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Effect of the tube-guiding channel on intubation success with videolaryngoscopes

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ABSTRACT

Background: Videolaryngoscopes are widely used to secure normal and difficult airways. A wide variety of devices has been marketed and videolaryngoscopes with and without a channel to guide the tube into the trachea are available. It is however unclear whether or not a tube-guiding channel does indeed facilitate intubation with videolaryngoscopes.
Aim: The aim of this analysis is to study the effect of the tube-guiding channel on the first attempt intubation success rate of different videolaryngoscopes and on other intubation parameters (such as time to successful intubation and visualisation parameters) in humans with a simulated difficult airway.
Methods: We analysed data of two previously published randomised controlled trials, both performed under the lead of our study group at the Department of Anaesthesiology and Pain Therapy at the Bern University Hospital and University of Bern, Bern, Switzerland. One study, published in cooperation with the University Hospitals of Lausanne and Geneva, evaluated the channelled versions of the videolaryngoscopes Airtraq™, A.P. Advance™ and KingVision™. The other study assessed the unchannelled versions of the same videolaryngoscopes. In the current analysis, the combined data of both studies was compared, the channelled version against its unchannelled counterpart. All patients had a simulated difficult airway with no neck movement and limited mouth opening.
Results: We found no difference in first attempt intubation success rates for all 3 devices in their channelled and unchannelled versions. Overall success rate was significantly better with the unchannelled A.P. Advance™ compared to the channelled A.P. Advance™ ($p < 0.01$). It did not differ between the channelled and unchannelled versions of the Airtraq™ and the KingVision™. Interestingly, the Cormack-Lehane grade and the Percentage of Glottic Opening (POGO) score were significantly worse for the unchannelled A.P. Advance™ compared to its channelled version (both p-values < 0.01).
Conclusion: General blade design seems to be more important for the performance of videolaryngoscopes than the presence of a tube-guiding channel.

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1. Introduction

Airway management remains one of the most important skills of anaesthetists [1,2]. Airway management related deaths have decreased over the last decades [3]. Nevertheless, unanticipated difficult airways are still a main cause of anaesthesiology-related morbidity and mortality [4–8] and remain challenging for anaesthesiologists [9,10].

The NAP4 audit project in Great Britain showed an incidence of serious complications in 1 of 22.000 and an incidence of serious adverse events in 1 of 180.000 airway management cases [11]. According to a number of studies the rate of difficult mask ventilation varies between 0.83 and 1% [12]; the rate of difficult direct laryngoscopy varies between 1.5 and 8% [13]; the rate of difficult intubation varies between 1.8 and 5.8% [12,14,15]; and the failed intubation rate varies between 0.1 and 0.3% [12,16].

The current gold standard to manage a patient with an anticipated difficult airway is the awake fibre-optic intubation. However, videolaryngoscopy is increasingly used to manage predicted and

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unpredicted difficult airways [17,18].

For routine airway management the 'sniffing position' is the preferred position [19]. However, in patients with suspected head and/or neck trauma this position is avoided [20] and instead, manual in-line stabilisation is applied to reduce c-spine movement during airway management [21]. Similarly, an extrication collar inhibits cervical spine movement and reduces mouth opening, which as a consequence worsens visualisation of the glottis during standard laryngoscopy [20,22–25]. Videolaryngoscopes usually provide a better laryngeal view compared to the standard Macintosh laryngoscope [1,2,4–7,13,17,18,23,25–52]. Using standard Macintosh laryngoscopes requires the alignment of the oral, pharyngeal and laryngeal axes for intubation to obtain a good glottic view. Videolaryngoscopes do not need to align these 3 axes to visualise the glottis opening; however, it is necessary to angulate the tracheal tube similar to the angulation of the blade in order to direct the tube into the trachea [8,25,48,49,53].

Studies showed a lower incidence of primary oesophageal intubations when using videolaryngoscopes compared to using standard Macintosh laryngoscopes [30]. However, the use of videolaryngoscopy prolongs the time to establish a patent airway [37].

Nowadays, videolaryngoscopes are often used as rescue devices for the management of the unanticipated difficult airway [13,37,40,54,55]. Additionally, there is a tendency to use videolaryngoscopes also as first line airway management devices for routine and difficult airway management [35,50,56,57]. Despite the fact that many videolaryngoscopes showed a high first attempt success rate of about 88–100% [45], conventional direct laryngoscopy is still used primarily in 83% of emergency airway management cases [58]. However, videolaryngoscopes are recommended to be used widely [34,45,48,50] to reduce intubation attempts during routine and difficult airway management [57].

