

Rescue ventilation using expiratory ventilation assistance : innovating while clutching at straws

Citation for published version (APA):

Hamaekers, A. E. W. (2015). *Rescue ventilation using expiratory ventilation assistance : innovating while clutching at straws*. Maastricht University. <https://doi.org/10.26481/dis.20151211ah>

Document status and date:

Published: 01/01/2015

DOI:

[10.26481/dis.20151211ah](https://doi.org/10.26481/dis.20151211ah)

Document Version:

Publisher's PDF, also known as Version of record

Please check the document version of this publication:

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Valorisation addendum

The focus of this thesis was on the management of a 'cannot intubate, cannot oxygenate' (CICO) scenario. This is a clinical situation wherein attempted tracheal intubation has failed and oxygenation cannot be maintained by non-invasive means. If not corrected rapidly hypoxia will inevitably lead to brain damage and death. The incidence of CICO in general anaesthetic practice is low. The 4th National Audit Project of the Royal College of Anaesthetists and Difficult Airway Society (NAP4) reported a calculated incidence of emergency percutaneous airway of 1 in 50,000 general anaesthetics. However, the incidence is strongly influenced by clinical setting and case-mix, and an incidence as high as 11% has been reported in the pre-hospital setting.

The clinical impact of the work described in this thesis is three-fold. Firstly, one of our studies revealed a potential hazard of currently recommended practice. Various simple, self-assembled devices made of a three-way stopcock and oxygen tubing have been proposed in standard anesthesia textbook for emergency jet ventilation. The assembling of these devices was also taught on several national and international airway and emergency courses (including ATLS). We tested the proposed devices and noticed that they carried an intrinsic risk as they didn't control the oxygen flow to the patient. We concluded that the self-assembled devices based on a three-way stopcock, as described in the textbooks, should not be used in a CICO situation. The results of

our study led to a change in the learning objectives of many airway courses, are included in updated airway algorithms and are already referred to in some anesthesia textbooks.

The second part of this thesis focused on the introduction of a new ventilation mode called expiratory ventilation assistance (EVA). Flow-controlled EVA is used for ventilation through small-bore cannulas and can be considered a hybrid technique in between intermittent positive pressure ventilation with passive expiration, which requires a wide-bore tube and sealed airway, and jet ventilation through a narrow-bore catheter, which requires high injection pressures and an open upper airway. The ability of controlling the expiration and achieving a sufficient respiratory minute volume of 7 litres through a narrow-bore catheter in a blocked airway allows for a new array of clinical applications. The full potential of EVA within modern airway management, including elective routine use for airway surgery, single lung ventilation and lung-protective ventilation, has yet to be explored.

Thirdly, probably the most evident impact on current clinical practice of this thesis is the development of an emergency ventilation device using EVA. Based on the optimized prototype for EVA (DE5, chapter 5), a portable, flow-regulated, manually operated, and ergonomically shaped ventilation device was developed by Dolphys Medical. The Ven-train® (Dolphys Medical BV, Eindhoven, The Netherlands) is available in Europe, Australia and the United States. Several

case reports of adults and children that have been rescued by emergency oxygenation using the Ventrain® illustrate the importance of the work described in this thesis.

In addition to the risk reduction for the patient and of course the commercial benefits this thesis has an important impli-

cation for all physicians responsible for securing the airway and maintaining oxygenation. For us it is a relief to know that when you get into serious difficulties insertion of only a 2 mm airway catheter will be sufficient to get control over the situation again.