Adequate minute volume ventilation through a 100 cm long, 3 mm inner diameter airway exchange catheter by expiratory ventilation assistance (EVA)

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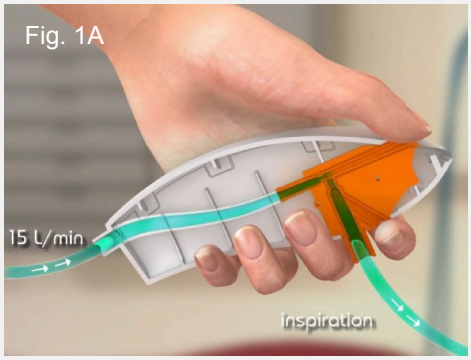
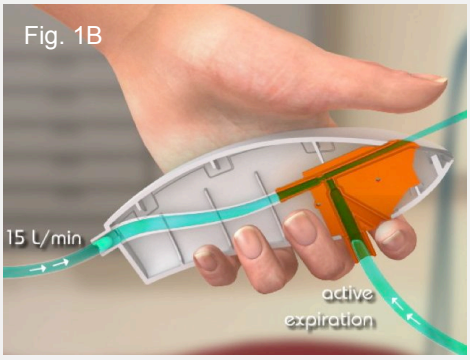
Background and goal of study

In the management of a difficult airway the use of an airway exchange catheter (AEC) is often suggested for facilitating intubation or oxygenation in critical situations [1]. Data on how to achieve safe and efficient oxygenation and ventilation through an AEC are still sparse. Recently, a jet-flow driven ventilation device, Ventrain (Dolphys Medical, Eindhoven, The Netherlands), applying expiratory ventilation assistance (EVA) by suction became available (fig. 1A + B). A prototype of this ventilation ejector has been able to achieve a minute volume of approximately 7 liters through a 7.5 cm long, 2 mm inner diameter (ID) transtracheal cannula [2, 3]. The goal of this study was to evaluate the efficacy of Ventrain in combination with a long small-lumen AEC (fig. 2).





Material and methods

A Ventrain was connected to an air flowmeter (Digiflow; Dräger, Lübeck, Germany) set at a flow of 15 l/min and an 100 cm long, 3 mm ID AEC (Cook Medical, Bloomington, IN, USA). On a ASL 5000 lung simulator (Ingmar Medical, Pittsburgh, PA, USA) inspiratory and expiratory times were measured during EVA and passive expiration (Ventrain disconnected) with tidal volumes of 600 ml at variable compliances (100, 50, 30, 10 ml/mbar) and resistances (5, 8, 32 mbar/l/s). Based on the means of five consecutive breaths the minute volume (MV) and inspiration/expiration ratio (I/E ratio) were calculated for each pulmonary setting.

Results

Because of small standard deviations only the means of the measured data are presented.

compliance (ml/mbar)	**100**	**50**	**30**	**30**	**30**	**10**
resistance (mbar/l/s)	**5**	**5**	**5**	**8**	**32**	**32**
inspiratory time (s) – EVA	2.39	2.40	2.39	2.39	2.40	2.41
expiratory time (s) – EVA	2.50	2.47	2.41	2.42	2.48	2.29
inspiratory time (s) – passive expiration	2.42	2.47	2.48	2.44	2.47	2.48
expiratory time (s) – passive expiration	18.80	10.96	7.77	7.32	8.45	4.27
MV (l/min) – EVA	7.36	7.39	7.49	7.48	7.38	7.66
I/E ratio (s) – EVA	1/1.04	1/1.03	1/1.01	1/1.01	1/1.03	1/0.95
MV (l/min) – passive expiration	1.70	2.69	3.52	3.69	3.30	5.33
I/E ratio (s) – passive expiration	1/7.79	1/4.45	1/3.14	1/2.99	1/3.42	1/1.72

Conclusion

Our in vitro data show that Ventrain is capable of achieving adequate minute volume ventilation through a 100 cm long, 3 mm ID AEC by applying EVA in a simulated completely obstructed airway. The I:E ratio of 1:1 facilitates clinical application of Ventrain with this AEC.

Literature
1) Anesthesiology 98 (2003): 1269-77
2) Br J Anaesth 106 (2011): 403-9
3) Br J Anaesth 108 (2012): 1017-21

Acknowledgements
Fig. 1A + B have been taken from an instructional animation (www.ventrain.com; see QR code) with permission of Dolphys Medical. Fig. 2 has been provided by Sebastian Enk.

Conflict of interests
Dietmar Enk is the inventor of the Ventrain and receives royalty payments from Dolphys Medical.

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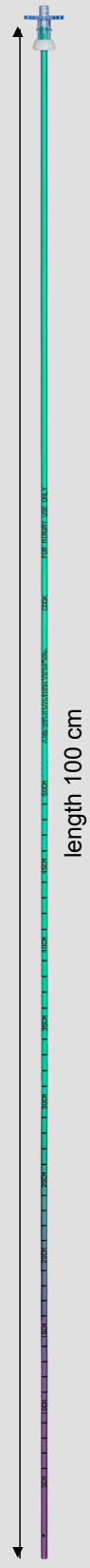
Fig. 2



Poster, ESA 2012 (Paris, France)