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Letter to the Editor

Bag-valve-mask resuscitators fitted with pressure-limiting valves—Safety feature or potential hazard?

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To the Editor,

Ventilation, while essential in cardiac arrest resuscitation, can potentially cause harm and adversely affect patient outcomes. Resuscitation guidelines address these risks by recommending optimal ventilation rates, volumes, and pressures. Safety features of bag-valve-mask (BVM) resuscitators, such as pressure-limiting or pop-off valves, may also mitigate the risks of excessive ventilation, particularly barotrauma.

The International Standards Organisation (ISO) recommends that BVM resuscitators be equipped with a mechanism to prevent airway pressures from exceeding 45–60 cmH₂O.¹ This is typically achieved via a spring-loaded, pressure-limiting valve. These standards emphasise that pressure release systems must also satisfy minimum guaranteed tidal volume requirements, balancing adequate ventilation with lung protection. However, limited evidence, along with our experience and published reports, suggests that these requirements may not always be met in practice.

Over the past 12-months, our emergency medical service in Victoria, Australia, has identified 4 patient safety events where BVMs fitted with a pressure-limiting valve may have prevented adequate ventilation during resuscitation (Table 1). Two of these cases are described.

Case one: An adult in cardiac arrest due to respiratory failure was ventilated with a supraglottic airway (SGA) device. Despite waveform capnography showing no trace, ventilation was deemed adequate based on the feel of the self-inflating bag and perceived chest movement. Ten minutes into resuscitation, paramedics noticed an audible air leak from the BVM resuscitator and closed the pressure-limiting valve. The BVM then became stiff and difficult to squeeze. Subsequent intubation revealed a bronchospasm capnography trace and high EtCO₂ values (>60 mmHg).

Case two: Paramedics performed rapid sequence intubation on an unconscious patient who had aspirated, reporting a grade one view with video laryngoscopy. Post-intubation ventilation, however, produced a flat capnography trace, which was suspected to be due to an equipment fault. During equipment troubleshooting, oxygen desaturation occurred, prompting tracheal tube removal and rescue ventilation with an SGA. This also failed to produce a capnography trace and desaturation

continued. Declaring a CICO situation, paramedics performed surgical cricothyroidotomy, yet upon ventilation the flat trace persisted. A leak from the BVM was then noticed and the pressure-limiting valve closed; immediately resulting in high EtCO₂ values (55–65 mmHg) and increasing oxygen saturation.

The hazards of pressure-limiting valves impeding adequate ventilation, though long recognised, have gained renewed attention through recent case reports.^{2,3} These reports have also underscored the safety implications of altering a familiar and commonly used piece of equipment without requisite notice. Indeed, in many of our cases, paramedic awareness of these valves on adult BVMs and its practical implications were lacking.

Like others, we are concerned about the efficacy of pressure-limiting valves in emergency settings and the difficulties in identifying associated ventilatory problems.^{2,3} Studies demonstrating elevated airway pressures during cardiac arrest resuscitation also raise concerns about adequacy of ventilation in this cohort.^{4,5} Given the described cases and limited evidence linking high airway pressure *alone* with lung injury, our EMS now mandates that pressure limiting valves are closed during the initial phases of resuscitation. Ironically, we consider this the safest option until knowledge gaps are addressed and evidence-based guidelines become available.

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Matthew Humar: Conceptualization, Investigation, Visualization, Writing – original draft. **Benjamin Meadley:** Conceptualization, Supervision, Writing – review & editing. **Christopher Groombridge:** Supervision, Writing – review & editing. **Bart Cresswell:** Writing – review & editing. **David Anderson:** Writing – review & editing. **Ziad Nehme:** Conceptualization, Visualization, Writing – review & editing.

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Table 1

Description of four cases where BVMs fitted with pressure limiting valves may have prevented adequate ventilation.

Case Number	Case summary	Airway technique	Signs of inadequate ventilation	Result
Case 1	52-year-old with an initial asystolic OHCA of respiratory aetiology	SGA	Audible air leak from PLV with no capnography trace for 10 min	PLV closed with immediate restoration of a capnography trace. Patient subsequently intubated, producing bronchospasm capnograms and high EtCO ₂ values
Case 2	30-year-old presented unconscious following drug overdose	Tracheal intubation	Audible air leak from PLV with no capnography trace for 6 min and oxygen desaturation (lowest SpO ₂ 37 %)	Following unsuccessful SGA ventilation, cricothyroidotomy was performed. This also failed to produce a capnography trace until the PLV was closed
Case 3	20-year-old presented unconscious following a drug overdose with suspected anaphylaxis during anaesthesia	Tracheal intubation	No capnography trace or chest movement for 9 min. Rescue ventilation techniques also failed to produce a capnography trace	Multiple intubations attempts were made. For the third intubation attempt a BVM without a PLV was used to provide ventilation, resulting in restoration of a capnography trace
Case 4	22-year-old presented in status epilepticus with airway compromise and respiratory failure	Tracheal intubation	Oxygen desaturation (lowest SpO ₂ 76 %) for 9-min following successful intubation	High airway pressures compromised mechanical ventilation, necessitating a return to BVM ventilation. Oxygen desaturation persisted until the PLV was closed

Key: OHCA – out-of-hospital cardiac arrest, SGA – supraglottic airway, PLV – pressure-limiting valve, EtCO₂ – end-tidal carbon dioxide, BVM – bag-valve-mask, SpO₂ – arterial oxygen saturation.

Declaration of competing interest

The authors declare the following financial interests/personal

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