

High-Flow Nasal Oxygen for Preoxygenation

Intraoperative teaching · CA-1

THE QUESTION

Where the evidence disagrees

This topic was selected because an evidence synthesis beats a textbook on it: the trials disagree, or the guidance has moved recently.

THE EVIDENCE

What each source contributes, and how strong it is

Study design first — a cohort and a randomised trial do not carry the same weight.

Design	Year	Journal	What it found
Meta-analysis	2023	Anesthesia and analgesia	In obese patients high-flow nasal cannula lengthened safe apnoea time and was more
Meta-analysis	2022	Medicine	High-flow nasal oxygen achieved a higher PaO ₂ and about 131 seconds more safe apnoea
Review	2026	critical care & pain medicine	HFNO prolongs safe apnoea time and decreases desaturation incidence compared to
Randomised trial	2023	British journal of anaesthesia	Median apnoea time in morbidly obese patients reached 18 minutes with either
Review	2026	British journal of anaesthesia	High-flow nasal oxygen does not clear carbon dioxide
Randomised trial	2019	EClinicalMedicine	Compared with non-invasive ventilation, preoxygenating obese patients with high-flow

6 resolved citations behind this deck; every point above traces to one of them.

WHERE THE GUIDANCE SITS

What the guidelines and pooled evidence say

2 findings, each on the slide that follows.

ANESTHESIA AND ANALGESIA 2023

In obese patients high-flow nasal cannula lengthened safe apnoea time and was more

In obese patients high-flow nasal cannula lengthened safe apnoea time and was more comfortable

MEDICINE 2022

High-flow nasal oxygen achieved a higher PaO₂ and about 131 seconds more safe apnoea

High-flow nasal oxygen achieved a higher PaO₂ and about 131 seconds more safe apnoea time than facemask, without reducing desaturation during...

WHERE THE GUIDANCE SITS

In obese patients high-flow nasal cannula lengthened safe apnoea time and was more

Meta-analysis · Anesthesia and analgesia

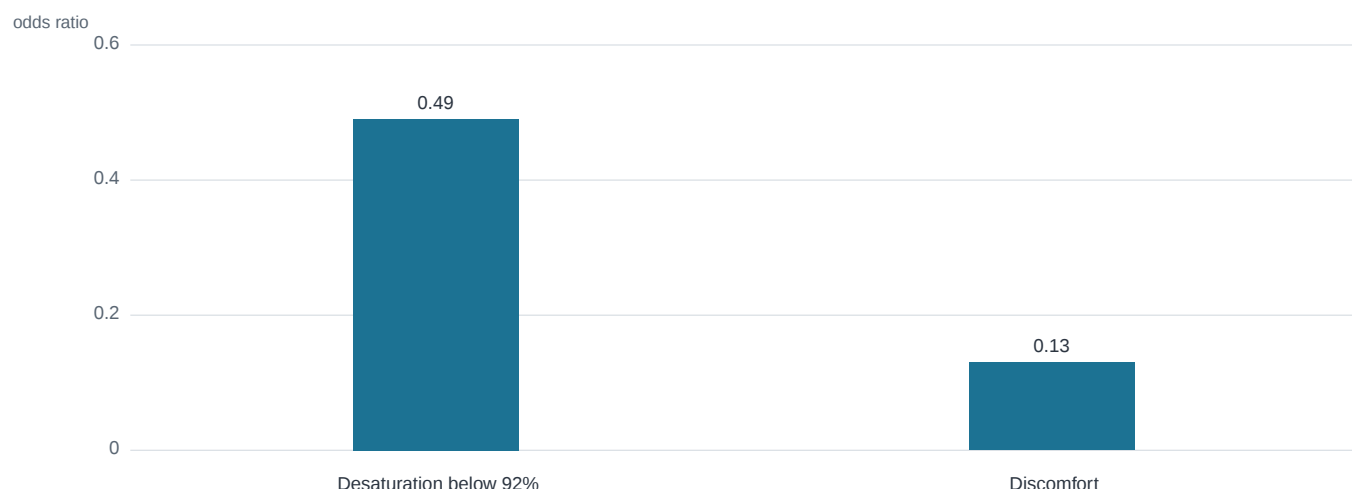
In obese patients high-flow nasal cannula lengthened safe apnoea time and was more comfortable, but did not reduce the odds of desaturating below 92% — it buys time rather than removing the risk.

