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A COMPARATIVE STUDY BETWEEN THE EFFECTS OF CISATRACURIUM AND ATRACURIUM FOR ABDOMINAL SURGERIES IN TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Neuromuscular blocking agents are an essential component of general anaesthesia for abdominal surgery, providing optimal conditions for tracheal intubation and surgical exposure. Atracurium and cisatracurium are intermediate-acting, non-depolarizing neuromuscular blocking agents with organ-independent elimination. However, differences in onset of action, surgical-site relaxation, haemodynamic effects, and histamine-related adverse effects may influence their clinical utility. **Aim:** To compare the clinical effects of cisatracurium 0.1 mg/kg and atracurium 0.5 mg/kg, corresponding to approximately 2 × ED95, in patients undergoing elective abdominal surgery under general anaesthesia, with particular emphasis on intubating conditions, surgical-site muscle relaxation, haemodynamic changes, and clinically apparent adverse effects.

Materials and Methods: This randomized comparative study included 60 adult patients aged 16–60 years, classified as American Society of Anesthesiologists (ASA) physical status I or II, undergoing elective abdominal surgery under general anaesthesia. Patients were randomly allocated into two groups of 30 each. Group I received atracurium 0.5 mg/kg intravenously, while Group II received cisatracurium 0.1 mg/kg intravenously. Standardized anaesthetic management and perioperative monitoring were used. Ease of tracheal intubation, quality of surgical-site relaxation, heart rate, systolic, diastolic and mean arterial blood pressure, end-tidal carbon dioxide, and clinically apparent features suggestive of histamine release were assessed.

Results: Good intubating conditions were observed in 80.0% of patients receiving atracurium and 70.0% receiving cisatracurium. Excellent surgical-site relaxation was observed significantly more frequently with cisatracurium (73.3%) than with atracurium (20.0%) (χ^2=17.14, p=0.000104). Heart rate increased in both groups, with the maximum increase occurring at intubation, followed by a gradual decline toward baseline. Similar peri-intubation changes were observed in blood pressure. Baseline heart rate and systolic blood pressure differed significantly between the groups, whereas baseline diastolic blood pressure and end-tidal carbon dioxide were comparable. No clinically apparent flushing, bronchospasm, or hypotension attributable to histamine release was observed in either group.

Conclusion: Haemodynamic changes were observed predominantly around tracheal intubation and subsequently tended toward baseline values. No clinically apparent histamine-related adverse reactions were observed with either agent. The findings should be interpreted considering the small sample size and baseline differences in heart rate and systolic blood pressure between the groups.

Keywords: Atracurium; Cisatracurium; Neuromuscular blockade; Abdominal surgery; General anaesthesia; Tracheal intubation; Surgical-site relaxation; Haemodynamic changes.

INTRODUCTION

Neuromuscular blocking agents are an integral component of balanced general anaesthesia, particularly during abdominal surgeries, where adequate skeletal muscle relaxation facilitates tracheal intubation, improves surgical exposure, and provides optimal operating conditions. The choice of a neuromuscular blocking agent is influenced by its potency, onset and duration of action, cardiovascular effects, metabolism, and adverse-effect profile. Among the intermediate-acting non-depolarizing neuromuscular blocking agents, atracurium and cisatracurium are widely used because their elimination is relatively independent of renal and hepatic function.[1]

Atracurium besylate is a benzylisoquinolinium compound that produces neuromuscular blockade by competitively antagonizing acetylcholine at the nicotinic receptors of the neuromuscular junction. Its clinical advantages include an intermediate duration of action and organ-independent elimination through Hofmann degradation and ester hydrolysis. However, atracurium can produce histamine release, particularly following rapid intravenous administration or higher doses. Histamine-mediated effects may manifest as cutaneous flushing, hypotension, tachycardia, bronchospasm, or other cardiovascular changes. Studies have demonstrated an association between atracurium administration, increased plasma histamine concentrations, and alterations in blood pressure and heart rate.[2]

Cisatracurium is one of the stereoisomers of atracurium and is approximately three times more potent than atracurium. Like atracurium, it is an intermediate-acting, non-depolarizing neuromuscular blocking agent and undergoes predominantly organ-independent degradation. The stereoselective properties of cisatracurium result in a substantially lower propensity for histamine release compared with atracurium, making it an attractive alternative when cardiovascular stability is particularly desirable. Clinical investigations have generally demonstrated minimal clinically significant histamine-mediated cardiovascular effects with cisatracurium, although histamine release cannot be considered completely absent at all doses.[3]

