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Effect of high-flow nasal oxygen on hypoxaemia during procedural sedation: a systematic review and meta-analysis.

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Aim

The aim of this systematic review and meta-analysis was to evaluate the efficacy of High Flow Nasal Oxygen (HFNO) for the reduction of hypoxaemia in adults and children undergoing sedation for various procedures, when compared with conventional oxygen delivery.

Methods

MEDLINE, EMBASE and CINAHL databases were searched for randomised controlled trials published to 31 December 2021 that compared HFNO with any single or combined conventional oxygen delivery, in patients of any age undergoing an elective procedure with sedation.

The reference lists of trials selected for appraisal were also screened for additional trials. Google Scholar, the PROSPERO registry and the International Trials Registry Platform of the World Health Organization were used to identify any relevant grey literature and unpublished trials. The methodological quality of included trials was assessed using the Cochrane Collaboration's new version risk of bias 2 tool, and certainty of evidence was categorised using the GRADE framework.

The primary outcome was the incidence of hypoxaemia during procedural sedation. Secondary outcomes were minimum oxygen saturation (SpO₂) during the procedure, hypercarbia, requirement for minor airway manoeuvres (chin lift/jaw thrust or insertion of oral/nasopharyngeal airway), and procedural interruptions. Definitions of hypoxaemia and hypercarbia followed those used in the included trials.

Results

Nineteen randomised controlled trials published between 2015 and 2021, with sample sizes ranging from 30 to 1994 patients (total sample size = 4121; HFNO = 2059; conventional oxygen = 2062), were included in the meta-analysis. Eight trials involved gastrointestinal procedures, with the remaining comprising bronchoscopy (n = 5), cardiology (n = 3), dental (n = 2) and endovascular (n = 1) procedures. Five trials enrolled patients at risk of hypoxaemia, and three trials studied children.

For HFNO, oxygen flow rate ranged from 30-70 L/min in adults, while a weight-based rate was used in children. Fraction of inspired oxygen (FiO₂) for HFNO was set at 1.0 in nine trials, <1.0 in nine trials, and was not reported in one trial. Conventional oxygen was delivered via a low-flow nasal cannula at 1-10 L/min in 14 trials, simple facemask at ≥5 L/min in two trials, bite block oxygen insufflation at 10-15 L/min in one trial, and a combination of low-flow nasal oxygen and bite block oxygen insufflation in one trial. In the last trial, mode of conventional oxygen delivery was left to the discretion of the participating centre, and consisted of standard nasal cannulae, facemask or nasopharyngeal catheters.

Sedation regimens included various combinations of propofol, fentanyl, alfentanil, remifentanyl, midazolam, ketamine and phencyclidine. Sixteen trials used a propofol-based sedation regimen, including target-controlled infusion or weight-based manual infusion in nine trials and an intermittent bolus approach in seven trials.

Pooled results from 17 trials, including three in children, revealed a significantly lower risk of hypoxaemia with HFNO compared with conventional oxygen (relative risk [RR] 0.37; 95% confidence interval [CI] 0.24-0.56; p <0.001; risk reduction 63%). HFNO was superior to conventional oxygen for this outcome regardless of the procedure involved, FiO₂ level, risk profile of patients and mode of propofol administration.

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Pooled results from 10 trials, including two in children, found a significantly higher minimum SpO₂ value (mean difference 4.10; 95% CI 2.70-5.50; p <0.001) with HFNO vs conventional oxygen. Results from another group of 10 trials, also including two in children, found a significantly reduced need for minor airway manoeuvres (RR 0.26; 95% CI 0.11-0.59; p<0.001) with HFNO vs conventional oxygen. Results from six trials, including one in children, revealed a significant reduction in procedure interruptions (RR 0.17; 95% CI 0.05-0.53; p=0.002) with HFNO versus conventional oxygen, while results from two trials found no significant difference between groups for risk of hypercarbia (RR 1.24; 95% CI 0.97-1.58; p=0.09).

GRADE evidence was considered moderate for all outcomes except for procedure interruptions, for which evidence was considered low.

Conclusion

There is moderate quality evidence that HFNO reduces the incidence of hypoxaemia, increases minimum SpO₂ and reduces the requirement for minor airway manoeuvres during procedural sedation when compared with conventional oxygen delivery. A low quality of evidence suggests that HFNO also reduces procedural interruptions compared with conventional oxygen.

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