

Workstation peril: Paradoxical inability to ventilate in manual/spontaneous mode with mechanical ventilation modes unaffected

Sir,

Traditional teaching prompts immediate switch-over to the manual-mode on encountering ventilator-

malfunction, then systematically investigating the cause of leak. We describe a case of paradoxical inability to ventilate the patient in the manual-mode, with smooth ventilation in the volume control (VC), pressure control (PC), and volume control-autoflow (VC-AF) modes, prompting Valsalva manoeuvre (VM) institution in the PC-mode of our Dräger-Perseus A-500 workstation, instead of the usual manual-mode.

VM is performed actively (awake patients), accidentally (straining/weight-lifting), or passively (intraoperative manual-mode).^[1,2] VM is often requested by surgeons intraoperatively (thyroid/head-neck surgery,

craniotomy) to unmask covert venous bleeders, and detect cerebrospinal fluid-leaks (spinal-surgery).^[1,2] VM-administration utilises the “intermittent positive-pressure technique” [manual-mode; fresh gas flow (FGF) 2 L/min; partial-closure (40 cmH₂O) of adjustable pressure-limiting (APL) valve; gentle manual squeezing of the reservoir-bag and compression maintained for 15–20 s].^[2]

A 53-year-old male was posted for tongue-commando surgery. The surgeons requested VM towards surgery completion. On switching from VC-AF mode to manual-mode for VM-institution, the reservoir-bag remained collapsed despite increasing FGF to 8 L/min, fully closed APL-valve (70 cmH₂O), and emergency oxygen-button activation. After affirming nasotracheal tube cuff-integrity (pilot-balloon compression), inflation with additional 2 mL air, pushing the existing oral-pack more snugly around the tube, tightening circuit connections, and replacing the right-angled connector, filter, reservoir-bag and the closed-circuit including Y-piece, in sequential steps, the leak persisted from an unidentifiable site. Since the peripheral oxygen saturation (SpO₂) plummeted, emergency oxygenation was administered by an Ambu-bag. To resume volatile anaesthetics, the patient was shifted back on VC-AF mode once the SpO₂ reached 100%. Fortunately, now the set tidal volume could be delivered (complete flow-volume loops). On switching to manual-mode for VM, there again occurred sudden inability to ventilate. Adequate ventilation in VC, PC and VC-AF modes negated breach in circuit-integrity (endotracheal tube to workstation-interface).^[3] Finally, a different technique to deliver VM in PC-mode was devised (pressure-cap setting 35 cmH₂O; positive end-expiratory pressure 30 cmH₂O; lowest respiratory rate of 3 breaths/min [inherent safety feature of Perseus-workstation]) delivering raised airway pressure (35 cmH₂O during inspiration; 30 cmH₂O during expiration) until switching to manual mode in 20 s [Figure 1]. Jugular venous distension was observed. The bleeder unmasked consequent to VM was cauterised successfully.

Subsequently, we pinpointed faulty seating of the sodalime canister (replaced intraoperatively, 5 h earlier, to rectify sodalime-exhaustion-induced rebreathing) for this anomaly. It was only partially installed in the canister-bracket, the canister-top being locked with the CLIC-adaptor system, generating a large gas-leak

by pressing open the spring-loaded rubber valve. The canister was removed and reset into position and *viola*; manual ventilation became possible.

In lesser machines, switching the sodalime-canister intraoperatively, disrupts controlled ventilation. High-end workstations (Perseus, Apollo, Zeus, Primus, Fabius) are endowed with the CLIC-adaptor (Drägersorb CLIC-system; Dräger, Inc, Telford, Pennsylvania) fitted with a spring-loaded rubber valve allowing the machine to successfully pass a pre-use check minus a sodalime-canister (Drägersorb 800; Dräger, Inc) and permitting its intraoperative replacement without disruption of controlled ventilation and volatile anaesthetics. General Electric machines with EZ-Change Mode (Avance-CS2; GE Healthcare, Madison, WI) allow continued ventilation without leak while changing carbon dioxide (CO₂)-absorbent.^[4-6] Our machine had passed the pre-use check (including leak-test) with the canister *in situ*. An automatic leak-test could not be technically performed after intraoperative canister replacement. The end-tidal CO₂ remained within normal limits with a FGF of 3 L/min without CO₂-absorber in the circuit because during mechanical ventilation (inspiratory phase), the fresh gas decoupling valve (FGDV) closed, permitting positive pressure ventilation of the lungs, and in the expiratory phase, room-air entered the breathing circuit via the canister-leak reaching the lungs through the open FGDV.

The changes in ventilator graphs, agent concentration, and alarms were insidious and did not indicate an obvious entrapment.



Figure 1: Administration of Valsalva manoeuvre in pressure control mode of Dräger Perseus anaesthesia workstation

The incident prompted us to order the optional radiofrequency identification sensor (exclusive to Perseus-workstation) which ensures the presence and proper installation of a sodalime-canister.

This report stresses thorough knowledge of the machine. However, only knowing the machine is not enough and one must also be a keen observer. While troubleshooting a large leak, one should be aware of a potential CLIC-adaptor related sodalime-canister leak.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that his name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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REFERENCES

1. Kumar CM, Van Zundert AAJ. Intraoperative Valsalva manoeuvre: A narrative review. *Can J Anaesth* 2018;65:578-85.
2. Beyoglu CA, Teksoz S, Ozdilek A, Akcivan M, Erbabacan E, Altindas F. A comparison of the efficacy of three different peak airway pressures on intraoperative bleeding point detection in patients undergoing thyroidectomy: A randomised, controlled, clinical trial. *BMC Surg* 2020;20:1-7.
3. Nethra SS, Nagaraja S, Sudheesh K, Duggappa DR, Sanket B. Comparison of effects of volume-controlled and pressure-controlled mode of ventilation on endotracheal cuff pressure and respiratory mechanics in laparoscopic cholecystectomies: A randomised controlled trial. *Indian J Anaesth* 2020;64:842-8.
4. Dräger. Just "CLIC" it! 2015. Available from: https://www.draeger.com/products/content/lisa_draegersorb_clic_casestudy_9051467_en.pdf [Last accessed on 2022 Aug 5].
5. GE Healthcare-Avance CS2. Available from: <https://www.gehealthcare.co.uk/-/jssmedia/800e8e7c4d914087a585f76d04cc0a69.pdf>. [Last accessed on 2022 Mar 31].
6. Kaur A, Goel A, Dias R, Kesarkar N. An unusual cause of intraoperative hypercarbia: Who's the boss: Machine or the man behind the machine? *Indian J Anaesth* 2021;65:256-7.

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