An important limitation of cisatracurium is its relatively slower onset at commonly used intubating doses. The conventional dose of 0.1 mg/kg (approximately 2 × ED95) has been associated with a slower onset of neuromuscular blockade compared with equipotent atracurium. In a randomized comparison, Bluestein et al. evaluated cisatracurium 0.1 mg/kg against atracurium 0.5 mg/kg and demonstrated that increasing the cisatracurium dose from 0.1 to 0.15 and 0.2 mg/kg progressively reduced the onset time.[4] Similarly, studies comparing 2 × ED95 doses have reported a significantly faster onset with atracurium than with cisatracurium.[4]

The onset of neuromuscular blockade is particularly important during induction of anaesthesia because rapid and adequate muscle relaxation contributes to satisfactory tracheal intubating conditions. The conventional intubating dose of atracurium is 0.5 mg/kg (approximately 2 × ED95), whereas cisatracurium is commonly administered at 0.1 mg/kg (approximately 2 × ED95). Despite their pharmacological relationship, these equipotent doses may not produce identical clinical onset characteristics. Earlier investigations have shown that atracurium 0.5 mg/kg can produce satisfactory intubating conditions relatively rapidly, whereas cisatracurium 0.1 mg/kg may require a longer interval to achieve comparable neuromuscular blockade.[5]

Apart from facilitating intubation, the degree of neuromuscular blockade during surgery is important for maintaining adequate surgical-site relaxation. In abdominal procedures, insufficient muscle relaxation may interfere with surgical exposure and can lead to increased intra-abdominal muscle tension and movement. Conversely, excessive neuromuscular blockade may prolong recovery and increase the risk of residual neuromuscular paralysis. Therefore, comparison of the clinical effectiveness of commonly used doses of atracurium and cisatracurium during abdominal surgery is clinically relevant.

Hemodynamic stability is another important consideration when selecting a neuromuscular blocking agent. Changes in heart rate and mean arterial pressure following administration may be related to histamine release as well as other pharmacological or peri-intubation factors. Atracurium has been associated with transient cardiovascular changes attributable, at least in part, to histamine release, whereas cisatracurium generally produces greater cardiovascular stability. In a comparative abdominal-surgery study, administration of atracurium and cisatracurium at 2 × ED95 was associated with differences in post-intubation heart rate and mean arterial blood pressure, while higher doses of cisatracurium showed comparatively limited cardiovascular effects.[1]

Although cisatracurium offers the potential advantage of greater cardiovascular stability and less histamine-related adverse effects, its slower onset at 0.1 mg/kg may be a disadvantage when rapid intubating conditions are required. Conversely, atracurium may provide a faster onset at the conventional 0.5 mg/kg dose but may be associated with a greater likelihood of histamine-mediated cardiovascular effects. This creates a clinically relevant balance between speed of neuromuscular blockade, adequacy of surgical relaxation, hemodynamic stability, and adverse drug reactions.

Therefore, the present study was undertaken to compare cisatracurium 0.1 mg/kg (2 × ED95) and

atracurium 0.5 mg/kg (2 × ED95) in patients undergoing abdominal surgeries under general anaesthesia. The study focuses on the time of onset of muscle relaxation and quality of surgical-site relaxation, while also evaluating peri-administration hemodynamic changes and clinically observed adverse drug reactions suggestive of histamine release. Such a comparison may help determine the relative clinical advantages of these two neuromuscular blocking agents and assist in selecting an appropriate muscle relaxant for patients undergoing abdominal surgery.

MATERIALS AND METHODS

Study Design and Sample Size

A comparative, randomized study was conducted among patients undergoing elective abdominal surgeries under general anaesthesia. The calculated sample size was **60 patients**, with **30 patients allocated to each study group**.

The study participants were randomly divided into two groups:

- **Group I (Atracurium, n=30):** Patients received atracurium 0.5 mg/kg intravenously, corresponding to approximately 2 × ED95.
- **Group II (Cisatracurium, n=30):** Patients received cisatracurium 0.1 mg/kg intravenously, corresponding to approximately 2 × ED95.

