

Atracurium and intraocular pressure

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SUMMARY The effect of atracurium on intraocular pressure was studied by comparing it with pancuronium in a randomised controlled trial. The intraocular pressure was measured in patients undergoing cataract surgery before administration of the muscle relaxant, at 1, 3, and 5 minutes after its administration, and at 1 minute after tracheal intubation. Atracurium was found to decrease intraocular pressure to a significantly greater degree than pancuronium. The intraocular pressure after tracheal intubation was found to be significantly higher than that measured immediately after induction of anaesthesia. The authors conclude that atracurium provides an acceptable alternative to pancuronium for ophthalmic surgery but does not overcome the ocular hypertensive effect of tracheal intubation.

The increased use of general anaesthesia for intraocular surgery in recent years bears witness to the significant contribution which can be made by the anaesthetist to optimise conditions for surgery. Since most patients for such operations are elderly, a technique involving controlled ventilation of the lungs has the advantage of achieving optimal and stable intraoperative conditions at a lighter plane of anaesthesia with minimisation of postoperative side effects. The use of controlled ventilation for intraocular surgery is particularly advantageous, since intraocular pressure can be significantly lowered by inducing intraocular vasoconstriction with mechanical hyperventilation.^{1,2} The non-depolarising neuromuscular blocking agents used to facilitate controlled ventilation have been shown to have no or minimal direct effects on intraocular pressure.

Atracurium is a new non-depolarising neuromuscular blocker whose effect on intraocular pressure has not heretofore been documented. In the present study the effect of atracurium on intraocular pressure was assessed and compared with that of pancuronium, a drug known to have no effect on intraocular pressure.^{3,4}

Patients and methods

Patients giving informed consent and undergoing cataract extraction under general anaesthesia were included prospectively in the study. Premedication

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was with diazepam 10 mg 90 minutes prior to surgery.

Anaesthesia was induced with thiopentone, 4-5 mg kg⁻¹ body weight intravenously, and followed one minute later by administration of the neuromuscular blocking agent. This consisted of atracurium 0.6 mg kg⁻¹ or pancuronium 0.1 mg kg⁻¹ body weight by random number sequence. As spontaneous breathing ceased, ventilation was controlled to maintain normocapnia (Siemens Elema 130 Infra Red CO₂ Monitor) with 70% nitrous oxide in oxygen via a face mask. Five minutes later orotracheal intubation was performed without prior spraying of the larynx with local anaesthetic, and thereafter ventilation was controlled mechanically and anaesthesia maintained with the addition of enflurane as required.

Measurements of intraocular pressure were made with a Digilab 30RT Pneuma-Tonometer/Tonographer, which was calibrated before, and rechecked after, each set of measurements. This instrument, designed exclusively for intraocular pressure measurement and using a pneumatic sensor, operates on the principle of applanation tonometry and records intraocular pressure continuously, in mmHg, with a freely moving pen recorder and a calibrated paper strip. Measurements were performed (by DFM or JBM) 1 minute after completion of thiopentone injection, 1, 3, and 5 minutes after the neuromuscular blocker was given, and 1 minute after intubation, in the eye not undergoing surgery. Values of intraocular pressure for both groups were compared by analysis of variance.

Results

Ten patients were included in each group, demographic data on whom are outlined in Table 1.

Individual variation in intraocular pressure was marked, but the direction and degree of alteration in intraocular pressure in each group was similar. Mean values for intraocular pressure in both groups is shown on Table 2.

Intraocular pressure was found to be decreased 5 minutes after either muscle relaxant compared with postinduction values. Atracurium caused a greater fall in intraocular pressure than pancuronium at all times ($p < 0.001$). Comparison of measurements taken at 1, 3, and 5 minutes after administration of either muscle relaxant failed to reach statistical significance ($0.05 > p > 0.025$), indicating that time was not a major contributor to the effect.

Comparison of values for both groups at 5 minutes after muscle relaxation with postintubation values indicated that a significant rise in intraocular pressure accompanied tracheal intubation in all cases ($p < 0.01$).

Discussion

The goal of anaesthesia for intraocular surgery is to achieve steady state anaesthesia with a minimum of disturbance to the patient, so that the intraocular pressure does not rise to a level which would endanger the eye from forward prolapse of the intraocular contents once an incision is made. The achievement and maintenance of optimal operating conditions is particularly important if intraocular lens implantation is undertaken, a technique which is becoming so widespread as to be almost the rule in many centres. The fine manipulations required for lens implantation demand an immobile field, minimal bleeding, and a low intraocular pressure. A technique involving spontaneous ventilation by the patient may be used, since the intravenous and inhalational agents are known to lower the

intraocular pressure⁵⁻⁷ and so create a good operating field for surgery. The disadvantages of this technique include the need to use suxamethonium prior to intubation and the danger of carbon dioxide retention, both of which significantly increase intraocular pressure.^{2,8} A further disadvantage is the need to attain deeper levels of anaesthesia, which, for the elderly population usually encountered, is undesirable. A technique using controlled hyper-ventilation can achieve similar operating conditions at a lighter plane of anaesthesia, and it eliminates the danger of straining during the critical stage of surgical incision. The anaesthetic induction agents, with the possible exception of ketamine,^{9,10} lower intraocular pressure, and the non-depolarising neuromuscular blocking agents have no effect¹ or reduce intraocular pressure³ so that this technique has much to recommend it for surgery.

The development of newer and better neuromuscular blocking agents further promotes this technique. Atracurium, the drug assessed in the present study, has a rapid onset and short duration of action, with a lessened danger of prolonged action due to its unique property of spontaneous degradation at body temperature (Hoffman elimination).

In the present study atracurium decreased intraocular pressure to a statistically greater degree than pancuronium, though in a clinical setting this difference is unlikely to be obvious. All intraocular pressure measurements remained within the normal physiological range, and atracurium may therefore be considered an acceptable alternative to pancuronium for patients undergoing intraocular surgery.

At the given dosages conditions for intubation were found to be adequate for both groups. It is interesting to note, however, that the intraocular pressure rose significantly after the stress of laryngoscopy and intubation despite adequate neuromuscular blockade. Much has been written about the dangers of administering suxamethonium to patients with perforating eye injuries but little about the intraocular hypertensive effects of intubation. Clearly, if the effects of intubation cannot be attenuated, then much of the work in development of ultra-rapidly acting non-depolarising neuromuscular blocking agents will be in vain, at least in the field of emergency intraocular surgery. The authors consider that further attention must be focused on the cause

Table 1 Group characteristics of patients studied

Patient group	Sex M/F	Age (yr)	Weight (kg)
Atracurium group	2/8	66.8±12.82 (SD)	58.0±11.1 (SD)
Pancuronium group	4/6	75.3±6.99 (SD)	62.2±15.0 (SD)

Table 2 Intraocular pressure (mmHg±SD) for both patient groups at the stated measurement times

Patient group	1 min post-induction	Post muscle relaxant			1 min post-intubation
		1 min	3 min	5 min	
Atracurium group	13.7±6.68	13.6±6.5	13.7±7.3	12.5±5.4	18.1±4.7
Pancuronium group	16.9±5.5	17.5±5.7	16.5±5.89	15.5±5.5	21.1±6.19

and elimination of the stress response to laryngoscopy and tracheal intubation.

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