Should positive end-expiratory pressure be used during elective general anaesthesia with supraglottic airway devices?

Anaesthetists' use of positive end-expiratory pressure during elective general anaesthesia via supraglottic airway devices varies. Positive end-expiratory pressure may help to maintain oxygenation and prevent atelectasis, but could worsen the risk of air leak, gastric insufflation and catastrophic aspiration.

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Introduction

Supraglottic airway devices are used in over half of all general anaesthetics performed in the UK to maintain the airway (Cook et al, 2011). The benefits include ease of use, minimisation of airway instrumentation and avoidance of neuromuscular blockade. However, aspiration remains a potentially serious complication, despite second generation devices having design features intended to overcome this issue, including increased oesophageal seal and a gastric drainage tube (Cook et al, 2011).

Anaesthetists differ in their use of positive end-expiratory pressure during elective general anaesthetic via supraglottic airway devices. Positive end-expiratory pressure may help to maintain oxygenation and prevent atelectasis, but could worsen the risk of air leak, gastric insufflation and catastrophic aspiration. This article addresses this common anaesthetic dilemma.

Advantages of positive end-expiratory pressure

Uneventful general anaesthetic can lead to alveolar collapse in 10–15% of lung tissue (Ray et al, 2014). Positive end-expiratory pressure is applied to improve alveolar recruitment and lung compliance and increase functional residual capacity, as well as reduce alveolar collapse, lung atelectasis and ventilation–perfusion mismatch (Martin-Loeches and Artigas, 2016).

During general anaesthetic via supraglottic airway devices, low levels of positive end-expiratory pressure (5–8 cmH_2O) may improve oxygenation, particularly in patients with a high body mass index and in older patients in the lithotomy position.

The effect of positive end-expiratory pressure on lung recruitability can be shown via computed tomography (Ray et al, 2014). Positive end-expiratory pressure reduced atelectasis seen on computed tomography in anaesthesia with endotracheal tubes (Östberg et al, 2018). However, there is limited evidence for the effect of positive end-expiratory pressure via supraglottic airway devices on lung recruitability.

Disadvantages of positive end-expiratory pressure

Despite the physiological arguments for use of positive end-expiratory pressure during general anaesthetic, there is insufficient evidence that this reduces risks of postoperative pulmonary complications and mortality (Odor et al, 2020), although most trials included in this systematic review and meta-analysis looked at endotracheal tubes rather than supraglottic airway devices.

Positive end-expiratory pressure can reduce cardiac output by increasing intrathoracic pressure and reducing venous return. However, a positive end-expiratory pressure of $<10\ cmH_2O$ in patients who are not hypovolaemic is unlikely to cause significant haemodynamic instability (Martin-Loeches and Artigas, 2016), so this effect is usually negligible in patients undergoing elective general anaesthetic via supraglottic airway device.

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Intraoperative positive end-expiratory pressure was not associated with increased risk of cardiac complications in a systematic review (Barbosa et al, 2014).

Positive end-expiratory pressure can contribute to increased peak airway pressure, which can lead to pulmonary barotrauma. However, during elective general anaesthesia via supraglottic airway device, the peak airway pressure is unlikely to rise above $<30\,cmH_2O$, so barotrauma is unlikely to occur. A systematic review found no evidence of increased barotrauma associated with positive end-expiratory pressure (Barbosa et al, 2014).

Air leak is a potential risk with supraglottic airway devices, which could lead to hypoventilation or gastric insufflation. Positive end-expiratory pressure, even at low settings used with supraglottic airway devices in elective general anaesthetic, could worsen the air leak by increasing the mean and peak airway pressure. However, Kim et al (2013) found no difference in leak fraction with supraglottic airway devices when comparing positive end-expiratory pressure levels of 0 vs $5\,cmH_2O$, although there are limitations in this trial.

Aspiration during general anaesthetic was the most common cause of death in anaesthesia and a considerable number of cases occurred during general anaesthetic via supraglottic airway device (Cook et al, 2011). However, there is limited evidence as to whether positive end-expiratory pressure may increase the risk of aspiration. A poorly positioned supraglottic airway device with air leakage may increase gastric insufflation and increase the risk of regurgitation of gastric contents.

Conclusions

Low levels of positive end-expiratory pressure used during elective general anaesthetic via supraglottic airway device are likely to be safe in most patients. Benefits of positive end-expiratory pressure include improved oxygenation and reduced atelectasis, but there is insufficient evidence that positive end-expiratory pressure reduces the risk of postoperative pulmonary complications. Recommendations from 4th National Audit Project (NAP4) remain relevant when considering the use of positive end-expiratory pressure with supraglottic airway device. The use of positive end-expiratory pressure with supraglottic airway devices should be assessed on an individual basis, taking into account surgical, patient and anaesthetic factors.

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