COMPARISON OF ATRACURIUM AND VECURONIUM DURING ANAESTHESIA FOR LAPAROSCOPY

D. M. BAILEY AND A. D. G. NICHOLAS

Several recent studies of anaesthesia for laparoscopy have examined the intermediate acting, non-depolarizing neuromuscular blocking drugs atracurium and vecuronium [1–3]. However, in none of these have the two drugs been directly compared although one study compared the effects with lower (ED_{90}) and higher doses [4]. Vecuronium was found to be slightly shorter acting than atracurium. The present randomized double-blind study was conducted to compare small equipotent doses of the two agents in clinical use during anaesthesia for laparoscopy. Particular attention was paid to speed of recovery from neuromuscular blockade before and after the administration of neostigmine.

PATIENTS AND METHODS

Sixty women undergoing laparoscopy for sterilization or for investigation of infertility were studied. Patients with a history of atopy, obesity (body mass index > 28) or taking medication likely to interact with neuromuscular blocking drugs were excluded. Relevant patient data are given in table I.

Informed verbal consent was obtained at the preoperative visit. All patients received papaveretum 10–15 mg and atropine 0.6 mg i.m. approximately 1 h before operation. The atropine was included to prevent the bradycardia during laparoscopy which had been noted occasionally when using atracurium or vecuronium.

In the anaesthetic room, a 21-gauge cannula was placed in a vein on the non-dominant hand. Monitoring electrodes were placed over the ulnar nerve and the hypothenar eminence on the other hand for electromyographic monitoring during anaesthesia.

Anaesthesia was induced with thiopentone 5 mg kg\(^{-1}\). Each injection of drug was flushed through the cannula with 2 ml of physiological saline. The electromyograph (Relaxograph: Vickers Medical) was connected to the electrodes and calibrated to obtain a supramaximal stimulus and 100% twitch response. This process took about 2 min. The neuromuscular blocking drug was then administered according to a randomized

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<th>Table I. Patient data for each group (mean (SD)). BMI = Body mass index. No statistically significant differences between groups</th>
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SUMMARY

Atracurium 0.3 mg kg\(^{-1}\) and vecuronium 0.06 mg kg\(^{-1}\) were compared directly in a double-blind randomized trial during anaesthesia for laparoscopy in 57 healthy young women. The effects of the drugs were monitored using a portable electromyograph. Both drugs provided adequate intubating conditions at 3 min, and prompt antagonism of paralysis after administration of neostigmine, but recovery was significantly faster with vecuronium (mean time to 20% recovery of control electromyographic response: vecuronium 15.1 min; atracurium 20.6 min (P < 0.001)). Atracurium caused a higher frequency of clinically observed allergoid reactions (21%) compared with vecuronium (3%).
schedule: either atracurium 0.3 mg kg\(^{-1}\) or vecuronium 0.06 mg kg\(^{-1}\), contained in identical, numbered syringes which had been drawn up before the start of the operating list by an anaesthetist not involved in the study. The drug was thus administered blind and its identity unknown until the numbered code was broken at the end of the trial. The atracurium was supplied as formulated by the manufacturer (10 mg ml\(^{-1}\)), and the vecuronium was dissolved in water to give a solution of 2 mg ml\(^{-1}\).

Anaesthesia was continued with 0.5 % enflurane and 67 % nitrous oxide in oxygen, via an anaesthetic face mask. If anaesthesia was judged to be inadequate, a further dose of thiopentone 50 mg was administered. No change was made in the inspired concentration of the anaesthetics until the end of the procedure. The patient was observed for clinical signs of histamine release, such as weal formation, urticaria or bronchospasm, following induction.

Intubation of the trachea with an 8.0-mm otracheal tube was undertaken 3 min after the administration of atracurium or vecuronium. Conditions at intubation were noted as "satisfactory" if there was no movement or only slight movement of the patient. Gross movement of the patient or coughing were judged as unsatisfactory. Following intubation of the trachea, the lungs were mechanically ventilated to achieve an end-tidal carbon dioxide concentration of between 4.25 and 4.75 %. This was monitored with an infra-red absorption analyser (Datex) throughout the anaesthetic.

