

# Effectiveness of preoxygenation during endotracheal intubation in a head-elevated position: a systematic review and meta-analysis of randomized controlled trials

Samuel Ern Hung Tsan<sup>1</sup>, Navian Lee Viknaswaran<sup>2</sup>, Jiaying Lau<sup>2</sup>, Chao Chia Cheong<sup>2</sup>, Chew Yin Wang<sup>2</sup>

<sup>1</sup>University of Malaysia Sarawak (UNIMAS), Sarawak, Malaysia

<sup>2</sup>University of Malaya, Kuala Lumpur, Malaysia

## Abstract

Preoxygenation during endotracheal intubation is important to ensure the safety of the procedure. This systematic review and meta-analysis aimed to evaluate the efficacy of preoxygenation in the head-elevated position as compared to the supine position. The Medline, PubMed, Scopus, Embase, and CENTRAL databases were searched systematically from inception of the study until 29 June 2021. Only randomized controlled trials (RCTs) were included. The Cochrane Risk of Bias Assessment Tool and GRADE assessment of certainty of evidence were used. Seven RCTs ( $n = 508$ ) were analysed, of which 6 were included in the meta-analysis ( $n = 227$ ). Six studies were carried out in the operating theatre (OT), while one was performed in the critical care (ICU) setting. Compared to the supine position, the head-elevated position significantly increased the duration of the safe apnoea period (mean difference 61.99 s; 95% confidence interval 42.93–81.05 s;  $P < 0.00001$ ;  $I^2 = 30\%$ ; certainty of evidence = high). This improvement was seen in both the obese and non-obese population ( $I^2 = 0\%$ ). No differences were seen between both groups with regard to recovery time after apnoea, arterial oxygen tension after preoxygenation, and the incidence of adverse events. In the ICU setting, no difference was found between groups for the incidence of hypoxaemia and the lowest oxygen saturation between induction and after intubation. This meta-analysis demonstrated that the head-elevated position significantly improved the efficacy of preoxygenation during elective intubation in the OT. Clinicians should consider the head-elevated position as a starting intubating position for all patients undergoing anaesthesia in view of its many benefits and the lack of proven adverse consequences.

Protocol Registration: This systematic review was registered prospectively in PROSPERO (CRD42019128962).

**Key words:** preoxygenation, head-elevated, safe apnoea period.

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## CORRESPONDING AUTHOR:

Samuel Ern Hung Tsan, University of Malaysia Sarawak (UNIMAS), Sarawak, Malaysia, e-mail: [tehsamuel@unimas.my](mailto:tehsamuel@unimas.my)

During endotracheal intubation (ETI), a difficult airway is a challenging scenario, with the potential to result in hypoxaemia, causing catastrophic consequences for both the patient and the clinicians involved. Preoxygenation before ETI is therefore of paramount importance because it serves to increase the amount of oxygen reserve in the body. This prolongs the buffer time before hypoxaemia occurs, allowing patients to tolerate a longer duration of apnoea. The clinicians in a crisis situation such as this would have a larger margin of safety, allowing them time to think and to act in securing access to the patient's airway, thus potentially saving the patient's life [1, 2]. The importance of preoxygenation is such that today it is an essential part of the arsenal available to clinicians performing ETI, and it has

been incorporated into many airway management guidelines [3, 4].

The head-elevated position has been recommended to be the optimal position for preoxygenation before ETI [1, 2]. Multiple studies have shown that this position increases the effectiveness of preoxygenation in patients undergoing general anaesthesia by prolonging the safe apnoea period (SAP), defined as the duration of apnoea before hypoxia sets in [5–9]. However, a study by Semler *et al.* [10] disputed this when they found that in critically ill patients, the ramping position did not improve oxygenation during ETI, as compared to the supine sniffing position.

Currently, although the head-elevated position is widely accepted as a method to improve preoxygenation, there is no systematic review or