

Correspondence

Checking of gas sampling tube by direct measurement of exhaled breath

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EDITOR:

We read with interest the article published by Gauthama and Morris [1] in which the authors reported the findings of a survey of UK anaesthetists for checking the capnograph before anaesthesia. The authors reported that majority of UK anaesthetists use exhaled breath to check the capnograph but the practice is not universal due to concerns of sterility. We wish to report a critical incident related to a gas sampling tube that supports the use of exhaled breath during checking of an anaesthetic machine and a breathing circuit. A partial break in the gas sampling tube was not detected on visual inspection and machine check was performed following published guidelines [2]. We believe, had we performed a direct measurement of exhaled breath, the break in the gas sampling tube would have been detected.

Case report

A 5-yr-old child was scheduled first on the list to undergo dental extractions. Anaesthetic machines (Dräger Cato, Lubeck, Germany) in the anaesthetic room as well as in the operating theatre were checked, prior to the start of the case, involving all 11 steps recommended by the Association of Anaesthetists of Great Britain and Ireland [2]. The gas sampling tubes (Anaesthesia Gas Sampling Line, disposable, 2 m; GE Healthcare, Helsinki, Finland) were checked in the anaesthetic room as well as in the operating theatre visually for obstruction, kink or breakage, and no defect was noted. The oxygen analyser readings on both machines were 21% in room air and 99% after activating the oxygen flush.

The patient was induced in the anaesthetic room using gas induction with oxygen, nitrous oxide and sevoflurane. An intravenous line was secured and routine monitors were attached. The airway was secured with a laryngeal mask (size 2) and the patient continued to breathe spontaneously. Oxygen, nitrous oxide, end-tidal carbon dioxide (ETCO₂) and end-tidal sevoflurane concentration readings were noted. The patient was then transferred to the operating theatre and appropriate flow of anaesthetic gases was set. The patient was connected to the breathing circuit. The patient continued to breathe spontaneously but we noticed the absence of ETCO₂ and sevoflurane and no change in inspiratory and expiratory pressures. The oxygen concentration reading was 21%. We suspected a fault in the sampling tube. The integrity of the sampling tube was checked again visually for break, kink, obstruction and connections. We replaced the gas sampling tube and this rectified the fault.

We examined the faulty sampling tube by blowing air and no apparent break was visible. Then we injected water with a syringe attached to the sampling tube and water was seen leaking from the area where the gas sampling tube had a partial break very close to the luer lock end.

Discussion

Side-stream anaesthetic gas analysers utilize a long sampling tube to connect the breathing system and the analyser. Sampling gases are continuously aspirated usually at a rate of about 250 mL min⁻¹ and graphic displays of gases, anaesthetic agent and pressure are displayed. The sampling tube usually hangs free between the breathing circuit and the monitor and this makes it vulnerable to crushing and may be breached or broken during machine movement. If there is a break in the sampling tube, oxygen, ETCO₂ and volatile agent concentrations will be absent and aspiration of atmospheric air

Correspondence to: Chandra Kumar, Department of Anaesthesia, The James Cook University Hospital, Middlesbrough TS4 3BW, UK. E-mail: chandra.kumar@stees.nhs.uk; Tel: 44 16428 54600; Fax: 44 16428 54246

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by the sampling machine will show an oxygen concentration of 21%.

In this incident the sampling tube damage in the operating theatre was not detected by visual inspection. We believe that atmospheric oxygen reached the anaesthetic gas analyser unit through the break in the gas sampling tube. The gold standard check that a breathing circuit is not blocked is by the use of capnography to demonstrate that expired air can pass retrogradely into the circuit [3] but this test can only be performed in an awake patient before induction of anaesthesia. We believe that direct measurement of exhaled breath through the gas sampling tube would have detected the faulty gas sampling tube.

There is no substitute for regular inspection and proper check of anaesthetic machine and its components. We believe that routine check of sampling tubes in the operating theatre should include visual inspection as well as the direct measurement of

exhaled breath and accept a rare theoretical risk of contamination.

S. Panchatsbaram, C. Kumar
Department of Anaesthesia
The James Cook University Hospital
Middlesbrough, UK

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Failure of back-up oxygen supply despite a full oxygen cylinder

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EDITOR:

Recently we had an incident, which has important implications for the checking of anaesthetic machines. A pre-use check of a Dräger Cato anaesthetic machine (Dräger Medical UK Ltd, Hertfordshire, UK) revealed that on disconnecting the oxygen pipeline, the oxygen failure alarm was working. The oxygen cylinder was then opened and the pressure gauge registered that it was full. However, on opening the oxygen flow-meter (rotameter) there was no flow of oxygen. Changing the cylinder made no difference, as the pressure gauge registered full but no flow of oxygen occurred, and so an alternative machine that was fully functional was used.

Investigation of the fault in our anaesthetic workshop concluded that a one-way valve between the cylinder and anaesthetic machine was sticking. Following its replacement, the machine was fully functional. The manufacturer's Technical Support Manager (Dräger Medical UK Ltd) was informed by letter. He replied to the effect that there had been

no previous reports of this fault and that the valve design had changed.

The purpose of the one-way (check) valve is to prevent retrograde leak, and it is a feature of most, if not all, modern anaesthetic machines.

The commonly used guideline for checking anaesthetic machines is *Checking Anaesthetic Equipment*, 3rd edition (2004) by the Association of Anaesthetists of Great Britain and Ireland. For checking medical gas supplies this advocates a 'tug test' for the pipeline and a contents check of cylinders using the pressure gauge. It also recommends a weekly disconnection of the oxygen hose to check the oxygen failure alarm and the concomitant gas shut-off device.

We point out that none of these checks will detect the problem of a sticking one-way (check) valve. Clearly, having done the pipeline disconnection for the oxygen failure alarm test, one should also check that opening the oxygen cylinder and flow-meter results in the actual flow of oxygen. We suggest that this be incorporated into the next edition of *Checking Anaesthetic Equipment*.

A. G. McKenzie, R. P. Alston
Royal Infirmary of Edinburgh
Edinburgh, UK

Correspondence to: Alistair G. McKenzie, Royal Infirmary of Edinburgh, 51 Little France Crescent, Edinburgh EH16 4SA, UK. E-mail: alistair.mckenzie@luht.scot.nhs.uk; Tel: +131 2423151; Fax: +131 2423174

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