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MOVEMENTS OF THE VOCAL CORDS ON INDUCTION OF ANAESTHESIA WITH THIOPENTONE OR PROPOFOL

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SUMMARY

Using a fibreoptic laryngoscope, we have recorded on video tape the movements of the vocal cords after induction of anaesthesia with either propofol or thiopentone. The angle formed by the vocal cords decreased after induction of anaesthesia in both groups. This reduction in angle was significantly greater in the thiopentone group. The vocal cords closed completely in four patients in the thiopentone group and one patient in the propofol group. This difference may be explained by greater depression of laryngeal reflexes by propofol and this may account for the lower incidence of laryngospasm after induction of anaesthesia with propofol in comparison with thiopentone.

KEY WORDS

Anaesthetics, intravenous. propofol, thiopentone. Intubation: tracheal.

Propofol has become widely used for i.v. induction of anaesthesia and is associated with ease of maintenance of the airway and early toleration of a Guedel airway [1]. Intubation of the trachea may also be accomplished easily under anaesthesia with propofol alone [2].

This study was designed to observe the movements of the vocal cords after induction of anaesthesia with propofol or thiopentone.

PATIENTS AND METHODS

After Ethics Committee approval and informed consent had been obtained, we studied 30 patients (23 male), ASA I and II, aged 20–78 yr undergoing dental surgery. Patients were excluded from the study if they had a history of hiatus hernia, symptoms of regurgitation, obesity, laryngeal pathology, nasal obstruction or coagulation disorders.

All patients were premedicated with temazepam 10–20 mg orally and glycopyrronium 0.3 mg i.m. 1 h before anaesthesia. On arrival of the patient in the anaesthetic room, monitoring was commenced using pulse oximetry and ECG and a 16-gauge cannula was inserted into a forearm vein.

The nasal mucosa was anaesthetized with 10% lignocaine (maximum dose of 150 mg) and a 6-mm nasopharyngeal airway was introduced. Preoxygenation was commenced for 5 min via a specially adapted face mask.

After preoxygenation, a fibrescope (Olympus LF1) was passed via the nasopharyngeal airway into the pharynx until a clear view of the larynx was obtained. A video camera (Panasonic CCD GL110 AE with Olympus AK-2C adaptor) was attached to the eyepiece of the fibrescope and colour video recordings of the vocal cord movements were made on to a videocassette recorder (Sony Umatic VO 5630). Events were recorded on the soundtrack simultaneously with the video recordings.

Patients were allocated randomly to receive either propofol 2.5 mg kg^{-1} or thiopentone 4.4 mg kg^{-1} for induction of anaesthesia [1, 3–5]. Before induction of anaesthesia the patients were given a 20-ml syringe to hold between the thumb and forefinger; induction of anaesthesia was judged to have occurred when the subject had dropped the syringe [6].

After 20 s of recording, the induction agent was administered over 20 s. Video recordings were continued for 60 s after induction of anaesthesia, as judged by the subject dropping the syringe. During the video recording of the larynx, we attempted to ensure that the position of the laryngoscope remained constant. At the end of this time the fibreoptic laryngoscope was removed and anaesthesia continued conventionally for the operative procedure.

The video recordings were played back on a video recorder with a freeze frame facility and a blinded observer made measurements of the anterior angle between the vocal cords, using a goniometer with the frame frozen. Measurements were made with the subjects awake, at the time of dropping the syringe and every 5 s for the first 1 min after induction.

Data were analysed statistically using multivariate analysis of variance for repeated measures to identify a difference between the two groups and by Student's *t* test to identify the times at which the difference occurred (SPSS PC+version 3.0). Chi-square test was used to compare the sex ratio of the two groups and Fisher's exact test to compare the incidence of complete glottic closure. Wilcoxon rank sum test was used to compare the minimum arterial oxygen saturation and duration of apnoea, as these data were not normally distributed.

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TABLE I. *Patient data, duration of apnoea, minimum arterial oxygen saturation and incidence of complete glottic closure after induction of anaesthesia (mean (SD) [range]). * P < 0.05 between groups*

	Thiopentone	Propofol
n	14	14
Sex (M/F)	11/3	12/2
Age (yr)	45 [23–68]	39 [20–78]
Weight (kg)	75.4 (12.6)	68.5 (9.4)
Duration of apnoea (s)	20.5 (21.9) [0–60]	38.0 (11.6)* [20–60]
Glottic closure (No.)	4	1
Minimum Sp_{O_2} (%)	93.6 (2.4) [92–100]	97.7 (1.2) [96–100]

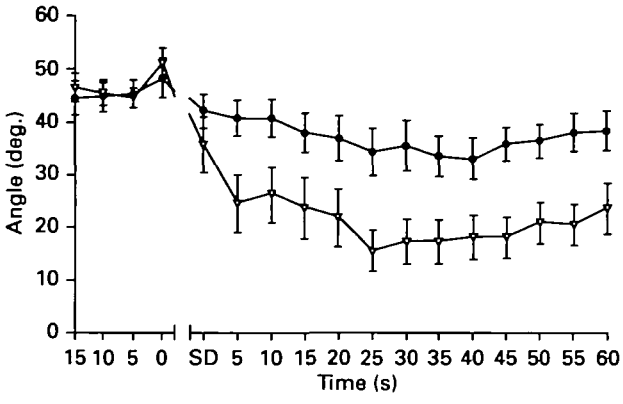

FIG. 1. Angle between vocal cords after induction of anaesthesia with propofol or thiopentone (mean, SEM). Time 0 = start of injection of thiopentone (▽) or propofol (●); SD = syringe drop.