Inclusion Criteria

Patients fulfilling the following criteria were included:

- Adult patients aged 16–60 years scheduled for elective abdominal surgery under general anaesthesia.
- Patients of either sex.
- Patients classified as American Society of Anesthesiologists (ASA) physical status I or II.
- Patients who provided valid written informed consent.
- Patients scheduled for elective abdominal surgical procedures requiring endotracheal intubation.

Exclusion Criteria

Patients meeting any of the following criteria were excluded:

- Patients posted for emergency surgery.
- Patients who did not provide written informed consent.
- Patients with ASA physical status III or higher.
- Pregnant or lactating women.
- Patients with myasthenia gravis or other neuromuscular disorders.
- Patients with a baseline blood pressure below 90/50 mmHg.
- Patients with a history of severe renal or hepatic disease.
- Patients with any known contraindication or hypersensitivity to the study drugs.

Study Drugs and Equipment

The drugs used during the study included:

- Injection atropine
- Injection fentanyl
- Injection ondansetron
- Injection propofol
- Injection atracurium
- Injection cisatracurium
- Injection neostigmine
- Emergency drugs
- Normal saline

Standard monitoring was performed using:

- Electrocardiography (ECG)
- Non-invasive blood pressure (NIBP)
- Pulse oximetry (SpO_2)
- End-tidal carbon dioxide ($ETCO_2$)

Anaesthetic Technique

All patients underwent a standardized anaesthetic protocol. Patients were premedicated with:

- Atropine 0.02 mg/kg intravenously
- Fentanyl 2 µg/kg intravenously
- Ondansetron 0.1 mg/kg intravenously

Patients were preoxygenated with 100% oxygen for 3 minutes.

Anaesthesia was induced with propofol 2 mg/kg intravenously, followed by administration of the assigned neuromuscular blocking agent:

- Atracurium 0.5 mg/kg intravenously in Group I, or
- Cisatracurium 0.1 mg/kg intravenously in Group II.

The assigned neuromuscular blocking agent was administered intravenously over **5–10 seconds** following a stable baseline observation period of at least 5 minutes.

After administration of the muscle relaxant, tracheal intubation was attempted after **2 minutes** using an appropriately sized endotracheal tube. A tube of size **8.0–9.0 mm internal diameter** was used for male patients and **7.0–7.5 mm** for female patients.

Anaesthesia was maintained with **nitrous oxide and oxygen in.

RESULTS

A comparative cross-sectional study was conducted among 60 patients undergoing abdominal surgeries under general anaesthesia. The study population was divided into two groups of 30 patients each: Group I (cisatracurium, n=30) and Group II (atracurium, n=30). The two groups were compared with respect to demographic characteristics, ease of tracheal intubation, quality of surgical-site muscle relaxation, and perioperative hemodynamic and respiratory parameters.

The mean age of patients in the cisatracurium group was 42.57 ± 10.31 years, whereas the mean age in the atracurium group was 40.27 ± 11.15 years. The difference in mean age between the two groups was not statistically significant (p = 0.40), indicating that

the groups were comparable with respect to age. The majority of participants in both groups were male. Males constituted 73.3% of the cisatracurium group and 83.3% of the atracurium group, while females constituted 26.7% and 16.7%, respectively.

Table 1: Distribution of study participants according to ease of tracheal intubation

Ease of intubation	Cisatracurium n (%)	Atracurium n (%)
Good	21 (70.0%)	24 (80.0%)
Poor	9 (30.0%)	6 (20.0%)
Total	**30 (100%)**	**30 (100%)**

Note: Values are expressed as number (percentage).

Good intubating conditions were observed in 21 (70.0%) patients in the cisatracurium group and 24 (80.0%) patients in the atracurium group. Poor intubating conditions were observed in 9 (30.0%) and 6 (20.0%) patients, respectively. Thus, good ease of intubation was observed more frequently in the atracurium group than in the cisatracurium group.

Table 2: Distribution of study participants according to quality of surgical-site relaxation

Quality of relaxation	Cisatracurium n (%)	Atracurium n (%)
Excellent	22 (73.3%)	6 (20.0%)
Poor	8 (26.7%)	24 (80.0%)
Total	**30 (100%)**	**30 (100%)**

Note: Values are expressed as number (percentage).

Excellent surgical-site relaxation was observed in 22 (73.3%) patients in the cisatracurium group compared with 6 (20.0%) patients in the atracurium group. Poor relaxation was observed in 8 (26.7%) and 24 (80.0%) patients, respectively.