High-Flow Nasal Cannula for Apneic Oxygenation in Obese Patients for Elective Surgery: A Systematic Review and Meta-Analysis, Anesthesia and analgesia 2023 · PMID 36469483

THE NUMBERS

It lengthens apnoea time without removing the risk

Obese patients, six trials pooled.



The desaturation difference did not reach significance — it buys time, it does not remove the problem.

High-Flow Nasal Cannula for Apneic Oxygenation in Obese Patients for Elective Surgery: A Systematic Review and Meta-Analysis, Anesthesia and analgesia 2023 · PMID 36469483

WHERE THE GUIDANCE SITS

High-flow nasal oxygen achieved a higher PaO₂ and about 131 seconds more safe apnoea

Meta-analysis · Medicine

High-flow nasal oxygen achieved a higher PaO₂ and about 131 seconds more safe apnoea time than facemask, without reducing desaturation during intubation.

A Comparison of High-Flow Nasal Cannula and Standard Facemask as Pre-Oxygenation Technique for General Anesthesia: A PRISMA-compliant Systemic Review and Meta-Analysis, Medicine 2022 · PMID 35451383

WHAT THE TRIALS FOUND

Where randomised evidence moved the question

2 findings, each on the slide that follows.

BRITISH JOURNAL OF ANAESTHESIA 2023

Median apnoea time in morbidly obese patients reached 18 minutes with either

Median apnoea time in morbidly obese patients reached 18 minutes with either high-flow nasal or low-flow facemask oxygen

ECLINICALMEDICINE 2019

Compared with non-invasive ventilation, preoxygenating obese patients with high-flow

Compared with non-invasive ventilation, preoxygenating obese patients with high-flow nasal cannula gave a lower end-tidal oxygen and more...

WHAT THE TRIALS FOUND

Median apnoea time in morbidly obese patients reached 18 minutes with either

Randomised trial · British journal of anaesthesia

Median apnoea time in morbidly obese patients reached 18 minutes with either high-flow nasal or low-flow facemask oxygen, but desaturation below 92% was less likely with high flow (hazard ratio 0.27).

Apnoeic Oxygenation in Morbid Obesity: A Randomised Controlled Trial Comparing Facemask and High-Flow Nasal Oxygen Delivery, British journal of anaesthesia 2023 · PMID 35027169

WHAT THE TRIALS FOUND

Compared with non-invasive ventilation, preoxygenating obese patients with high-flow

Randomised trial · EClinicalMedicine

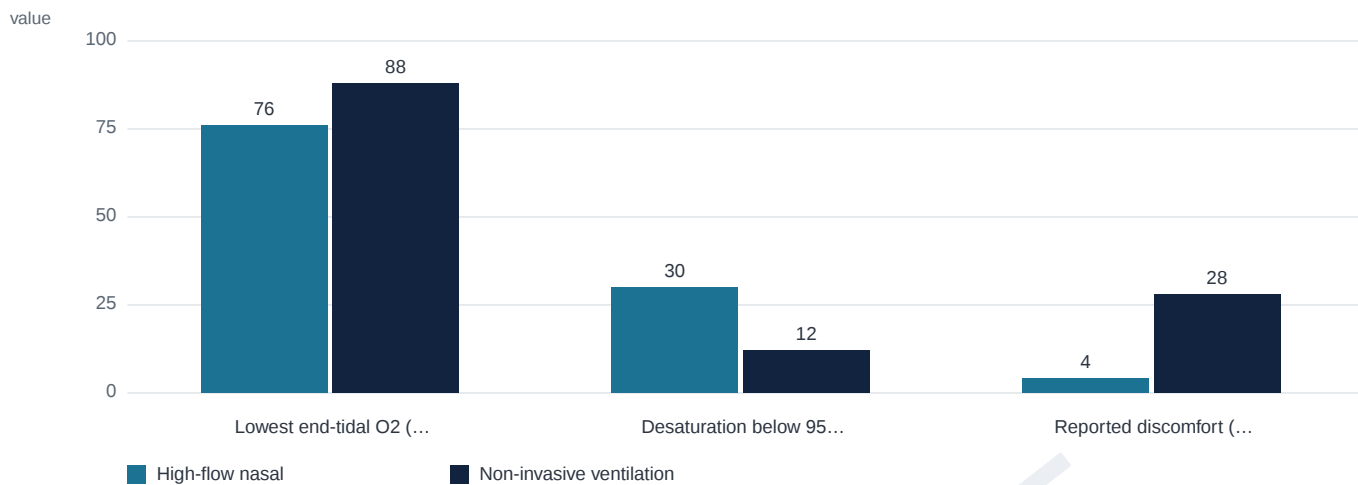
Compared with non-invasive ventilation, preoxygenating obese patients with high-flow nasal cannula gave a lower end-tidal oxygen and more desaturation below 95% (30% versus 12%), although patients found it far more comfortable.

