The Use of Atracurium in Paediatric Anaesthesia

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Atracurium is a novel neuromuscular blocking agent, containing two quarternary ammonium groups. The drug is considered to be free of undesirable cardiovascular side-effects and is designed to undergo rapid chemical inactivation by "Hofmann elimination" at physiological pH and body temperature. Therefore it is minimally cumulative (Payne and Hughes, 1981; Payne and Utting, 1983).

The purpose of this study was to investigate the pros and cons of using atracurium in the clinical setting of the busy pediatric anaesthesia practice.

Patients and methods

Atracurium was used during anaesthesia of 21 children, who were being operated on for various conditions requiring a surgery. All the operations were elective. The nature of operations is specified in table 1:

TABLE 1

Operation	*No. of cases*
Neurosurgery	2
Urology	6
Orthopedic surgery	1
Abdominal surgery	6
ENT surgery	4
Thoracic/cardiovascular surgery	2
	21

Atracurium was used as a part of a wide range of anaesthetic techniques (see table 2).

TABLE 2

Anesthetic technique	*No. of cases*
N_2O + halothane	8
N_2O + ketamine + diazepam	5
N_2O + caudal block	5
N_2O + fentanyl	3

All patients were ventilated artificially. The duration of operations ranged from 25 minutes to 8 hours 45 minutes.

For an induction of anaesthesia various drugs and anaesthetics were used in conventional doses: ketamine (12 cases), thiopentone (8 cases), diazepam (5 cases), nitrous oxide and halothane (2 cases) and etomidate (1 case).

There was one baby of less than one year of age, 8 children were of a pre-school age and the remaining children were older. The weight of children ranged between 4,5 to 50 kg.

The dose of 0,5 – 0,6 mg/kg of atracurium was chosen to facilitate intubation. The interval from its administration to intubation was noted. The intubation was attempted after the jaw muscles had relaxed. The conditions for intubation were rated as being excellent, acceptable or poor. A further dose of 0,2 mg/kg of atracurium was given, whenever the operating conditions were demanding. This dosage scheme was used as a guide only, as the real amount of the relaxant given approximated within the accuracy of 5 mg.

At the end of an operation the anaesthetist ventilated the patients manually, then augmented their breathing effort till the respiration became adequate. The adequacy of ventilation was judged by measuring the expiratory tidal volume by Draeger's ventilometer. The anaesthetist was satisfied, when the child performed successfully either "sustained head lift" or "tongue stick-out" test. The time from administration of the last dose of atracurium to the return of an adequate spontaneous breathing and extubation was noted. EGC was monitored throughout the operation, blood pressure was measured by sphygomanometry at 5 minutes' intervals. We were looking, too, for the signs of histamine liberation.

The average dose of the actually used atracurium – for intubation and for further maintenance of muscle relaxation – was then calculated,

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as well as the average time elapsed between the administration of atracurium and intubation. The average interval of the incremental doses of atracurium was calculated, too.

The number of cases where muscle paralysis had worn off spontaneously and where the pharmacological decurarization had been performed was noted.

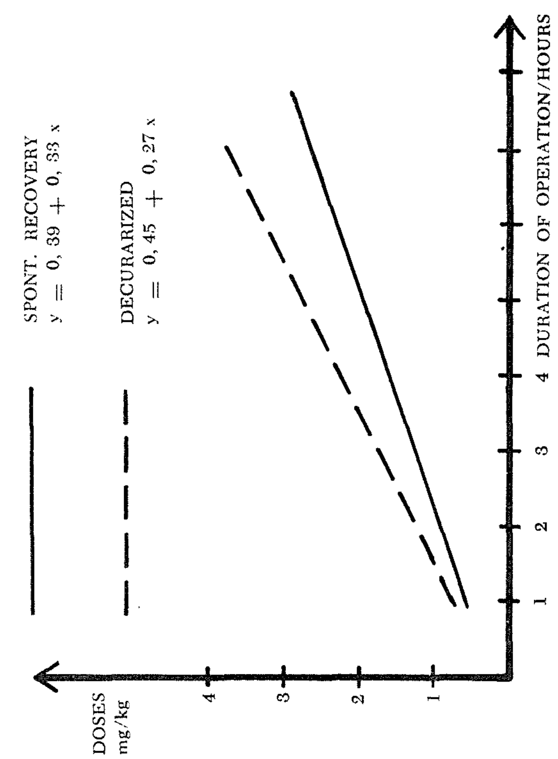
The relation between the total amount of atracurium, used up during anaesthesia, and the duration of procedure was calculated, using regression analysis. The relation was specified for the children who had started to breathe spontaneously and for those requiring decurarization separately.

