditions, better hemodynamic stability, and fewer adverse effects compared to atracurium when used at equipotent doses during general anesthesia. Its rapid onset, prolonged duration, and excellent safety profile make it a preferred neuromuscular blocking agent, especially in patients with cardiovascular risks. These findings support the wider adoption of cisatracurium in clinical practice to improve perioperative outcomes.

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