

When Ventilation Goes Wrong: Recognition and First Steps

Intraoperative ventilation SA-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
Other	2002	Anesthesia and Analgesia	In volume-controlled ventilation a widening gap between peak and plateau press
Other	1984	Anesthesiology	A capnograph that goes flat is a disconnection or a displaced tube until you h
Other	2010	BMJ	Trust the depth mark before you trust your stethoscope when you are new
Other	2022	Clinics in Chest Medicine	Patient-ventilator dyssynchrony is not one thing but three - a problem with tr
Other	2005	Quality and Safety in Health Care	Bronchospasm under anaesthesia usually shows itself as falling compliance and
Other	2009	Current Opinion in Anaesthesiology	Laryngospasm is treated first with your hands on the airway and only then with

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

IN PRACTICE

What the cohorts and reviews add

6 findings, each on the slide that follows.

ANESTHESIA AND ANALGESIA 2002

In volume-controlled ventilation a widening gap between peak and plateau press

In volume-controlled ventilation a widening gap between peak and plateau pressure points at resistance somewhere between the ventilator and the...

ANESTHESIOLOGY 1984

A capnograph that goes flat is a disconnection or a displaced tube until you h

A capnograph that goes flat is a disconnection or a displaced tube until you have proved otherwise

BMJ 2010

Trust the depth mark before you trust your stethoscope when you are new

Trust the depth mark before you trust your stethoscope when you are new, because first-year residents in a randomised blinded trial missed...

CLINICS IN CHEST MEDICINE 2022

Patient-ventilator dyssynchrony is not one thing but three - a problem with tr

Patient-ventilator dyssynchrony is not one thing but three - a problem with triggering the breath, with the flow delivered during it, or with cycling...

IN PRACTICE

In volume-controlled ventilation a widening gap between peak and plateau press

Other · Anesthesia and Analgesia

In volume-controlled ventilation a widening gap between peak and plateau pressure points at resistance somewhere between the ventilator and the alveolus, and the same obstruction under pressure control hides from you, because bench and modelling work showed delivered tidal volume did not fall until the tube was nearly completely occluded.

Tung et al., Anesthesia and Analgesia 2002 · PMID 12088967

IN PRACTICE

A capnograph that goes flat is a disconnection or a displaced tube until you have proved otherwise

Other · Anesthesiology

A capnograph that goes flat is a disconnection or a displaced tube until you have proved otherwise, and you should treat it that way: breathing-circuit disconnection was among the most frequently reported preventable critical incidents when anaesthetists were interviewed about their own near-misses, and international consensus guidance makes removal of the tube the default action when sustained exhaled carbon dioxide cannot be restored.

Cooper et al., *Anesthesiology* 1984 · PMID 6691595

IN PRACTICE

Trust the depth mark before you trust your stethoscope when you are new

Other · BMJ

Trust the depth mark before you trust your stethoscope when you are new, because first-year residents in a randomised blinded trial missed endobronchial intubation on auscultation in 55 per cent of cases while insertion depth detected it with 88 per cent sensitivity, and that trial's own recommendation was to site tubes at 20 to 21 cm at the teeth in women and 22 to 23 cm in men.

Sitzwohl et al., *BMJ* 2010 · PMID 21062875

IN PRACTICE

Patient-ventilator dyssynchrony is not one thing but three - a problem with triggering the breath, with the flow delivered during it, or with cycling out of it

Other · Clinics in Chest Medicine

Patient-ventilator dyssynchrony is not one thing but three - a problem with triggering the breath, with the flow delivered during it, or with cycling out of it - and each is identified by looking at the pressure, flow and volume waveforms rather than at the patient's chest.

Doerschug and Peters, *Clinics in Chest Medicine* 2022 · PMID 36116818

IN PRACTICE

Bronchospasm under anaesthesia usually shows itself as falling compliance and a falling saturation alongside the wheeze

Other · Quality and Safety in Health Care

Bronchospasm under anaesthesia usually shows itself as falling compliance and a falling saturation alongside the wheeze, and in the Australian incident reports the leading causes were airway irritation, a problem with the tracheal tube itself and aspiration of gastric contents - which is why you check the tube before you reach for the salbutamol.

Westhorpe et al., *Quality and Safety in Health Care* 2005 · PMID 15933304

IN PRACTICE

Laryngospasm is treated first with your hands on the airway and only then with drugs

Other · Current Opinion in Anaesthesiology

Laryngospasm is treated first with your hands on the airway and only then with drugs, and if there is no intravenous line, suxamethonium can be given by the intramuscular, intraosseous or intralingual route - the delay you are racing is not hypoxaemia alone but the negative-pressure pulmonary oedema that intense inspiratory effort against a closed glottis produces.