Table 3: Association between type of muscle relaxant and quality of surgical-site relaxation

Muscle relaxant	Excellent relaxation n	Poor relaxation n	χ^2	*p*-value
Cisatracurium	22	8	17.14	**0.000104**
Atracurium	6	24		
Total	**28**	**32**		

Note: Chi-square test was used to assess the association between type of muscle relaxant and quality of surgical-site relaxation.

There was a statistically significant association between the type of muscle relaxant and the quality of surgical-site relaxation (χ^2=17.14, p=0.000104). Excellent relaxation was observed more frequently among patients who received cisatracurium than among those who received atracurium. Thus, surgical-site relaxation was significantly better in the cisatracurium group (**p<0.001**).

Table 4: Mean heart rate at different time intervals

Time interval	Cisatracurium Mean ± SD (beats/min)	Atracurium Mean ± SD (beats/min)
Preoperative	86.17 ± 3.76	73.73 ± 5.29
After muscle relaxant	88.86 ± 3.80	76.73 ± 5.29
At intubation	101.00 ± 3.70	90.73 ± 5.29
5 min	96.17 ± 3.76	85.73 ± 5.29
10 min	93.07 ± 3.69	83.73 ± 5.29
15 min	91.17 ± 3.76	81.73 ± 5.29
20 min	86.17 ± 3.76	76.73 ± 5.29
45 min	92.03 ± 3.69	86.73 ± 5.29
Baseline *p*-value		**0.000001**

Note: Values are expressed as mean ± standard deviation. The *p*-value represents the between-group comparison of baseline heart rate.

The mean baseline heart rate was 86.17 ± 3.76 beats/min in the cisatracurium group and 73.73 ± 5.29 beats/min in the atracurium group. Following administration of the muscle relaxant, heart rate increased in both groups and reached a maximum at the time of intubation. Thereafter, heart rate gradually decreased toward baseline values.

The baseline heart rate differed significantly between the two groups (p=0.000001).

Table 5: Mean systolic blood pressure at different time intervals

Time interval	Cisatracurium Mean ± SD (mmHg)	Atracurium Mean ± SD (mmHg)
Preoperative	101.47 ± 6.77	109.93 ± 5.97
After muscle relaxant	94.07 ± 4.17	99.87 ± 6.02
At intubation	139.37 ± 5.57	135.13 ± 5.32
5 min	130.87 ± 4.79	125.67 ± 5.52
10 min	121.50 ± 4.79	115.20 ± 6.19
15 min	110.05 ± 5.12	105.20 ± 5.73
20 min	108.32 ± 4.92	103.70 ± 4.28

45 min	118.40 ± 4.39	114.87 ± 5.93
Baseline *p*-value		**0.000003**

Note: Values are expressed as mean ± standard deviation. The *p*-value represents the between-group comparison of baseline systolic blood pressure.

The mean preoperative SBP was 101.47 ± 6.77 mmHg in the cisatracurium group and 109.93 ± 5.97 mmHg in the atracurium group. Following administration of the muscle relaxant, SBP decreased in both groups. At intubation, SBP increased to 139.37 ± 5.57 mmHg in the cisatracurium group and 135.13 ± 5.32 mmHg in the atracurium group. Thereafter, SBP gradually declined in both groups.

The baseline SBP differed significantly between the two groups (p=0.000003).

Table 6: Mean arterial blood pressure at different time intervals

Time interval	Cisatracurium Mean ± SD (mmHg)	Atracurium Mean ± SD (mmHg)
Preoperative	78.76 ± 3.79	82.02 ± 3.09
After muscle relaxant	74.47 ± 2.83	76.55 ± 2.06
At intubation	94.80 ± 4.40	78.38 ± 2.33
5 min	90.49 ± 3.36	77.77 ± 2.06
10 min	86.72 ± 2.66	77.97 ± 2.26
15 min	81.54 ± 2.69	77.91 ± 2.25
20 min	80.63 ± 1.99	77.93 ± 2.25
45 min	84.28 ± 1.87	77.29 ± 2.26

Note: Values are expressed as mean ± standard deviation.

The mean preoperative MABP was 78.76 ± 3.79 mmHg in the cisatracurium group and 82.02 ± 3.09 mmHg in the atracurium group. Following administration of the muscle relaxant, MABP decreased to 74.47 ± 2.83 mmHg and 76.55 ± 2.06 mmHg, respectively. At intubation, the mean MABP increased to 94.80 ± 4.40 mmHg in the cisatracurium group, whereas it was 78.38 ± 2.33 mmHg in the atracurium group. Thereafter, MABP gradually approached the preoperative values in the cisatracurium group and remained relatively stable in the atracurium group.