Neuromuscular function was monitored until the end of anaesthesia. The electromyograph gave a supramaximal train-of-four stimulus to the ulnar nerve at the wrist every 20 s. The value of the first response in the train-of-four as a percentage of the control was displayed, in addition to the train-of-four ratio. Further doses of atracurium 2.5 mg or vecuronium 0.5 mg were given when the response recovered to 20 % of the control value or greater. The following observations were made:

- Time to reach 10 % of control response (T < 10).
- Time to recover to 20 % of control response (T > 20).
- Number of additional doses of neuromuscular blocking drug required.
- Time to recover to a train-of-four ratio of 70 % after administration of neostigmine (REV-70 %).

At the end of laparoscopy, the enflurane was discontinued and the electromyographic response was allowed to recover to 20 % of the control value. Atropine 0.02 mg kg\(^{-1}\) and neostigmine 0.04 mg kg\(^{-1}\) were then given. Once the train-of-four ratio had recovered to 70 %, 100 % oxygen was administered, the end-tidal carbon dioxide tension was allowed to increase and the trachea was extubated when the patient was breathing spontaneously.

The patients were interviewed later to see if they had experienced any weakness in the recovery period. Results were analysed statistically using Student's \(t\) test and Chi-squared (with Yates' correction).

**RESULTS**

Three patients were excluded during the trial, two because of monitoring problems and one who proceeded to laparotomy due to bleeding. There were therefore 28 in the atracurium group and 29 in the vecuronium group.

The times taken to reach an electromyographic response of less than 10 % of control (T < 10) were similar in the two groups. Vecuronium was shorter acting than atracurium and was also significantly faster to antagonize following the administration of neostigmine. None of the patients took more than 6 min to recover safely from neuromuscular blockade, judged by a train-of-four ratio of 70 % (table II).

No evidence was seen of cumulation of either atracurium or vecuronium when patients who had received no additional doses were compared with those who had received two or more in each group.

Intubating conditions were unsatisfactory in a minority of patients (two out of 28 in the atracurium group and three out of 28 in the vecuronium group). In none of these patients were severe difficulties encountered.

There was a higher frequency of allergoid reactions with atracurium (six patients: 21 %) compared with vecuronium (one patient: 3 %), but this did not reach statistical significance. All the observed reactions were erythema and cutaneous weals along the line of the vein, fading by the end of the operation. No systemic manifestations of histamine release were seen in any of the patients.

At follow up, there were no patients who had recall of weakness or diplopia following anaesthesia.
DISCUSSION

The results of this double-blind randomized clinical investigation are similar to those found by Robertson and colleagues [4] with smaller doses. Doses used in the present study were designed to obtain paralysis adequate for intubation, combined with minimum duration of neuromuscular block. They were slightly greater than the ED_{95} dose [5]. The dose ratio of 1:5 was that calculated by Gramstad and Lilleasen [5], and similar to that of Robertson and colleagues [4] (1:4.4).

Clinically, these doses provided good intubating conditions at 3 min. The electromyographic response was depressed by 90% in an average of 3–3.5 min by both drugs. A recent study by Healy and colleagues [6] suggested that there was little increase in the speed of onset using larger doses in the normally recommended range. Their trial found a slightly more rapid onset of action with both drugs (about 3 min) using a similar method to assess neuromuscular blockade.

Another recent trial [2], using strain-gauge measurement of the adductor pollicis response to ulnar nerve stimulation, found a much faster onset time (1 min), probably caused by using enfurane in higher concentrations during induction (1–1.5%). Enfurane was used in this study in a low concentration (0.5%) to prevent awareness, whilst affecting the neuromuscular blockade as little as possible. The concentration was considerably lower than those previously found to potentiate other neuromuscular blocking drugs [7].

A train-of-four ratio of 70% was chosen as an indication of adequate recovery, as recommended previously [8,9]. Clinically there were no difficulties with recovery.

The frequency of allergoid reactions with atracurium is similar to that found by other authors [1,3]. All the reactions seen were of a minor nature. This may be because all the drugs were flushed immediately with saline, preventing chemical reaction with thiopentone [10].

In conclusion, both atracurium and vecuronium offer acceptable conditions for intubation and prompt antagonism of paralysis for short procedures such as laparoscopy. The frequency of allergoid reactions to atracurium, and the faster recovery from vecuronium make the latter a more attractive agent for such short procedures.

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REFERENCES