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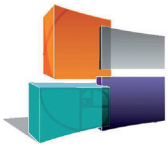

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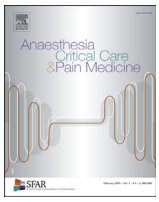

Editorial

Severe patient injury associated with mechanical ventilators: a "never event"

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Ventilator misuse, is a rare, but entirely preventable cause of patient harm. In this issue of *Anaesthesia Critical Care & Pain Medicine*, Theissen et al. [1] describe four patients who were severely injured as a result of errors in the use of mechanical ventilators, with information obtained from the files of the French malpractice insurer SHAM. All of the patients sustained a cardiac arrest due to hypoxemia from lack of effective ventilation. Outcomes were poor: three patients died and one survived in a permanent vegetative state. The causes of the events are instructive to all anaesthesiologists: lack of familiarity with transport ventilator resulting in connecting the patient to the expiratory valve instead of the inspiratory valve, failure to turn on a ventilator in the emergency room, assembly error in the anaesthesia system confused with bronchospasm, and connection to a ventilator in self-test mode in the intensive care unit. Common themes were lack of verification of ventilator function prior to use, failure to check the efficacy of ventilation, and delayed detection of inadequate ventilation and use of back-up ventilation systems.

These failures exactly mirror causes of severe patient injuries from anaesthesia gas delivery equipment reported in 2013 by the Anesthesia Closed Claims Project in the United States [2]. In this report, the majority (85%) of patient injuries from anaesthesia gas delivery equipment involved provider error with (n = 7) or without (n = 25) equipment failure. Seven cases in this review involved a mechanical ventilator and/or its breathing circuit. In two cases, the breathing circuit was misconnected and difficult ventilation was presumed to be bronchospasm. In five cases, the practitioner failed to resume mechanical ventilation occurred after position change, termination of cardiopulmonary bypass, or transfer to intensive care unit. Capnography was available in the majority of these cases, however, the practitioner ignored, disabled, or turned off alarms or disconnected monitors. Therefore, provider error was the cause of poor patient outcomes, due to inadequate or ignored alarms, misdiagnosis, and/or failure to use back-up ventilator methods. Since this publication, three additional cases of ventilator misuse have been added to the Anesthesia Closed Claims database (total database n of 11,034). All of the new cases involved provider error: failure to continue mechanical ventilation during femoral-to-femoral bypass due to lack of knowledge, failure to turn on an anaesthesia ventilator due to lack of familiarity with equipment and distraction from placement of an arterial catheter, and failure to recognize circuit disconnection due to focusing upon the pulse oximeter, assuming it was malfunctioning.

Although injury from mechanical ventilator equipment failure is uncommon, ventilator failure is one of the more frequent critical incidents arising from anaesthesia equipment. Cassidy et al. [3] found that ventilator problems formed close to 18% (185 out of 1029) incidents related to anaesthesia equipment in the United Kingdom between 2006 and 2008. The most common ventilator malfunction was a sudden failure despite previously passing machine checks (n = 142) [3]. Other ventilator failures included problems with expiratory or positive end-expiratory pressure valves, alarm malfunction, non-responsive ventilator controls, power failure, and faulty connections [3]. None of these critical incidents resulted in patient harm as the anaesthesiologist readily detected and treated it appropriately. However, as is evident from the above closed claims studies, [1,2] if the diagnosis and correction of the ventilator failure is not performed in a timely manner, patient injury from hypoxemia and subsequent cardiac arrest can occur. The malpractice claims highlight the importance of analysing errors to make recommendations to prevent future patient harm from ventilator misuse.

Why might these provider errors occur? Patients had complicated diseases and procedures. Provider attention was focused other clinical care concerns, including haemodynamic instability, possible equipment failure (e.g., inability to monitor arterial pressure, low oxygen saturation), insertion of invasive monitoring devices, treatment of suspected bronchospasm, or excessive workload. Situational awareness errors [4] and cognitive errors, [5] including use of cognitive shortcuts or "heuristics", anchoring/fixation or "tunnel vision", confirmation bias, and omission bias were also present. Use of capnography to assess adequacy of ventilation as recommended by Theissen et al. [1] is important.

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However, provider errors may still occur if capnography alarms are deactivated, ignored, or situational awareness failures and cognitive errors occur. Enhanced education and training procedures, including simulation of rare ventilator failure events, may improve provider performance and patient safety. A "call for help" and use of cognitive aides (e.g., emergency checklists or manuals) may also be useful to reduce errors.

As this type of equipment error is considered a "never event", e.g., a serious medical error that should never happen to a patient, [6] it is imperative to enhance health care provider training and support systems to successfully manage a rare, catastrophic event. The study by Theissen et al. [1] provides some recommendations to address areas of risk: provider education regarding ventilator equipment; pre-procedure assurance of ventilation function before use; checking the adequacy of ventilation through auscultation, chest visualisation, and capnography; and rapidly using back-up ventilator systems such as an Ambu bag when problem-solving ventilator malfunction.

Disclosure of interest

The authors declare that they have no competing interest.

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