High-Flow Nasal Cannulae Versus Non-Invasive Ventilation for Preoxygenation of Obese Patients: The PREOPTIPOP Randomized Trial, EClinicalMedicine 2019 · PMID 31528849

THE NUMBERS

Against non-invasive ventilation, high flow came off worse

PREOPTIPOP, 100 obese patients.



Better tolerated, but worse preoxygenation — comfort and effectiveness point in opposite directions here.

High-Flow Nasal Cannulae Versus Non-Invasive Ventilation for Preoxygenation of Obese Patients: The PREOPTIPOP Randomized Trial, *EClinicalMedicine* 2019 · PMID 31528849

IN PRACTICE

What the cohorts and reviews add

2 findings, each on the slide that follows.

CRITICAL CARE & PAIN MEDICINE 2026

HFNO prolongs safe apnoea time and decreases desaturation incidence compared to

HFNO prolongs safe apnoea time and decreases desaturation incidence compared to conventional oxygen therapy, especially in high-risk patients like...

BRITISH JOURNAL OF ANAESTHESIA 2026

High-flow nasal oxygen does not clear carbon dioxide

High-flow nasal oxygen does not clear carbon dioxide: arterial CO₂ accumulates across a wide range of flow rates, so treat it as apnoeic oxygenation...

IN PRACTICE

HFNO prolongs safe apnoea time and decreases desaturation incidence compared to

Review · critical care & pain medicine

HFNO prolongs safe apnoea time and decreases desaturation incidence compared to conventional oxygen therapy, especially in high-risk patients like obese or cardiothoracic surgical patients.

High-Flow Nasal Oxygen in the Perioperative Setting: A Narrative Review, *Anaesthesia, critical care & pain medicine* 2026 · PMID 41903885

IN PRACTICE

High-flow nasal oxygen does not clear carbon dioxide

Review · British journal of anaesthesia

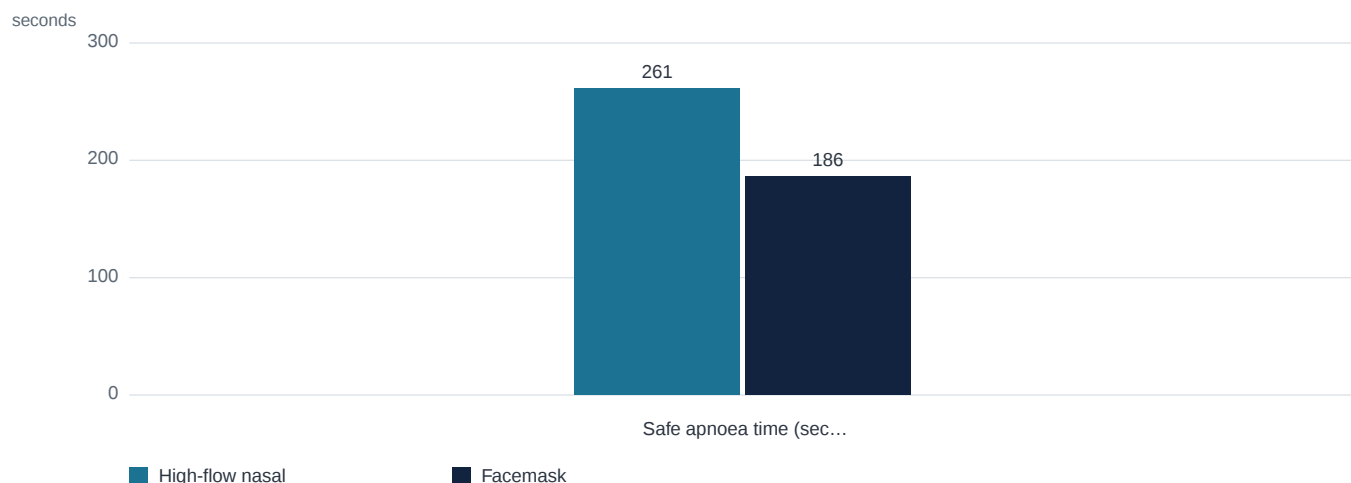
High-flow nasal oxygen does not clear carbon dioxide: arterial CO₂ accumulates across a wide range of flow rates, so treat it as apnoeic oxygenation and monitor CO₂ rather than assuming ventilation.

