

Total Power Failure in a Desflurane Vaporizer Resulting in Discontinuation of Anesthetic Delivery

Case Report

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Abstract

An unrecognized power failure in a desflurane vaporizer is possible with a concomitant alarm battery failure. Consequent discontinuation of desflurane delivery may go unrecognized and create the potential for intraoperative awareness and inadequate depth of anesthesia. Preventive measures could include assignment of an exclusive power outlet for the desflurane vaporizer, periodic replacement and testing of the alarm battery, vigilant monitoring and documentation of desflurane levels, and even potential re-design of the vaporizer alarm system.

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Introduction

The desflurane vaporizer (Tec 6 Plus Vaporizer by Datex-Ohmeda) requires electrical power for heating the agent to 39°C to establish optimal vapor pressure for delivery of anesthesia [1]. Without electrical power the vaporizer's dial will remain locked to prevent initiation of agent delivery; meanwhile, ongoing delivery of desflurane will stop within 10 seconds in the setting of power failure [2]. Such an unexpected loss of power should be recognized via an auditory alarm and visual display – both of which are powered by a 9-volt battery incorporated in the base of the vaporizer. This case report describes a uniquely rare situation in which the discontinuation of desflurane delivery went unrecognized due to concomitant failure of the backup alarm battery.

Case Description

A healthy 35-year-old male was scheduled for open reduction and internal fixation of a right ankle fracture under general anesthesia. He denied any significant past medical history and presented with

normal vital signs and an unremarkable airway. Induction of general anesthesia and endotracheal intubation were achieved with intravenous administration of propofol (200 mg), midazolam (2 mg), fentanyl (100 mcg) and rocuronium (50 mg). Intraoperative anesthesia was maintained with an inhalational admixture of 50% nitrous oxide/oxygen and 6% desflurane. Initial skin incision resulted in a blood pressure rise from 120/70 to 159/96 and the heart rate from 82 to 125. Despite additional fentanyl bolus (total 250 mcg), the blood pressure and the heart rate remained elevated and the patient was noted to be diaphoretic. Inspection of the anesthesia machine revealed an unpowered desflurane vaporizer without function of the LED light panel or LCD agent level indicator. Sevoflurane was started immediately followed by intravenous midazolam (6 mg). Hemodynamic values returned to baseline over the next several minutes, and the remainder of the case was unremarkable. The patient was extubated and transferred to the recovery unit. An interview was conducted on postop day 1, and the patient did not report any recall or intraoperative awareness.

Discussion

Numerous reasons for vaporizer failures have been reported in the literature. Some failures are centered on the potential for electrical or mechanical errors inherent to the devices themselves, and some are a product of human error. General chamber compromise, improper mounting, overfilling, tilting, or incompatibilities with certain anesthesia machine systems have all been shown to produce inaccurate anesthetic delivery [3-8]. Unlike most common vaporizers, the desflurane vaporizer can be considered a “smarter” device – one capable of recognizing and reporting potential clinical problems as they arise. However, such features can present a double-edged sword for the clinician: a situation in which vigilance can be supplanted by electronics.

Although rare, inherent safety features of the Tec 6 Plus Vaporizer (the one used in this case) can be overridden or go unrecognized. To begin, when the vaporizer is powered up, an internal system check is supposed to indicate a low battery level through

an LED display. This is not fail-safe. For instance, if the alarm battery depletes beyond the alarm threshold charge following activation of the vaporizer, detection of the vaporizer power failure will depend solely on the clinician. That is, the clinician must recognize the loss of the LED display, or notice the decreasing exhaled end-tidal concentration on the anesthesia monitor.

In another scenario involving a normally functioning vaporizer, if desflurane is being delivered while the main power supply is interrupted, delivery of the gas should stop within 10 seconds. This unexpected loss of power should then become immediately apparent by the auditory alarm and LED error display, which is activated by a 9-volt battery incorporated in the base of the vaporizer. Obviously, if the battery is fully depleted, then further due diligence is placed on the clinician to avert complications. (Of note, the alarm battery is not designed to resume desflurane delivery).

Finally, although the vaporizer itself requires very little power, a failure of the desflurane vaporizer may be possible from sharing the power source with other equipment [9]. For example, multi-outlet cords are frequently used to supply electric power to Anesthesia Information Management Systems attached to the anesthesia machine. When the desflurane vaporizer is also connected to such a multi-outlet strip, exceeding the power limit or an electrical surge can cause a silent shutdown. Once again, the 9-volt battery and clinician are on the hook.

In closing, minimal measures to prevent unrecognized vaporizer failure should include:

1. An assignment of an unshared power outlet for the desflurane vaporizer
2. Annual replacement and periodic testing of the battery and power failure alarm in the vaporizer
3. Vigilant intra operative monitoring of the vapor agent levels on the monitors

Although beyond the breadth and scope of this discussion; one could also imagine potential vaporizer design modifications that could further mitigate this scenario.

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