RESULTS

Two patients (one from each group) were excluded from analysis as they were unable to tolerate insertion of an airway or the fibrescope. The groups were comparable in age, weight and sex (table I).

The mean induction dose of thiopentone was 332 (SD 106) mg and the mean induction dose of propofol was 170 (29.6) mg. There was no statistical difference in the pre-induction vocal cord angle between the two groups (fig. 1).

The angle between the vocal cords decreased in both groups after induction of anaesthesia. The decrease in angle was significant in the thipentone group (MANOVA $P = 0.009$) and in the propofol group (MANOVA $P < 0.001$). However, the decrease in angle was significantly greater in the former group (MANOVA $P = 0.008$). In the thipentone group, the decrease in angle was significantly greater at the following times after induction: 5 s, 10 s, 15 s, 25 s and 35 s ($P < 0.05$); 30 s, 45 s, 50 s, 55 s and 60 s ($P < 0.01$). There were no significant differences between the groups at syringe drop or at 20 s after syringe drop.

DISCUSSION

This study has shown that the vocal cords were adducted to a greater extent after induction of anaesthesia with thiopentone than with propofol. The mechanism underlying this difference may include a greater depressant effect of propofol on airway reflexes, heightening of airway reflexes by thiopentone or possible neuromuscular blocking actions of propofol. However, available evidence suggests that the first mechanism is the most likely.

Evidence for depression of upper airway reflexes by propofol was provided by Mackenzie and Grant [1], who commented on the ease of insertion of a Guedel airway after induction with propofol induction, and by Szneke [7] who found that an oral airway could be inserted earlier after induction of anaesthesia with propofol than with thiopentone.

Keaveny and Knell [2] found that 19 of 20 patients in whom anaesthesia was induced with propofol 2.5 mg kg^{-1} had satisfactory conditions for tracheal intubation, although seven coughed on tracheal intubation. Mulholland and Carlisle [8] intubated the trachea of 22 of 30 patients after induction of anaesthesia with propofol 2.5 mg kg^{-1}.

There is little evidence for any neuromuscular blocking effects of propofol. Jacques and colleagues [9] found that propofol possessed poor neuromuscular blocking properties and could not recommend its use as a post-induction intubating agent.

In studies by Burnstein [10] on the effects of short acting barbiturates on the patency of the glottis, it was found that most of the animals studied would cough, sneeze or hiccup during the course of anaesthesia. Inspection of the glottis revealed adduction of the vocal cords. Burnstein also found, in cases where there was no spontaneous coughing, that inspection of the glottis showed hyperactive adducted vocal cords and lifting the epiglottis elicited complete closure of the vocal cords. After the introduction of thiopentone into human anaesthetic practice in 1934, several reports of laryngeal spasm as a complication of thiopentone anaesthesia began to appear [10]. In 1939, Ruth and colleagues [11] reviewed the first 5 years of the use of thiopentone and highlighted the occurrence of temporary closure of the glottis and the hyperactive state of the laryngeal reflex after induction of anaesthesia using thiopentone.

In a recent study, Brown, Patel and Ellis [12] compared propofol with thiopentone for laryngeal mask insertion and found that the former was more effective in producing satisfactory conditions for insertion of the mask and there was a lower incidence of gagging after insertion.

In this study we found that 28 of the 30 patients examined were able to tolerate the procedure; in all patients, arterial oxygen saturation exceeded 90% throughout the study. Patients were premedicated with an antisialagogue, as it was found in preliminary studies that it was necessary to prevent secretions obscuring the view through the fibrescope.

Syringe drop [6] was used to assess induction of anaesthesia, as the eyelash reflex is difficult to assess in the presence of involuntary movements such as those occurring during induction with propofol; this also avoids repeated stimulation of testing the eyelash reflex.

In summary, we found that the vocal cords adducted after induction of anaesthesia with propofol 2.5 mg kg^{-1} or with thiopentone 4.4 mg kg^{-1}. The vocal cords adducted to a greater extent after

induction of anaesthesia with thiopentone than with propofol. It is likely that this was caused by greater depressant effects of propofol on upper airway reflexes, and this may explain the low incidence of laryngospasm after induction of anaesthesia with propofol [13].

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