High-Flow Nasal Oxygenation, Not Ventilation: Time to Stop Holding Our Breath, *British journal of anaesthesia* 2026 · PMID 41402219

THE NUMBERS

High-flow nasal oxygen extended safe apnoea time

Morbidly obese patients, safe apnoea time to SpO₂ 95%.



About 76 seconds more, a 40% longer margin before desaturation, in exactly the patients who have least to spare.

INDICATIONS

When this is the right block

PREOXYGENATION STRATEGIES NETWORK META-ANALYSIS, BR J ANAESTH 2024

Prolonging safe apnoea time before induction

In a network meta-analysis of 52 studies and 3914 patients, high-flow nasal oxygen with the patient head-up was the technique most likely to prolong safe apnoea time, by a mean of 291 seconds (95% credible interval 138 to 456) against a supine facemask and 203 seconds against a head-up facemask.

THRIVE, ANAESTHESIA 2015

Difficult airways where the apnoeic window is the whole problem

In 25 patients with difficult airways undergoing hypopharyngeal or laryngotracheal surgery, transnasal humidified rapid-insufflation ventilatory exchange gave a median apnoea time of 14 minutes (range 5 to 65) with no patient desaturating below 90%.

HFNC FOR APNOEIC OXYGENATION IN OBESE PATIENTS META-ANALYSIS, ANESTH ANALG 2023

Obese patients for elective surgery, with realistic expectations

Across six studies in 351 obese patients, high-flow nasal cannula gave a significantly longer safe apnoea time than facemask preoxygenation (mean difference 124 seconds) and lower odds of discomfort (OR 0.13), but there was no difference in the odds of desaturation below 92% (OR 0.49, 95% CI 0.15 to 1.63) on low-certainty evidence.

CONTRAINDICATIONS

When it is not

THRIVE, ANAESTHESIA 2015

Treating apnoeic oxygenation as ventilation

During THRIVE, end-tidal carbon dioxide rose at 0.15 kPa per minute and post-apnoea levels reached a mean of 7.8 kPa with a maximum of 15.3 kPa. Oxygenation buys time; it does not clear carbon dioxide, and the clock is running the whole time.

PREOXI TRIAL, NONINVASIVE VENTILATION FOR PREOXYGENATION, N ENGL J MED 2024

Choosing it over noninvasive ventilation in the hypoxaemic critically ill

In the PREOXI trial of 1301 critically ill adults, preoxygenation with noninvasive ventilation produced hypoxaemia in 9.1% versus 18.5% with an oxygen mask, and cardiac arrest in 0.2% versus 1.1%, with no increase in aspiration. In that population the randomised evidence sits with positive pressure.

HFNC FOR APNOEIC OXYGENATION IN OBESE PATIENTS META-ANALYSIS, ANESTH ANALG 2023

Reading longer apnoea time as prevented desaturation

In obese elective surgical patients, high-flow nasal cannula did not significantly change the odds of desaturation below 92%, the lowest arterial oxygen content, or the lowest peripheral saturation before intubation, despite extending the safe apnoea window.