Pieters and colleagues tested a wide variety of videolaryngoscopes with all key operators (consultants, residents, nurse anaesthetists), but could not identify a single best videolaryngoscope [55]. It also remains unclear, which kind of videolaryngoscope would be superior - with or without a tube guiding channel. To answer this question, we analysed two data sets obtained by studies of our own group: The randomised controlled study published by Kleine-Brueggeney et al. from our study group (in cooperation with the University Hospitals of Lausanne and Geneva), including 3 channelled and 3 unchannelled videolaryngoscopes, suggested that the blade design indeed might determine the performance of the device rather than the presence of a tube-guiding channel [33]. A second randomised controlled trial by our study group, which used the same study design and methods, then assessed the unchannelled versions of the channelled videolaryngoscopes tested in the first study and found mixed results [36].

To our knowledge there are no randomised controlled trials directly comparing channelled and unchannelled videolaryngoscopes to investigate the effect of a tube-guiding channel. To close this knowledge gap, we performed this additional analysis of our previously published data [33,36]. We therefore compared the performance of the channelled and the unchannelled versions of 3 videolaryngoscopes.

2. Methods

This analysis of previously published data [33,36] was performed under the lead of the Department of Anaesthesiology and Pain Therapy, Bern University Hospital and University of Bern, Bern, Switzerland from April to June 2017. As this is an analysis of already recorded data no new IRB approval was needed. Both original studies obtained ethics committee approval by the local cantonal ethics committee and all study participants provided written informed consent as described in the respective publications [33,36].

Data of the following three channelled videolaryngoscopes and their three unchannelled counterparts were used: the Airtraq™ (Prodol, Meditec SA, Vizcaya, Spain), the A.P. Advance™ (Venner Medical SA, Singapore) and the KingVision™ (Kingsystem, Noblesville, IN, USA). The data of the three channelled videolaryngoscopes originate from a randomised controlled trial from our study group [33], while the data of the three unchannelled versions of the videolaryngoscopes originate from another randomised controlled trial from our study group which used the same study design [36].

Both prospective randomised controlled trials included patients with a simulated difficult airway created by using an extrication collar (Stifneck™; Laerdal, Copenhagen, Denmark) to reduce mouth opening and inhibit neck movement. The primary hypothesis of both studies was that the 95% confidence interval of the first attempt intubation success rate would be above 90% for each device.

The methods and measurements as well as the in- and exclusion criteria were the same for both studies and were published in 2013 [29]. There were slight methodological differences between both studies: The first study was performed at three centres: the University Hospitals of Bern, Lausanne and Geneva, all in Switzerland. It included 120 patients for each videolaryngoscope. Twelve experienced anaesthesiologists performed 10 intubations with each device [33]. The second study was a single-centre study at the University Hospital of Bern, Switzerland and also included 120 patients for each videolaryngoscope. In this study only 6 experienced anaesthesiologists participated and each of them performed 20 intubations with each device [36]. Before the start of the studies none of the videolaryngoscopes was a standard intubation device at the departments. All participating experienced anaesthesiologists practiced with all devices on manikins, and on patients with predicted normal airways, until they gained competency with the devices.

For the current analysis we extracted the data from these original studies [33,36]. We performed a comparison of the channelled versus the unchannelled versions of the respective devices. The comparisons included 120 patients for each device:

(1) Airtraq™ (Prodol Meditec SA, Vizcaya, Spain), channelled blade, size 2 in women; size 3 in men [33] versus Airtraq™ (Prodol Meditec SA, Vizcaya, Spain), unchannelled blade, size 2 in women; size 3 in men [36].
(2) A.P. Advance™ MAC (Venner Medical SA, Singapore), channelled difficult airway blade [33] versus A.P. Advance™ MAC (Venner Medical SA, Singapore), unchannelled Macintosh-style blade size 3 [36].
(3) KingVision™ (Kingsystems, Noblesville, IN, USA), channelled blade size 3 [33] versus KingVision™ (Kingsystems, Noblesville, IN, USA), unchannelled blade size 3 [36].

To control whether both cohorts are comparable we assessed baseline characteristics such as sex, age, ASA status, BMI, Mallampati score, and mouth opening before and after adjustment of an extrication collar.

Primary outcome parameter was the first attempt intubation success rate. Secondary outcome parameters included the Cormack-Lehane (CL) grade [59] and percentage of glottic opening (POGO) score [60], the overall success rate, device insertion into the oropharynx, quality of view, ease of tube advancement, time to visualise the glottis, the intubation time as well as any adverse events. Time was measured from the moment the facemask was

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