Failure of Anaesthetic Machine Automated Self-Check to detect massive leak in Ventilator Bellows

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BJA: British Journal of Anaesthesia, Volume 117, Issue eLetters Supplement, 11 October 2016

DOI: https://doi.org/10.1093/bja/el_14128

Published: 12 September 2016

Dear Editor,

Anaesthetic machines are designed to provide for a safe, non-hypoxic gas mixture delivered to the patient. For this reason, anaesthetic machines provide a number of features to ensure such safety. Still, a number of anaesthetic societies, including the Association of Anaesthetists of Great Britain and Ireland [1], the American Society of Anaesthesiologists [2] and the Canadian Society of Anaesthesiologists [3] recommend that anaesthetic machines should be checked prior to each list, and prior to each case.

Our Department uses mainly Aestiva, Aespire and Avance Anaesthesia machines (GE Healthcare, UK). The latter have an electronic interface, and provides an electronic self-check. We describe a case where an Avance machine passed the self-test despite a massive leak of more than 4 litres/min.

It is customary in our Department that any anaesthetic machine that requires any servicing for faults or preventive maintenance is first checked by one of two dedicated clinicians prior to clinical use. An Avance anaesthetic machine had to be serviced for an internal leak. The machine was first checked by a self-test, as guided by the on-screen instructions. Although not mandatory, a negative pressure leak test for the low pressure circuit was also performed. All these tests did not show any leak or malfunction.

A manual version of the electronic tests was performed, where possible. The manual circle system was pressurized to 40 cmH20, and the flow reduced to the minimum amount necessary to maintain that pressure. The flow needed was less than 250 mL/min.

A second inflatable bag was attached to the end of the patient circuit, and the ventilator was switched on. At this point, it was apparent that there was a significant leak. The bellows would not ascend to the top of the chamber, and the leak was estimated to be around 4-5 L/min. The self-test was repeated: the leak was not detected by the automated test, but the bellows were already descending minimally during the test.

Since the leak appeared only in the circuit involving the ventilator, the actual ventilator bellow chamber was disassembled. It was noticed that the bellows was not attached properly (Figure 1), causing gas to escape from the attachment. Once the bellows was properly affixed, there was no further leak, even at 250 mL/min.

Figure

The same fault was then simulated on other GE Avance anaesthetic machines, and these also displayed the same behaviour. In these simulated cases, the leak from the ventilator bellows was not detected during the electronic self-test done by the machine.

There are already a number of case reports [4-8] in the literature that show that electronic self-checks can still miss a number of leaks. Most of these scenarios may in fact be quite uncommon in clinical practice, and it might be debated that even an anaesthetist might have not detected the faults. This case that we describe, however, is worrying because of the nature of the leak, and the fact that it was easily observable by trained staff.

We would recommend that clinicians should not rely completely on the electronic self-checks. At the very least, leak tests as described [9] should be performed before each case, even if the self-checks are performed. Furthermore, we have sought out to

inform the manufacturer of the problem, in order to possibly update the electronic self-test.

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Conflict of Interest: