

Major leak during controlled ventilation due to faulty exhaust valve missed during pre-use machine check

Sir,

During the evolution of the basic anaesthesia machine to the modern-day workstation, incorporation of new safety features has always been of prime importance. The presence of an undetected leak in the machine can have catastrophic consequences on the patient.

The American Society of Anesthesiologists and Association of Anaesthetists of Great Britain and Ireland (AAGBI) have given detailed guidelines for conducting the pre-use machine check. However, we should select the suitable pre-use test keeping in mind the individual manufacturer's recommendation.

We describe a case of a 15-year-old child with arteriovenous malformation in the neck posted for fluoroscopy-guided embolisation under general anaesthesia. On the day of the procedure, we followed the automated checkout on Dräger Fabius plus™ machine. The self-test results showed a system leak of 20 ml/min and ventilator leak of 12 ml/min. A positive pressure leak test was done by occluding the Y-piece, closing the adjustable pressure limiting (APL) valve and fresh gas flow (FGF) and pressurising the circuit to 30 cmH₂O. The pressure was maintained for >10 s, showing no leak. It was then repeated with each vaporiser switched on, affirming no leak.

After induction of anaesthesia and tracheal intubation, ventilation was switched over to volume-controlled mode, and FGF reduced to 2 L/min. Soon we noticed that the reservoir bag was not filling appropriately during the inspiratory phase. We switched back to manual ventilation and checked for leak around the endotracheal tube cuff, which was not detected. Flowmeters, vaporisers, canister and circuit connections were inspected again, but no leak was found. In manual mode, we were able to ventilate with FGF of 1 L/min whereas in ventilator mode, the bag was not filling properly even at an FGF of 5 L/min. The machine was then replaced, and rest of the case was carried out uneventfully.

On analysis, technical support staff of Dräger medical found a fault in the exhaust valve (AGS system). This one-way valve, on ventilator mode, exerts a pressure of 1–2 cmH₂O diverting FGF to the reservoir bag during inspiration before venting it out.^[1] A faulty valve will directly vent out the FGF instead of filling the bag, thus explaining the leak only in ventilator mode.

Knowledge of parts being checked by automated leak test is important. In our case, no leak was detected using self-test or positive pressure leak test, as the exhaust valve is not included in any of these.^[2] The ventilator leak test checks for leaks in between

the fresh gas decoupling valve and the positive end-expiratory pressure valve [Figure 1a], whereas the system leak test incorporates flow meters, vaporisers, inspiratory and expiratory valves and limbs, canister, bag and APL valve [Figure 1b]. As positive pressure leak test is performed with APL valve in closed position; this overrides the exhaust valve. The only test that could have identified the leak is a 'two-bag test'. The AAGBI guideline recommends to perform a two bag test after the breathing system, vaporisers and ventilator have been checked individually.^[3] It checks the patency of the whole system making it a more inclusive test. Moreover, it is applicable to most of the modern anaesthesia workstations and may be termed more aptly as 'universal leak test.'

Dräger Fabius plus manual recommends to carry out automatic leak test, which is then repeated with each vaporiser turned on. Further, the ventilator is checked by attaching a test lung to Y-piece and switched over to control mode. It should be ascertained that the movements of piston ventilator, test lung, reservoir bag, inspiratory and expiratory unidirectional valves are appropriate. The negative pressure leak test is not applicable for Dräger Fabius plus machine.

This article highlights that anaesthesiologist and technicians should have detailed knowledge about the parts included in an automated machine check. Furthermore, they should be aware of the fact that some parts like the exhaust valve [Figure 1c and d] are not included in automated machine check, and manufacturer recommended test for that workstation should be selected from the array of tests available.

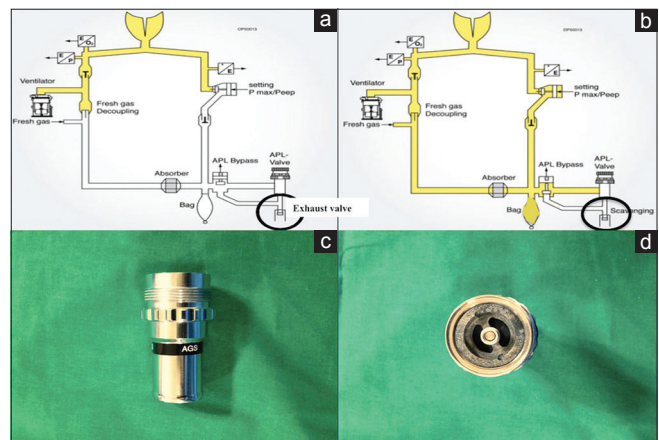


Figure 1: (a) Yellow-shaded area - parts checked in automated ventilator leak test. (b) Yellow-shaded area - parts checked in automated system leak test. (c) Exhaust valve housing. (d) Exhaust valve from inside

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Conflicts of interest

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REFERENCES

1. Dorsch JA, Dorsch SE. Understanding Anesthesia Equipment. Philadelphia, USA: Lippincott Williams & Wilkins; 2008. p. 338-9.
2. Dräger Fabius Leak Test Questioned. Available from: http://www.apsf.org/newsletters/html/2010/winter/05_dearsirs.htm. [Last accessed on 2017 Oct 12].
3. Association of Anaesthetists of Great Britain and Ireland (AAGBI), Hartle A, Anderson E, Bythell V, Gemmell L, Jones H, et al. Checking anaesthetic equipment 2012: Association of Anaesthetists of Great Britain and Ireland. *Anaesthesia* 2012;67:660-8.

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