Al-almi et al., *Current Opinion in Anaesthesiology* 2009 · PMID 19434787

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 volume-controlled ventilation a widening gap between peak and plateau pressure points at resistance somewhere between the ventilator and the alveolus, and the same obstruction under pressure control hides from you, because bench and modelling work showed delivered tidal volume did not fall until the tube was nearly completely occluded.
- 2**
A capnograph that goes flat is a disconnection or a displaced tube until you have proved otherwise, and you should treat it that way: breathing-circuit disconnection was among the most frequently reported preventable critical incidents when anaesthetists were interviewed about their own near-misses, and international consensus guidance makes removal of the tube the default action when sustained exhaled carbon dioxide cannot be restored.
- 3**
Trust the depth mark before you trust your stethoscope when you are new, because first-year residents in a randomised blinded trial missed endobronchial intubation on auscultation in 55 per cent of cases while insertion depth detected it with 88 per cent sensitivity, and that trial's own recommendation was to site tubes at 20 to 21 cm at the teeth in women and 22 to 23 cm in men.

4

Patient-ventilator dyssynchrony is not one thing but three - a problem with triggering the breath, with the flow delivered during it, or with cycling out of it - and each is identified by looking at the pressure, flow and volume waveforms rather than at the patient's chest.

5

Bronchospasm under anaesthesia usually shows itself as falling compliance and a falling saturation alongside the wheeze, and in the Australian incident reports the leading causes were airway irritation, a problem with the tracheal tube itself and aspiration of gastric contents - which is why you check the tube before you reach for the salbutamol.

KEY TAKEAWAYS

What to carry into the next case

In volume-controlled ventilation a widening gap between peak and plateau press

Anesthesia and Analgesia 2002

A capnograph that goes flat is a disconnection or a displaced tube until you h

Anesthesiology 1984

Trust the depth mark before you trust your stethoscope when you are new

BMJ 2010

Patient-ventilator dyssynchrony is not one thing but three - a problem with tr

Clinics in Chest Medicine 2022

Ventilation goes wrong in a small number of ways, and every one of them declares itself on the capnograph, the pressure trace or the returned tidal volume before it declares itself on the saturation probe, so the fastest diagnostic manoeuvre available to you is to take the patient off the ventilator and squeeze the bag yourself.

QUESTIONS I'LL ASK YOU IN THE ROOM

1. The capnograph trace has gone flat and the airway pressure has dropped to nothing - what is your first action, and what is your second?
2. Peak pressure has risen and plateau pressure has not. What does that tell you, and where is the problem?
3. How would you distinguish endobronchial intubation from a right-sided mucus plug at the head of this bed, without a chest X-ray?
4. The patient is biting the tube and the pressure trace is chaotic - is this dyssynchrony, laryngospasm or light anaesthesia, and how does your answer change what you give?

ORAL BOARDS STEM

You are twenty minutes into a laparoscopic cholecystectomy in a 46-year-old smoker. The peak inspiratory pressure alarm sounds; the number has gone from 22 to 38 cmH₂O, the delivered tidal volume has fallen from 500 to 340 mL, the capnograph still has a trace but its upstroke has become a slurred slope, and the saturation is 94 per cent and drifting. The surgeon says nothing has changed at his end. Walk me through what you look at, in what order, and what you do with your hands while you are looking.

Ventilation goes wrong in a small number of ways, and every one of them declares itself on the capnograph, the pressure trace or the returned tidal volume before it declares itself on the saturation probe, so the fastest diagnostic manoeuvre available to you is to take the patient off the ventilator and squeeze the bag yourself.

SOURCES

- [1] Tung et al., Anesthesia and Analgesia 2002 · PMID 12088967
- [2] Cooper et al., Anesthesiology 1984 · PMID 6691595
- [3] Chrimes et al., Anaesthesia 2022 · PMID 35977431
- [4] Sitzwohl et al., BMJ 2010 · PMID 21062875
- [5] Doerschug and Peters, Clinics in Chest Medicine 2022 · PMID 36116818
- [6] Westhorpe et al., Quality and Safety in Health Care 2005 · PMID 15933304
- [7] Al-alamy et al., Current Opinion in Anaesthesiology 2009 · PMID 19434787
- [8] Bhattacharya et al., Chest 2016 · PMID 27063348