Effect of neuromuscular block on depth of anaesthesia as measured by the auditory evoked response

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Summary

In a double-blind, randomized, controlled, prospective study, we have investigated the effects of vecuronium and laryngoscopy on the auditory evoked response (AER) of the electroencephalogram (EEG) in 40 ASA I and II patients under steady state anaesthesia. After stable anaesthesia had been achieved with 1.0 MAC of isoflurane and nitrous oxide in oxygen, patients were allocated randomly to receive two separate doses of vecuronium 0.05 mg kg\(^{-1}\) or saline. The AER was recorded before and after each dose and then after 20-s laryngoscopy in each group to determine any changes in the early cortical components of the AER waveform (Pa and Nb). There were no statistically significant changes between the vecuronium and saline groups. However, there was a statistically significant increase in mean Pa amplitude of 36 % (\(P = 0.008\)) and a reduction in mean Nb latency of 6 % (\(P = 0.05\)) after laryngoscopy in both the paralysed and unparalysed groups, and these changes did not differ significantly between groups. There were correspondingly significant haemodynamic responses to laryngoscopy in both groups. We conclude that neuromuscular block with vecuronium does not affect depth of anaesthesia as measured by the AER in either stimulated or unstimulated patients. In addition, we have demonstrated clearly the arousal effect of laryngoscopy on the AER. (Br. J. Anaesth. 1996; 76: 446–448)

Key words


Neuromuscular block was thought to decrease anaesthetic requirements in humans [1, 2], but recent investigations have not confirmed this [3, 4]. We have used the auditory evoked response (AER), which reflects the level of anaesthetic depth [5], to investigate this effect. The Pa and Nb waves from the primary auditory cortex show graded changes in amplitude and latency with increasing concentrations for a wide range of anaesthetics [5]. When a stimulus is applied to a patient during steady state anaesthesia, for example skin incision [5], Pa and Nb amplitudes increase suggesting cortical arousal. The AER therefore reflects both the level of anaesthesia and the balance between anaesthesia and stimulation in anaesthetized patients. In this study, we have examined the effect on the AER of neuromuscular block and laryngoscopy during a period after induction of anaesthesia.

Method and results

With the approval of the Harrow Research Ethics Committee, written informed consent was obtained from 40 ASA I or II patients undergoing surgery. We chose patients only if neuromuscular block and ventilation via a laryngeal mask airway were appropriate. Patients were premedicated with temazepam 10 mg orally, 1 h before operation. Before induction, full monitoring was commenced and heart rate, oxygen saturation, arterial pressure and neuromuscular block were recorded continually. The AER was monitored as described previously [6]. Anaesthesia was induced with fentanyl 1 \(\mu\)g kg\(^{-1}\) and propofol 2–3 mg kg\(^{-1}\). A laryngeal mask was inserted and the patient’s lungs ventilated with 66 % nitrous oxide in oxygen and isoflurane to an end-tidal concentration of 0.35–0.4 % (MAC 1.0) and an end-tidal carbon dioxide concentration of 4.5–5.0 % (Datex Capnomac). Patients were allocated randomly, using sealed envelopes, to receive two doses of either vecuronium 0.05 mg kg\(^{-1}\) or a similar volume of saline. The two groups were similar; there were seven females and 13 males with a mean age of 45.6 yr in the vecuronium group and 10 females and 16 males with a mean age of 46.8 yr in the saline group.

After a 10-min stabilization period, the AER was monitored for a period of 1024 sweeps before and after each dose of vecuronium or placebo and before and after stimulation by laryngoscopy for 20 s. Pa and Nb amplitudes and latencies were determined at

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Neuromuscular block and depth of anaesthesia

changes in heart rate was 6.6 (SEM 1.9) beat min⁻¹ for the vecuronium group and 8.2 (1.9) beat min⁻¹ for the saline group, from an average baseline of 58 beat min⁻¹ (P < 0.001). Mean changes in systolic arterial pressure was 16.6 (SD 2.7) mm Hg in the vecuronium group and 18.5 (3.4) mm Hg in the saline group from an average baseline value of 95 mm Hg (P < 0.001). There was no statistically significant difference between the vecuronium and saline groups.

Comment

There was no clinically significant effect on the AER when vecuronium was given during steady state anaesthesia in unstimulated patients. Forbes, Cohen and Eger demonstrated a 25 % reduction in halothane requirements in humans after administration of pancuronium 0.1 mg kg⁻¹ [1]. They suggested that pancuronium reduced MAC by abolishing muscle spindle afferent input to the reticular activating system, causing cortical depression. All neuromuscular blocking agents should reduce anaesthetic requirements to the same degree at equipotent doses. In this study, we should have seen a measurable change in the AER but we did not. Fahey and colleagues were also unable to find a change in the MAC of halothane in patients given pancuronium 0.1 mg kg⁻¹, vecuronium 0.1 mg kg⁻¹ or atracurium 0.5 mg kg⁻¹ [3]. Sessler, Olofsson and Chow, using frequency of spontaneous lower oesophageal contractions as a measure of anaesthetic depth, showed that the MAC of halothane in patients paralysed with vecuronium 0.1 mg kg⁻¹ did not differ from that in unparalysed patients [4]. Schwartz, Navedo and Berman have shown that pancuronium 0.1 mg kg⁻¹ administered to dogs given isoflurane, caused an increase in the percentage of the EEG that was isoelectric [2] compared with burst suppression; this was dose-related and reversible. They also suggested that reduced proprioceptive afferent activity caused the cortical depression.

In contrast with the effect of vecuronium, we have demonstrated that laryngoscopy produced lightening of depth of anaesthesia as measured by the AER. This effect was independent of the presence of neuromuscular block and coincided with the haemodynamic response to laryngoscopy.

References

4. Sessler DI, Olofsson CI, Chow F. Low oesophageal contractility predicts movement during skin incisions; Vecuronium does not decrease the MAC of halothane Anesthesia and Analgesia 1988; 67: S201.