further by the authors. Of the six videolaryngoscopes, there are five with highly angulated blades, namely C-MAC D-Blade, GlideScope, KingVision, Airtraq, and A.P. Advance with difficult airway blade. In contrast, the McGrath as the sixth videolaryngoscope was chosen with a MAC blade. Even though the authors stated in their methodology paper[2] that the McGrath MAC is a further development of the original McGrath Series 5, the blade design of the two series differs significantly. The McGrath MAC used in the present study has a Macintosh-type blade that is very similar to a conventional laryngoscope blade that anaesthesiologists use in their daily practice. In contrast, the McGrath Series 5 has a highly angulated blade that would have compared much better with the other five videolaryngoscopes in the present study. Thus, one Macintosh-type blade almost every anaesthesiologist is familiar with was compared with five curved blades. Proper handling of curved blades requires a significant amount of training. The important difference between Macintosh-type and highly angulated blades with regard to handling and intubation success has been addressed by several studies.[3 4] However, this aspect was not addressed further in the present study.

Readers might become puzzled because of the incomplete description of the videolaryngoscopes used in this study. In the flowchart, use of the C-MAC is clearly stated as D-Blade, both GlideScope and Airtraq are self-explainable curved blades, and the McGrath blade type has been discussed above. However, A.P. Advance and KingVision have no further description of their blade types, at least in the flowchart, so that it is not clear whether the A.P. Advance is used with the Mac-blade (as usually done) or the difficult airway blade, and the KingVision could also be used with a non-channelled blade. Exact classification of the studied material is of paramount importance, especially for A.P. Advance and KingVision, for which few data are available. Finally, the number of missing data for insertion of the device into the oropharynx, quality of view, and ease of tube insertion are not proportional between the different devices tested, and ranges between 9 (A.P. Advance) and 0 (McGrath).

Declaration of interest

None declared.

References

1. Kleine-Brueggeney M, Greif R, Schoettker P, Savoldelli GL, Nabecker S, Theiler LG. Evaluation of six videolaryngoscopes in 720 patients with a simulated difficult airway: a multicentre randomized controlled trial. *Br J Anaesth* 2016; **116**: 670–9
2. Theiler L, Hermann K, Schoettker P, *et al*. SWIVIT–Swiss video-intubation trial evaluating video-laryngoscopes in a simulated difficult airway scenario: study protocol for a multicenter prospective randomized controlled trial in Switzerland. *Trials* 2013; **14**: 94
3. Teoh WHL, Saxena S, Shah MK, Sia ATH. Comparison of three videolaryngoscopes: Pentax Airway Scope, C-MAC™, Glidescope® vs the Macintosh laryngoscope for tracheal intubation. *Anaesthesia* 2010; **65**: 1126–32
4. Alvis BD, Hester D, Watson D, Higgins M, St Jacques P. Randomized controlled trial comparing the McGrath MAC video laryngoscope with the King Vision video laryngoscope in adult patients. *Minerva Anestesiol* 2016; **82**: 30–5

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An unusual sidestream capnogram

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Editor—We report an unusual record of exhaled CO_2 observed during end-expiratory occlusion in a chronic obstructive pulmonary disease patient receiving invasive mechanical ventilation because of a severe acute exacerbation attributable to a bacterial pneumonia. As the patient fulfilled moderate acute respiratory distress syndrome criteria, he was deeply sedated and under neuromuscular block. The 70-yr-old male patient was ventilated (assist-controlled) with a CARESCAPE R860 ventilator (GE Healthcare, Madison, WI, USA). An end-expiratory occlusion manoeuvre was performed to determine the total PEEP level. The duration of the expiratory pause was extended to 15 s, because of the clinical observation of a very unusual record (Fig. 1a). The airway CO_2 monitoring system (sidestream sampling, aspiration flow 120 ml min^{-1} as indicated by the manufacturer) displayed at first a so-called 'curare cleft'[1] and further a short 'plateau-like' line, rapidly followed by a decrease in CO_2 fraction, associated with an increase in measured airway O_2 fraction. Indentations were observed during the decreasing phase at a rate very similar to the cardiac frequency. Such a pattern was repeatedly observed over time, even after switching to another CARESCAPE R860 ventilator. Moreover, prolonged expiration was additionally obtained by disconnection of the respiratory line at the Y-piece level, immediately after the port of the CO_2 monitoring device. We then observed the expected pattern, with a slow CO_2 fraction ascending rate, but without reaching a true plateau (Fig. 1b).

