High-flow nasal oxygenation during induction of general anaesthesia in obstetric patients: a systematic review

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Background & Aims

Pre-induction oxygenation (PO2) to achieve an end-tidal oxygen concentration (ETO2) of ≥90% is recommended in preparation for Rapid Sequence Induction. This is typically performed by completing 3 minutes of tidal volume breathing or 8 vital capacity breaths using a tight-fitting facemask.

Pregnancy-related physiological changes predispose to a much faster rate of desaturation and PO2 is therefore of particular significance in the obstetric population. However, PO2 is often poorly performed in practice due to various factors, including time pressures and issues relating to human factors.

High-flow nasal oxygen (HFNO) **[Figure 1]** has well-established benefits in non-obstetric patients, and it has been shown to prolong apneic oxygenation during intubation attempts. Therefore, it potentially has important practical applications in obstetric patients.

As there are no systematic reviews to date on the use of HFNO in the obstetric population, our aim was to conduct a systematic literature review to further evaluate the currently available evidence.



Figure 1. Typical HFNO setup [From Cooper, J *et al*.; APSF newsletter, Oct 2018]

Methods

A comprehensive systematic search was performed for literature relevant to HFNO, general anaesthesia, and obstetrics using preferred reporting items for systematic review and meta-analysis protocols (PRISMA) recommendations. Medline, Embase, and Cochrane databases were searched to identify all randomised clinical trials (RCTs), observational studies, and meta-analyses published between 1990 and 2021. Risk of bias and overall evidence quality were evaluated using GRADE criteria.

Results

We identified a total of 5 relevant studies – 3 RCTs and 2 observational studies (247 patients in total) – which investigated the use of HFNO in obstetrics **[Table 1]**. Outcomes and interventions were too heterogenous for a meta-analysis to be undertaken, and a narrative review was performed instead.

Pre-induction oxygenation

Compared with HFNO, the use of standard face mask (FM) for PO2 was superior with a higher percentage of patients achieving ETO2 >90% at 3 mins **[1,2]**. One study had to be terminated early because even after 20 vital capacity breaths, FM ventilation remained superior **[3]**. An RCT found that after 8 mins of HFNO, 92% of patients were unable to achieve ETO2 >90% compared with 3.6 mins when using a standard FM **[4]**.

Apneic oxygenation

In contrast, one RCT measured PaO2 and ETO2 immediately after tracheal intubation as the primary outcome and this showed both a significantly higher PaO2 and ETO2 in the HFNO group (59 ± 6 kPa versus 43 ± 10 mmHg; $p < 0.0001$) **[5]**.

Intervention: high-flow nasal oxygen (HFNO)
Comparator: standard face mask (FM)

	Outcomes (Primary 1 and Secondary 2)	No. of participants	Quality of evidence (GRADE)
1. Shippam *et al.*, 2019	1. ETO2 after pre-O2 2. Proportion of patients achieving ETO2 >90%	40	Moderate
2. Tan *et al.*, 2019	1. Proportion who achieved ETO2 >90% 2. Proportion who achieved ETO2 >80%; FHR before and after test; comfort levels of HFNO/FM	73	Moderate
3. Al-Sulttan *et al.*, 2020	1. Number of VC breaths required using HFNO to achieve EN90 2. Assessment of EN90 using mouth open vs closed; maternal satisfaction	20	Moderate
4. Au *et al.*, 2020	1. Time for 90% of patients to achieve ETO2 >90% 2. Proportion of patients achieving ETO2 >90%; tolerability of both pre-O2 techniques	80	Moderate
5. Zhou *et al.*, 2021	1. PaO2 after intubation 2. Lowest saturations throughout intubation procedure; ETO2 on commencing ventilation	34	Low

Table 1. Key details of studies comparing the use of HFNO with standard face mask technique in obstetric patients identified from this systematic review. [To assess the full journal articles, please scan the corresponding QR code.]

Discussion

Moderate-quality evidence shows that HFNO is not superior to standard FM technique for PO2 of obstetric patients undergoing GA. However, low-quality evidence demonstrates that HFNO may prevent arterial oxygen desaturation in obstetric patients as a result of apneic oxygenation. It has been proposed that the poor efficacy of HFNO is due to difficulty for patients breathing with their mouths closed, resulting in air entrainment and reduction in the delivery of continuous positive airway pressure. Gastric insufflation may also occur, which results in inadequate denitrogenation.

Limitations

The studies identified had all been performed on healthy parturients rather than high-risk patients, who are likely to benefit most from HFNO. The practical constraints of using HFNO in an emergency setting was also not examined. Additionally, we were not able to explore the ethical considerations surrounding oxygen desaturation in this patient population. These limitations, along with the lack of a meta-analysis, meant that a definitive conclusion cannot be drawn.

Conclusion

Decision to use HFNO should be individualised; it may be beneficial in certain high-risk obstetric patients and should be considered in those with high BMI or a difficult airway. However, further study investigating the effectiveness and harms of HFNO is necessary.