HYPOXAEMIA
Supporting information

This guideline has been produced with reference to the following:

O'Driscoll BR, Howard LS, EarisJ et al. BTS guideline for oxygen use in adults in healthcare and emergency settings. Thorax 2017;72:i1-i90

https://www.brit-thoracic.org.uk/document-library/guidelines/emergency-oxygen/bts-guideline-for-oxygen-use-in-adults-in-healthcare-and-emergency-settings/

What is the evidence for the postoperative application of CPAP to patients with COPD having major surgery?
Patients with COPD have a 2.7-4.7-fold increased risk of postoperative pulmonary complications (Trayner, 2001).
A study of 65 patients after upper abdominal surgery (Stock, 1985) found that nasal CPAP improved functional residual capacity more than deep breathing or incentive spirometry, but did not improve the incidence of radiographic or clinical complications more than the other two treatments.
A prospective study of 72 patients treated with NPPV after abdominal surgery (Jaber, 2005) found that 48 (67%) were able to avoid intubation as a result of the treatment.

Jaber S, Delay JM, Chanques G, et al. Outcomes of patients with acute respiratory failure after abdominal surgery treated with noninvasive positive pressure ventilation. Chest 2005;128:2688-95
http://journal.publications.chestnet.org/article.aspx?articleid=1083894

Stock MC, Downs JB, Gauer PK, et al. Prevention of postoperative pulmonary complications with CPAP, incentive spirometry, and conservative therapy. Chest 1985;87:151-7
http://journal.publications.chestnet.org/data/Journals/CHEST/21454/151.pdf

Trayner E, Celli BR. Postoperative pulmonary complications. Med Clin North Am 2001;85:1129-39

Evidence Level: IV

What is the evidence for CPAP in surgical patients with sleep apnoea?
A 2021 review suggests that CPAP reduces apnoea and hypopnea frequency and related hypoxemia after surgery (Fagerlund, 2021). This review identified four trials investigating the effect of CPAP on a total of 398 patients with a polysomnographic diagnosis or a high suspicion of obstructive sleep apnoea (OSA). All patients with OSA were newly diagnosed preoperatively, and they were naive to CPAP before the trials. Two trials reported a reduction in the apnea-hypopnea index (AHI) using auto-CPAP, while one of them also reported that oxygen saturation improved, with a reduction in the oxygen-desaturation index. One trial reported that lung function (forced vital capacity) was better if Boussignac CPAP was initiated immediately after surgery in the operating theatre versus half an hour later in the postanesthesia care unit. Auto-CPAP had no effect on postoperative delirium or hospital length of stay. Compliance with auto-CPAP was generally low after surgery in all 3 studies using auto-CPAP. Problems using CPAP included generalized discomfort, nausea, and vomiting after surgery. Many patients regarded CPAP as uncomfortable or intolerable.
The American Society of Anesthesiologists (ASA) guidelines suggest sleep apnoea investigations before surgery in patients at risk, followed by the treatment to reduce postoperative morbidity and mortality (ASA, 2014). Moreover, the Society of Anesthesia and Sleep Medicine (SASM) guidelines published in 2016 recommend that sleep apnoea patients on CPAP should continue with treatment both preoperatively and postoperatively. CPAP use should be considered case by case in suspected but previously undiagnosed obstructive sleep apnoea (Chung, 2016).

American Society of Anesthesiologists Task Force on Perioperative Management of patients with obstructive sleep apnea. Practice guidelines for the perioperative management of patients with obstructive sleep apnea: an updated report by the American Society of Anesthesiologists Task Force on perioperative management of patients with obstructive sleep apnea. Anesthesiology. 2014;120:2686
https://pubs.asahq.org/anesthesiology/article/120/2/268/11781/Practice-Guidelines-for-the-Perioperative

Chung F, Memtsoudis SG, Ramachandran SK, et al. Society of anesthesia and sleep medicine guidelines on preoperative screening and assessment of adult patients with obstructive sleep apnea. Anesth Analg. 2016;123:452–43

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https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4956681/

Fagerlund MJ & Franklin KA. Perioperative Continuous Positive Airway Pressure Therapy: A Review With the Emphasis on Randomized Controlled Trials and Obstructive Sleep Apnea. Anesth Analg. 2021;132:1306-13

Evidence Level: IV

Does skin colour effect pulse oximeter readings?

Several studies have demonstrated that pulse oximeters overestimate oxygen saturation in patients with darker skin colour. The largest and most recent study is from the USA and involved 1609 inpatients who were receiving supplemental oxygen or intensive care (Sjoding, 2020). All patients had their pulse oximetry measure of oxygen saturation and measures of oxygen saturation in arterial blood gas taken within 10 minutes of each other. The authors tested for "occult hypoxaemia" (i.e. arterial oxygen saturation of less than 88% despite an oxygen saturation of 92% to 96% on pulse oximetry). In white patients, occult hypoxaemia was found in 3.6% (95% confidence interval [CI] 2.7 to 4.7) of paired measurements, however in dark skinned patients the corresponding numbers where 11.7% (95% CI 8.5 to 16.0). Hence black patients were nearly three times more likely to suffer from hypoxaemia that was not detected by pulse oximetry as were white patients. These results are consistent with older and smaller studies by Feiner et al. in 36 patients (2009), Bickler et al. in 21 patients (2005) and Jubran et al. in 54 patients (1990). Two studies by Addler et al. in 284 patients (1998) and Bothma et al. in 100 patients (1996) however found no evidence that skin colour had an effect on the accuracy of pulse oximetry.

Adler JN, Hughes LA, Vivilecchia R et al. Effect of skin pigmentation on pulse oximetry accuracy in the emergency department. Academic emergency medicine. 1998; 5: 965-70
https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1553-2712.1998.tb02772.x?sid=nlm%3Apubmed

Bickler PE, Feiner JR & Severinghaus JW. Effects of skin pigmentation on pulse oximeter accuracy at low saturation. Anesthesiology; 2005; 102: 715-9
https://pubs.asahq.org/anesthesiology/article/102/4/715/7364/Effects-of-Skin-Pigmentation-on-Pulse-Oximeter

Bothma PA, Joynt GM, Lipman JH et al. Accuracy of pulse oximetry in pigmented patients. South African medical journal. 1996; 86: 594-6

Feiner JR, Severinghaus JW & Bickler PE. Dark skin decreases the accuracy of pulse oximeters at low oxygen saturation: the effects of oximeter probe type and gender. Anesthesia and analgesia. 2007; 105:18-23

Jubran A & Tobin MJ. Reliability of pulse oximetry in titrating supplemental oxygen therapy in ventilator-dependent patients. Chest; 1990; 97; 1420-5

Sjoding MW, Dickson RP, Iwashyna TJ et al. Racial Bias in Pulse Oximetry Measurement. The New England journal of medicine. 2020; 383: 2477-8
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7808260/

Evidence level: II

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