



Aberrant cessation of inhalation anesthesia in an anesthesia machine equipped with a digital vaporizer

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To the Editor,

When a vaporizer malfunctions during general anesthesia, an anesthetic overdose can result in extreme hypotension and bradycardia,^{1,2} whereas interruption of the inhaled anesthetic supply can cause intraoperative awareness.^{3,4} We report a case of a sudden interruption of sevoflurane supply with a new GE Aisys Carestation™ 2 (CS2; GE HealthCare, Madison, WI, USA).

After inducing general anesthesia in a patient, the attending anesthesiologist began by administering 2.6% sevoflurane. After endotracheal intubation, manual ventilation was switched to mechanical ventilation. When the anesthesiologist attempted to adjust the gas flow settings, the adjustment buttons for oxygen concentration, flow, and inhaled anesthetic concentration settings did not respond. The message “set backup O₂ flow, agent supply off” was displayed on the screen. Moreover, the sevoflurane and fresh gas flow adjustments were blanked out on the screen. Only 100% oxygen was supplied, and the exhaled sevoflurane concentration decreased breath-by-breath.

Immediately, the anesthesiologist administered bolus doses of *iv* propofol and started a continuous propofol infusion. A clinical engineer in our hospital checked the

anesthesia machine but could not determine the cause. The anesthesiologist pressed the case start button again but the screen remained the same. The CS2 was restarted once more, but the screen did not change and the error message persisted. The patient was moved to another operating room, and the scheduled surgery was performed using a different anesthesia machine. The patient had no intraoperative awakenings or awareness, and written informed consent was obtained for the publication of the case.

Afterward, a GE engineer found that the root cause was a failure of the oxygen, air, and anesthetic gas blender, due to a dysfunction of the mixer unit. The error log “ACB: MIX FRSH GAS SLCT VLV 10VA OVR CUR” and “ACB: +12.0V L VOLT GAS SEL VALVES” suggested that the mixer unit was the source of the problem, and the applicable parts were replaced. The error log indicated that the main issue was the valve inside the mixer unit that controlled the concentration and flow rate of the fresh gas flow. The dysfunctional valve caused an output error, which triggered the safety function to shift to the backup O₂ flow output mode, thus the machine discontinued to supply a mixed gas.

Following the incident, GE advised that a similar error was reported by the Japanese Society of Anesthesiology in 2020. Nevertheless, although the defective parts replaced were identical, the usable ranges and functions of the equipment were not identical because of multiple or different causes of the defects. In the case reported in 2020, the inhaled anesthetic agent was continuously available, whereas sevoflurane was suddenly unavailable in our case. GE reported an incidence of 0.97%, but they did not have data on whether an inhaled anesthetic agent was continuously available.

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In our system, the automatic vital sign monitor and recordings stopped when the anesthesia machine malfunctioned, so we changed the operating room. Modern anesthesia workstations are often equipped with automatic digital vaporizers, gas flow meters, and ventilators, with commonly integrated vital monitors, anesthesia recording systems, and electronic medical record systems. In such a fully automated general anesthetics system, one intraoperative function failure generally causes the cessation of other functions.

The digital vaporizer and Aladdin2 Cassette™ system (GE HealthCare, Chicago, IL, USA), which are in the state-of-the-art CS2,⁴ did not work well in our case. The CS2 has an end-tidal control function that requires a digital vaporizer.⁵ A fully automated system is a highly regarded technological innovation; however, convenient as it may be, a system in which a single point of trouble can halt all functions should be considered unsafe.

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