Results and discussion

It was easily possible to intubate after the dose of 0,54 ± 0,1 mg/kg (mean ± standard deviation) of atracurium. The mean time for intubation was 77 ± 27 seconds. In all the cases the conditions were rated excellent. It is perhaps worth noting that three smooth nasotracheal intubations in our series (the rest were orotracheal) were all performed in less than 40 seconds after the administration of atracurium. It is obvious, that this technique does not request such a deep relaxation of muscles of a jaw. The average incremental doses of atracurium was 0,21 ± 0,01 mg/kg (mean ± standard error of a mean) given in intervals of 36 ± 1,8 minutes. A negligible scatter of values suggests predictable effect and minimal cumulation. It certainly deserves mentioning, that the termination of the paralyzing effect of atracurium is rather sudden and might disturb the surgeon.

In the two thirds of children the muscle paralysis wore off spontaneously at the end of an operation. The interval between the last dose of atracurium and the adequate spontaneous respiration was 33 ± 14 minutes (mean ± standard deviation). That is quite close to the average interval of doses during an operation. The scatter we contribute to the fact, that the test performed at the end of an anesthetic required the cooperation of a child. That is possible only, when the effect of various anaesthetics wears off – thus the difference with various anaesthetic techniques. In a third of children a decurarization with conventional doses of atropine and neostigmine was carried out. It was performed when the busy operating list did not allow sufficient time at the end of a procedure.

There is a linear correlation between the total amount of atracurium and length of operation. It is interesting to note that the linear regression in cases where the relaxant wore off spontaneously ($y = 0{,}39 + 0{,}33x$) and where the atropine and neostigmine were given ($y = 0{,}45 + 0{,}27x$) is within the limits of confidence $P = 0{,}05$ identical. Then as the dosage was practically identical, it seems highly probable, that – time permitting – those who were decurarized would also start to breathe spontaneously within similar time relations.



Minimal side-effects were noted. Blood pressure and pulse rate remained stable. There were no arrythmias. On one occasion we noted an occurence of histamine liberation. At the end of the operation a generalized macule-papulous rash developed, at the same time with the oedema of the sacral area. The child had been an epileptic, for a long time on barbiturates and hydantoinates. A blood transfusion was given during the operation, too. Thus the phenomenon cannot solely be attributed to atracurium.

Conclusions

It is possible to draw several conclusions, based on previous observations:

1. After a dose of 0,5 – 0,6 mg/kg of atracurium children can be easily intubated within 70 – 90 seconds.

2. Atracurium is versatile and compatible with various anesthetic techniques.
3. Incremental doses of 0,2 mg/kg of atracurium are necessary at regular intervals of 30 – 40 minutes.
4. There is no evidence of cumulation; after 30 – 40 minutes effect of atracurium wears off and the resuming of spontaneous breathing activity is to be expected, regardless the length of an operation.
5. Atracurium is suited perhaps for shorter procedures, where a quick recovery is desirable or where the decurarization is to be avoided. Where an operation takes longer time, regular increments at rather short intervals may be at disadvantage.
6. Cardiovascular stability during the use of atracurium is excellent. Perhaps it is wise to avoid its use in allergic persons.

Definitely, atracurium seems to be a useful addition to the anaesthetists' armamantarium and can safely be used in pediatric cases.

Acknowledgement

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Literature

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