Table 7: Mean end-tidal carbon dioxide at different time intervals

Time interval	Cisatracurium Mean ± SD (mmHg)	Atracurium Mean ± SD (mmHg)
Preoperative	33.27 ± 1.64	33.03 ± 1.71
After muscle relaxant	33.07 ± 1.60	34.03 ± 1.61
At intubation	34.07 ± 1.68	34.03 ± 1.61
5 min	33.07 ± 1.69	33.03 ± 1.61
10 min	32.27 ± 2.66	32.03 ± 1.57
15 min	31.37 ± 1.53	31.06 ± 1.57
20 min	31.03 ± 1.49	30.17 ± 1.46
45 min	32.27 ± 1.58	32.23 ± 1.61
Baseline *p*-value		**0.886**

Note: Values are expressed as mean ± standard deviation. The *p*-value represents the between-group comparison of baseline $ETCO_2$.

The mean baseline $ETCO_2$ was 33.27 ± 1.64 mmHg in the cisatracurium group and 33.03 ± 1.71 mmHg in the atracurium group. $ETCO_2$ values remained relatively comparable between the two groups throughout the observation period. No statistically significant difference was observed in baseline $ETCO_2$ between the groups (p=0.886).

Table 8: Mean diastolic blood pressure at different time intervals

Time interval	Cisatracurium Mean ± SD (mmHg)	Atracurium Mean ± SD (mmHg)
Preoperative	67.40 ± 3.78	68.07 ± 3.22
After muscle relaxant	64.67 ± 3.34	61.77 ± 4.62
At intubation	72.53 ± 5.71	72.80 ± 4.33
5 min	70.30 ± 4.17	64.93 ± 4.38
10 min	69.33 ± 3.44	65.33 ± 3.35
15 min	67.07 ± 3.31	65.60 ± 2.89
20 min	66.77 ± 2.61	64.37 ± 3.39
45 min	67.23 ± 2.53	65.70 ± 3.88
Baseline *p*-value		**0.4648**

Note: Values are expressed as mean ± standard deviation. The *p*-value represents the between-group comparison of baseline diastolic blood pressure.

The mean preoperative DBP was 67.40 ± 3.78 mmHg in the cisatracurium group and 68.07 ± 3.22 mmHg in the atracurium group. Following administration of the muscle relaxant, DBP decreased to 64.67 ± 3.34 mmHg and 61.77 ± 4.62 mmHg, respectively. At intubation, DBP increased to 72.53 ± 5.71 mmHg in the cisatracurium group and 72.80 ± 4.33 mmHg in the atracurium group. Thereafter, DBP gradually returned toward baseline values. The baseline DBP did not differ significantly between the two groups (p=0.4648).

DISCUSSION

The present comparative study evaluated the clinical effects of cisatracurium 0.1 mg/kg (2 × ED95) and atracurium 0.5 mg/kg (2 × ED95) in patients undergoing abdominal surgery under general anaesthesia. The parameters assessed included ease of tracheal intubation, quality of surgical-site muscle relaxation, perioperative heart rate (HR), blood pressure, $ETCO_2$, and clinically observed features suggestive of histamine release. The findings demonstrate that both drugs provided clinically useful neuromuscular blockade, although differences were observed in the quality of surgical-site relaxation and peri-intubation hemodynamic responses.

Hemodynamic changes

In the present study, an increase in HR was observed following administration of the muscle relaxant and particularly at the time of tracheal intubation in both groups. In the cisatracurium group, mean HR increased from 86.17 ± 3.76 beats/min at baseline to 101.00 ± 3.70 beats/min at intubation, while in the atracurium group it increased from 73.73 ± 5.29 to 90.73 ± 5.29 beats/min. The baseline difference between the groups was statistically significant (p=0.000001). However, the increase observed around intubation should be interpreted cautiously because laryngoscopy and tracheal intubation themselves produce a sympathetic cardiovascular response and may confound the direct effect of the neuromuscular blocking agent.

A similar pattern has been reported by Lien et al,[6] who investigated the cardiovascular effects and histamine-releasing properties of cisatracurium (51W89). They reported that the maximum changes in HR and mean arterial blood pressure following cisatracurium were small and comparable with those observed after atracurium. Basta et al,[7] also evaluated the clinical pharmacology of atracurium and described cardiovascular effects associated with atracurium administration, particularly in relation to dose and administration rate.