Assuming it wins on every endpoint

In the same network meta-analysis that ranked high-flow nasal oxygen first for safe apnoea time, arterial desaturation was less likely to occur when a facemask with pressure support was used than with the other techniques studied. The strategy that maximises the apnoeic window is not automatically the one that minimises every risk.

PEARLS

What experience adds

PREOXYGENATION STRATEGIES NETWORK META-ANALYSIS, BR J ANAESTH 2024

Head-up is part of the intervention

The technique that ranked highest for prolonged safe apnoea time was high-flow nasal oxygen with the patient in the head-up position, and it held that rank in the subgroup of studies that used no apnoeic oxygenation at all.

THRIVE, ANAESTHESIA 2015

It only works through an open airway

In the original THRIVE series, upper airway patency was maintained with jaw thrust throughout the apnoeic period, and the mechanism proposed was flow-dependent deadspace flushing with continuous positive airway pressure — all of which requires a patent passage from nose to trachea.

Start the flow before the patient lies down

Get the cannula on and running while they are still sitting up and talking, and do not let anyone swap it for a facemask at induction. Treating the two as sequential steps throws away the part of the technique that was doing the work.

IN THE ROOM

What this changes about the next case

Colour is the strength of the evidence behind each step, not the urgency.

- 1 In obese patients high-flow nasal cannula lengthened safe apnoea time and was more comfortable, but did not reduce the odds of desaturating below 92% — it buys time rather than removing the risk.
- 2 High-flow nasal oxygen achieved a higher PaO₂ and about 131 seconds more safe apnoea time than facemask, without reducing desaturation during intubation.
- 3 Median apnoea time in morbidly obese patients reached 18 minutes with either high-flow nasal or low-flow facemask oxygen, but desaturation below 92% was less likely with high flow (hazard ratio 0.27).
- 4 Compared with non-invasive ventilation, preoxygenating obese patients with high-flow nasal cannula gave a lower end-tidal oxygen and more desaturation below 95% (30% versus 12%), although patients found it far more comfortable.
- 5 HFNO prolongs safe apnoea time and decreases desaturation incidence compared to conventional oxygen therapy, especially in high-risk patients like obese or cardiothoracic surgical patients.

KEY TAKEAWAYS

What to carry into the next case

In obese patients high-flow nasal cannula lengthened safe apnoea time and was more

Anesthesia and analgesia 2023

High-flow nasal oxygen achieved a higher PaO₂ and about 131 seconds more safe apnoea

Medicine 2022

HFNO prolongs safe apnoea time and decreases desaturation incidence compared to

critical care & pain medicine 2026

Median apnoea time in morbidly obese patients reached 18 minutes with either

British journal of anaesthesia 2023

In obese patients high-flow nasal cannula lengthened safe apnoea time and was more

QUESTIONS I'LL ASK YOU IN THE ROOM

1. Walk me through your setup for this before we start.
2. What are you watching on the monitor that would tell you this is going wrong?

3. What is your first move if it does?
4. What would you want ready in the room before induction?

ORAL BOARDS STEM

A 47-year-old with a BMI of 45 and a short neck is scheduled for laparoscopic cholecystectomy. You anticipate a short safe apnoea time and the resident asks how best to preoxygenate.

BOARD QUESTIONS

1. A colleague states that high-flow nasal oxygen "ventilates" an apnoeic patient. In one or two sentences, say what high-flow nasal oxygen does and does not do to arterial CO₂ during apnoea, and what that means for how you monitor the patient.
2. A systematic review and meta-analysis compared high-flow nasal cannula with standard preoxygenation in obese patients having elective surgery. Name the two outcomes that favoured high-flow nasal cannula, name the outcome that did not improve, and state in one sentence what that pattern means for how you use the technique.
3. A randomised trial compared high-flow nasal cannula with non-invasive ventilation for preoxygenating obese patients. Describe how the two techniques compared on end-tidal oxygen, on desaturation below 95%, and on patient comfort, and say which technique the oxygenation endpoints favoured.
4. A meta-analysis reports that high-flow nasal oxygen achieved a higher PaO₂ and about 131 seconds more safe apnoea time than facemask preoxygenation. A resident concludes that high-flow nasal oxygen therefore prevents desaturation during intubation. State whether the cited result supports that conclusion, and explain what the data did and did not show.

