Tracheal tube and laryngeal mask cuff pressure during anaesthesia, a prospective quality-design-study.

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Abstract

Background: To prevent lesion of the endothelium or provoke nerve lesions, respectively, tracheal tube and laryngeal mask cuff pressures are to be maintained at a low level and still be high enough to minimize silent aspiration.

Method: In a prospective quality-design-study, 201 patients undergoing surgery during anaesthesia without the use of nitrous oxide, where included for determination of the cuff pressure of tracheal tubes and laryngeal masks.

Results: In the 119 patients provided with an endotracheal tube, the mean cuff pressure was 36 (range 8 – 100) cm H₂O and the pressure exceeded 30 cm H₂O (upper recommended level) for 54 patients and conversely, the cuff pressure was lower than 25 cm H₂O for 38 patients. In the 82 patients provided with a laryngeal mask, the mean cuff pressure was 87 (range 10 – 121) cm H₂O and it was above 60 cm H₂O (upper recommended level) for 56 patients and in 34 of these patients, the pressure exceeded the upper cuff gauge limit (120 cm H₂O). There was no association between cuff pressure and age, body mass index, type of surgery, or time from induction of anaesthesia to the cuff pressure was measured.

Conclusion: For maintenance of epithelia flow and prevention of nerve lesions with minimal risk of silent aspiration, this evaluation indicates that the cuff pressure needs to be checked as part of the procedures involved in induction of anaesthesia.
**Background**

Attention to the risk of iatrogenic complications of general anaesthesia due to high intracuff pressure of tracheal tube or laryngeal mask is mandatory. During general anaesthesia, pulmonary ventilation is secured with a tracheal tube or by a laryngeal mask. For a tracheal tube, it is recommended that the cuff pressure is maintained at 25 cmH$_2$O to avoid silent aspiration to the lungs along the laminar folds of the high volume/low pressure cuff [1, 2]. On the other hand, when the cuff to tracheal wall pressure exceeds the tracheal capillary pressure (27-40 cmH$_2$O) for approximately 15 min, the tracheal mucous membrane suffers from ischaemia [3]. The intracuff pressure approximates the cuff to tracheal wall pressures in high volume/low pressure cuffs [4] and a cuff pressure below 30 cmH$_2$O is recommended to prevent ischaemic injury [3, 5]. Recurrent laryngeal nerve palsy has been demonstrated in up to 5% of patients after intubation and a high cuff pressure is suspected to be important in that regard [6, 7]. Similarly in patients provided with a laryngeal mask, a high cuff pressure may lead to palsy of the lingual, hypoglossal, and recurrent laryngeal nerves [8-10] and with the laryngeal mask cuff pressure maintained below 60 cmH$_2$O the airway seal is optimized [11, 12] and the incidence of postoperative sore throat is low [13-15].

Here patients provided with either a tracheal tube or a laryngeal mask during elective surgery requiring general anaesthesia, were assessed for the established cuff pressure. We hypothesized that since high body mass index carries a risk of gastroesophageal reflux [16] and a high peak inspiratory pressure during mechanical ventilation [17], especially overweight patients would be exposed to a high cuff pressure.
**Materials and Methods**

We determined the cuff pressure in 201 randomly chosen patients, 110 women and 91 men (mean age 59 (range 18 – 93) years, mean body mass index 25 (Range 14 – 48) kg.(m\(^2\))\(^{-1}\)), while the airway was kept patent with an tracheal tube (high volume/low pressure; Unomedical, Copenhagen, Denmark; n=119) or a laryngeal mask (AuraOnce; Ambu A/S, Ballerup, Denmark; n=82) for mamma (n=49), gastrointestinal (n=33), gynaecological (n=11), orthopaedic (n=5), plastic (n=11), urological (n=71), hepatic (n=6), or vascular surgery (n=15). For induction of anaesthesia propofol or thiopental was administered guided by the weight of the patient and the administration was continued until the cilia reflex was eliminated. Anaesthesia was maintained with propofol, sevoflurane or desflurane and fentanyl or remifentanil was used for analgesia, while rocuronium or suxamethonium facilitated tracheal intubation. When anaesthesia was established and the tracheal tube or laryngeal mask was in place, the cuff pressure was determined 58 (range 2 – 360) min after induction of anaesthesia by a Universal cuff pressure gauge with an upper scale limit of 120 cmH\(_2\)O (VBM Medizintechnik GmbH, Baden-Württemberg, Germany). In case the cuff pressure was outside the recommended levels [1, 5, 14], the pressure was adjusted.

Data are presented as mean and range and a p-value < 0.05 was considered to be statistical significant. For correlations between cuff pressure and age, type of surgery, body mass index and time from induction of anaesthesia to determination of the cuff pressure, Spearman’s Rho was used.
Results

In the 119 patients provided with a tracheal tube during surgery, the mean cuff pressure was 36 (range 8 – 100) cmH₂O and it exceeded 30 cmH₂O for 54 patients. Conversely, a cuff pressure < 25 cmH₂O was recorded for 38 patients and thus for only 27 patients, the cuff pressure was within the recommended level. For the 82 patients provided with a laryngeal mask, the mean cuff pressure was 87 (range 10 – 121) cmH₂O reflecting that for 56 patients, the cuff pressure was higher than 60 cmH₂O and it exceeded the upper gauge limit for 34 patients. There was no significant relation between cuff pressure and age, body mass index, type of surgery, or the time from induction of anaesthesia to determination of the cuff pressure.
**Discussion**

In contrast to our suspicion, overweight patients were not more frequently exposed to a high cuff pressure than other patients, but even without the use of nitrous oxide for maintained anaesthesia, the cuff pressure exceeded the recommended levels for about half of the patients provided with a tracheal tube and for almost three quarters of those patients provided with a laryngeal mask. A low laryngeal mask cuff pressure secures the airway seal [11, 12] and reduces the incidence of postoperative sore throat [13]. It was therefore surprising to us that the majority of the patients were exposed to a high cuff pressure. We expected a high cuff pressure to be predominant in obese patients since high body mass index caries a risk of gastroesophageal reflux [16] and a high peak inspiratory pressure during mechanical ventilation [17].

The risk of aspiration increases when the tracheal tube cuff pressure is below 25 cmH₂O [1, 2] and together with the risk of tracheal mucous membrane ischemia at cuff pressures > 30 cmH₂O [3], there is left only a narrow window for a correct cuff pressure. Sengupta et al. found that in 93 patients provided with a tracheal tube and undergoing general anaesthesia only 27 % were having a cuff pressure within the recommended level of 20 – 30 cmH₂O [18]. The window of correct laryngeal mask cuff pressure is broader (< 60 cmH₂O) and it has been shown that estimation of the cuff pressure by palpation of the pilot balloon is possible after adequate training [19], but favouring the use of a cuff pressure gauge is the confirmation of correct cuff pressure in both tracheal tube and laryngeal mask, considering also the cost of this device is modest (~100 euro).

In conclusion this study suggests that attention to the cuff pressure is needed and cuff pressure should be checked as part of the procedures involved in induction of anaesthesia.
References