In the present study, MABP increased at intubation in the cisatracurium group, from 78.76 ± 3.79 mmHg preoperatively to 94.80 ± 4.40 mmHg, whereas the corresponding values in the atracurium group were 82.02 ± 3.09 and 78.38 ± 2.33 mmHg, respectively. The subsequent values tended to return toward baseline. These observations suggest that the marked changes occurring around intubation may have been related to the stress response to laryngoscopy and differences in the degree of neuromuscular relaxation rather than solely to the pharmacological effects of the muscle relaxants.

The findings are broadly consistent with the randomized abdominal-surgery study by El-Kasaby et al,[1] in which atracurium 2 × ED95 was compared with different doses of cisatracurium. They reported significant post-intubation increases in HR and MABP with the 2 × ED95 doses of both atracurium and cisatracurium, while the hemodynamic changes observed later in the postoperative observation period were not significant.

The cardiovascular stability associated with cisatracurium has also been demonstrated in previous studies. Lien et al,[6] reported relatively small cardiovascular changes with cisatracurium, supporting its use when hemodynamic stability is important. Nevertheless, evidence from clinical settings indicates that hypotension is not exclusively determined by the choice of neuromuscular blocker. For example, a retrospective ICU study comparing continuous atracurium and cisatracurium found no significant difference in the incidence of hypotension between the two drugs.[8] Thus, the hemodynamic response should be interpreted in the context of induction drugs, depth of anaesthesia, intubation stimulus, dose, and rate of administration.

Surgical-site muscle relaxation

One of the important findings of the present study was the significant difference in the quality of surgical-site relaxation between the two groups. Excellent surgical-site relaxation was observed in 73.3% (22/30) of patients receiving cisatracurium compared with only 20.0% (6/30) of patients receiving atracurium. Conversely, poor relaxation was observed in 26.7% of the cisatracurium group compared with 80.0% of the atracurium group. The association was statistically significant (χ^2=17.14, p=0.000104).

This finding is interesting because several previous studies have reported that atracurium 0.5 mg/kg may have a faster onset than cisatracurium 0.1 mg/kg at equipotent doses. The better surgical relaxation observed with cisatracurium in the present study may therefore reflect differences in the clinical assessment of relaxation, timing of assessment, anaesthetic technique, or the specific surgical requirements rather than onset time alone.

The abdominal-surgery study by El-Kasaby et al,[1] provides particularly relevant comparative evidence. They reported that the 2 × ED95 dose of atracurium produced more effective neuromuscular blockade than the equivalent 2 × ED95 dose of cisatracurium with respect to onset, whereas higher doses of cisatracurium produced more rapid and effective blockade. Therefore, the finding in the present study of better surgical-site relaxation with cisatracurium should be presented as a finding specific to the observed clinical assessment rather than as evidence that cisatracurium universally produces stronger blockade at equipotent doses.

Onset and neuromuscular blockade

The pharmacodynamic difference between the two drugs has been demonstrated by several investigators. Mellinghoff et al,[9] compared cisatracurium 0.1 mg/kg with atracurium 0.5 mg/kg and reported onset times of 3.1 ± 1.0 minutes for cisatracurium and 2.3 ± 1.1 minutes for atracurium, with a statistically significant difference (p=0.008). Their findings indicate a faster onset with

atracurium at these equipotent doses. (ResearchGate)

Similarly, Bluestein et al,[10] studied 80 ASA I–II patients and compared cisatracurium at 0.1, 0.15, and 0.2 mg/kg with atracurium 0.5 mg/kg. They found that increasing the cisatracurium dose progressively reduced the onset time from 4.6 minutes at 0.1 mg/kg to 3.4 minutes at 0.15 mg/kg and 2.8 minutes at 0.2 mg/kg. They also reported good or excellent intubating conditions in more than 90% of patients across the treatment groups.

The observations of Mellinghoff et al,[9] and Bluestein et al,[10] therefore support the pharmacological principle that cisatracurium has a somewhat slower onset than atracurium when equipotent 2 × ED95 doses are used. This is an important consideration when rapid tracheal intubation is required.