ANSWER KEY

1. It does not clear carbon dioxide. Arterial CO₂ accumulates across a wide range of flow rates, so treat high-flow nasal oxygen as apnoeic oxygenation and monitor CO₂ rather than assuming the patient is being ventilated.

Call it apnoeic oxygenation, not ventilation - the oxygen buys you time while the CO₂ keeps climbing.

High-Flow Nasal Oxygenation, Not Ventilation: Time to Stop Holding Our Breath, British journal of anaesthesia 2026 · PMID 41402219

2. Safe apnoea time was longer and patients found it more comfortable, but the odds of desaturating below 92% were not reduced. In this pooled analysis high-flow nasal cannula buys time rather than removing the risk of desaturation.

The extra apnoeic time is real, but in this meta-analysis it did not translate into fewer desaturations below 92% - plan as though the patient can still desaturate.

High-Flow Nasal Cannula for Apneic Oxygenation in Obese Patients for Elective Surgery: A Systematic Review and Meta-Analysis, Anesthesia and analgesia 2023 · PMID 36469483

3. High-flow nasal cannula gave a lower end-tidal oxygen and more desaturation below 95% than non-invasive ventilation (30% versus 12%), although patients found high-flow far more comfortable. The oxygenation endpoints favoured non-invasive ventilation in this trial.

Comfort and oxygenation can point in opposite directions - in this trial the more comfortable technique was the one that desaturated more often.

High-Flow Nasal Cannulae Versus Non-Invasive Ventilation for Preoxygenation of Obese Patients: The PREOPTIPOP Randomized Trial, EClinicalMedicine 2019 · PMID 31528849

4. It does not support it. The pooled data showed a higher PaO₂ and about 131 seconds more safe apnoea time, but no reduction in desaturation during intubation - the oxygenation and time endpoints improved while the desaturation endpoint did not.

A better surrogate - PaO₂, seconds of apnoea - is not the same as fewer desaturations, and here the two came apart.

A Comparison of High-Flow Nasal Cannula and Standard Facemask as Pre-Oxygenation Technique for General Anesthesia: A PRISMA-compliant Systemic Review and Meta-Analysis, Medicine 2022 · PMID 35451383

In obese patients high-flow nasal cannula lengthened safe apnoea time and was more

SOURCES

- [1] High-Flow Nasal Cannula for Apneic Oxygenation in Obese Patients for Elective Surgery: A Systematic Review and Meta-Analysis, Anesthesia and analgesia 2023 · PMID 36469483
- [2] A Comparison of High-Flow Nasal Cannula and Standard Facemask as Pre-Oxygenation Technique for General Anesthesia: A PRISMA-compliant Systemic Review and Meta-Analysis, Medicine 2022 · PMID 35451383
- [3] High-Flow Nasal Oxygen in the Perioperative Setting: A Narrative Review, Anaesthesia, critical care & pain medicine 2026 · PMID 41903885
- [4] Apnoeic Oxygenation in Morbid Obesity: A Randomised Controlled Trial Comparing Facemask and High-Flow Nasal Oxygen Delivery, British journal of anaesthesia 2023 · PMID 35027169
- [5] High-Flow Nasal Oxygenation, Not Ventilation: Time to Stop Holding Our Breath, British journal of anaesthesia 2026 · PMID 41402219
- [6] High-Flow Nasal Cannulae Versus Non-Invasive Ventilation for Preoxygenation of Obese Patients: The PREOPTIPOP Randomized Trial, EClinicalMedicine 2019 · PMID 31528849
- [7] Preoxygenation strategies network meta-analysis, Br J Anaesth 2024 · PMID 38599916
- [8] THRIVE, Anaesthesia 2015 · PMID 25388828
- [9] PREOX trial, noninvasive ventilation for preoxygenation, N Engl J Med 2024 · PMID 38869091

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