The decrease in CO_2 fraction during the extended expiratory pause could be in relation to contamination of the gas sampling by fresh inspiratory gas. A leak between the port of the CO_2 monitoring device and the patient was ruled out by the pattern (increase in CO_2 fraction) observed after disconnection at the Y-piece (Fig. 1b). A leak between the port of the CO_2 monitoring device and the ventilator was also ruled out because it would have been associated with a decrease in O_2 fraction, attributable to exposure to a gas mixture with 21% fractional inspired O_2, contrasting with the observed increase in O_2 fraction (Fig. 1a). Therefore, we believe that the pattern was attributable to contamination by fresh gas on the ventilator side. We assume that

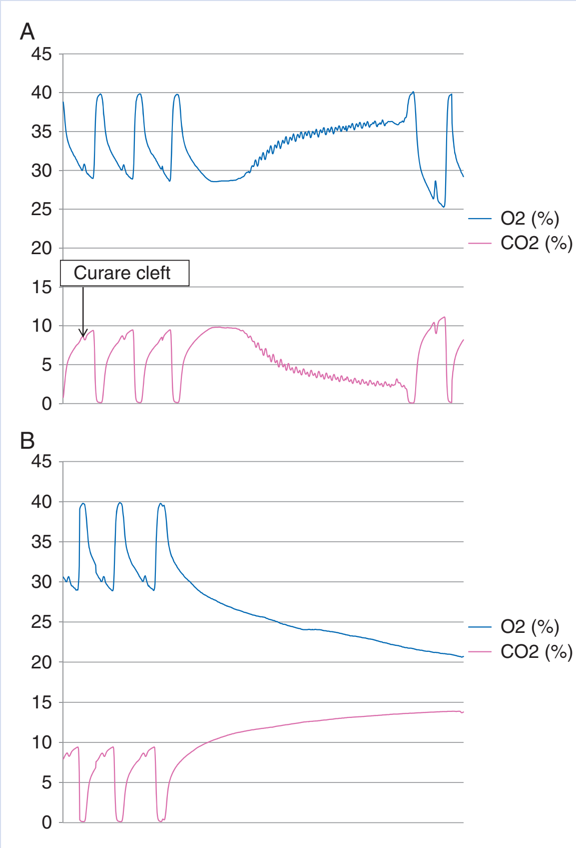

Fig 1 Records of respiratory O_2 and CO_2 fractions obtained during a prolonged (15 s) end-expiratory occlusion manoeuvre (A) and after disconnection of the respiratory line at the Y-piece level (B). Records were obtained using the ventilator sensors and the OhmedaCom Research Tool acquisition system.

the contamination was in relation with the specific configuration of the CARESCAPE R860 ventilator, with a minimal flow-by circuit set at 2 litres min^{-1}. Accordingly, the aspiration flow of the sidestream CO_2 monitoring system was nearly twice the flow measured between the CO_2 sampling port and the patient. The oscillations observed in the waveforms were probably related to the cardiac beats in a patient under neuromuscular block with low pulmonary compliance, with adiabatic compressions and decompressions, or both.

To the best of our knowledge, this is the first report of such a capnographic pattern during a prolonged end-expiratory occlusion manoeuvre. The pattern was probably explained by the sidestream (rather than mainstream) CO_2 monitoring system and by a minimal flow-by circuit set at 2 litres min^{-1} leading to frank contamination of the sampled gas by fresh gas issued from the ventilator. Clinicians must be aware of this pattern, because it could considerably underestimate end-tidal CO_2 fraction. This is of particular importance in circumstances in which capnographic monitoring has been considered of value, such as pulmonary embolism diagnosis,[2] cardiopulmonary resuscitation,[3] or acute respiratory distress syndrome.[4] Such patterns could also explain, in part, the disappointing results observed for end-expiratory occlusion CO_2-based prediction of fluid responsiveness in the operating theatre.[5]

Authors' contributions

Conception, design, and acquisition of data: J.-L.D., C.C., E.G. Analysis and interpretation of data, drafting the article for important intellectual content, and final approval: J.-L.D., C.C., A.M., J.C.R., E.G.

Declaration of interest

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References

1. Hess DR. Capnometry. In: MJ Tobin, ed. *Principles and Practice of Intensive Care Monitoring*, New York, USA: McGraw-Hill, Inc. 1997; 377–400
2. Chopin C, Fesard P, Mangalaboyi J, *et al.* Use of capnography in diagnosis of pulmonary embolism during acute respiratory failure of chronic obstructive pulmonary disease. *Crit Care Med* 1990; **18**: 353–7
3. Link MS, Berkow LC, Kudenchuk PJ, *et al.* Adult advanced cardiovascular life support. AHA guidelines for CPR and emergency cardiovascular care. *Circulation* 2015; **132**: S444–64
4. Nuckton TJ, Alonso JA, Kallet RH, *et al.* Pulmonary dead-space fraction as a risk factor for death in the acute respiratory distress syndrome. *N Engl J Med* 2002; **346**: 1281–6
5. Guinot PG, Godart J, De Broca B, Bernard E, Lorne E, Dupont H. End-expiratory occlusion manoeuvre does not accurately predict fluid responsiveness in the operating theatre. *Br J Anaesth* 2014; **112**: 1050–4

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