Condition of tracheal intubation

In the present study, good intubating conditions were observed in 70% of patients in the cisatracurium group and 80% of patients in the atracurium group, while poor intubating conditions were observed in 30% and 20%, respectively. Thus, although good intubation conditions were numerically more frequent with atracurium, the difference was relatively small. The findings are consistent with the observations of Bluestein et al,[10] who reported that intubating conditions were good or excellent in more than 90% of patients after approximately 2 × ED95 doses of cisatracurium or atracurium when intubation was performed at the specified observation interval.

The abdominal-surgery study by El-Kasaby et al,[1] similarly reported that the intubating conditions produced by 2 × ED95 doses of atracurium and cisatracurium were comparable, while higher doses of cisatracurium produced significantly better intubating conditions than the lower 2 × ED95 cisatracurium dose.

Mandal et al,[11] and other investigators have subsequently explored strategies for improving the relatively slower onset of cisatracurium. Studies using higher doses, priming, or adjunctive drugs have demonstrated improvement in the quality and speed of intubating conditions. For example, a study using cisatracurium 0.15 mg/kg demonstrated that pretreatment with ephedrine could shorten onset and improve intubating conditions. These observations emphasize that the intubating characteristics of cisatracurium are dose- and technique-dependent.

Histamine release and adverse effects

No clinically evident signs of histamine release were observed in either group in the present study. There were no reported episodes of clinically apparent flushing, bronchospasm, or hypotension that could clearly be attributed to histamine release.

This finding is clinically relevant because atracurium is known to have a greater potential for histamine release than cisatracurium, particularly with rapid administration and higher doses. Scott et al,[2] specifically investigated strategies for preventing histamine release and attenuating the hemodynamic response to atracurium. Their work demonstrated that the cardiovascular response to atracurium can be influenced by the dose and rate of administration. In contrast, cisatracurium has generally demonstrated a lower propensity for clinically significant histamine-mediated cardiovascular effects. A pharmacological review reported that cisatracurium was not associated with dose-related histamine release at bolus doses up to 8 × ED95 and was associated with cardiovascular stability in clinical studies. However, the absence of clinically observed signs of histamine release in the present study should not be interpreted as proof that no histamine release occurred, because plasma histamine or tryptase levels were not measured. Clinical observation may fail to detect subclinical mediator release. Therefore, the appropriate conclusion is that no clinically apparent histamine-related adverse reactions were observed.

Overall comparison with previous studies

The present findings demonstrate both similarities and differences with previous investigations. The observation of increased HR and MABP around the time of intubation is consistent with the work of Lien et al,[6] and El-Kasaby et al,[2] who also documented cardiovascular changes around intubation with both agents. The absence of clinically apparent histamine-related reactions in the present study is consistent with the recognized cardiovascular stability of cisatracurium and with studies showing that clinically significant histamine-mediated effects are uncommon at conventional doses.

With regard to intubation, the present observation of slightly better intubating conditions with atracurium is compatible with the findings of Mellinghoff et al,[9] and Bluestein et al,[10] who reported a faster onset with atracurium than with cisatracurium at equipotent doses.However, the present study found significantly better surgical-site relaxation with cisatracurium, which differs from the onset-based findings of some previous studies. This discrepancy may be explained by differences in assessment methods, timing of assessment, anaesthetic technique, surgical procedure, and patient characteristics.

Summary of discussion

Overall, the present study suggests that both cisatracurium and atracurium can provide satisfactory neuromuscular blockade for abdominal surgery. Atracurium showed a numerical advantage in ease of intubation, whereas cisatracurium demonstrated a significantly higher proportion of patients with excellent surgical-site relaxation in the present study. Hemodynamic changes were most pronounced around the time of tracheal intubation and subsequently tended to decrease toward baseline. No clinically apparent signs of histamine release were observed with either drug.

These findings should be interpreted in light of the relatively small sample size (30 patients per group)

and the fact that histamine release was assessed clinically rather than by plasma histamine or tryptase measurement. In addition, because the supplied data show significant baseline differences in HR and SBP, the observed post-intubation changes should not be attributed solely to the muscle relaxants without an appropriate repeated-measures or adjusted analysis.

CONCLUSION

We can conclude that at the same dose (2×ED95 dose) atracurium is more effective neuromuscular blocking agent than cisatracurium, both drugs have similar hemodynamic changes, and increase in heart rate and blood pressure changes at the time of intubation and gradually reached baseline readings after 10 min of intubation and significant changes after 45min of administration of drug.

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