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REVIEW PAPER

What is new in airway management

Sanne Bombeek[1] · Davide Cattano[2] · Tom C. R. V. Van Zundert[3]

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Nature knows no pause in progress and development, and attaches her curse on all inaction.
– J. W. von Goethe

Although not as exceptional as 2020, last year remained subjugated by the COVID-19 pandemic. One of the tiniest of all living creatures, a virus, was and is still keeping humanity under its thumb. National Geographic estimated there are a mind-boggling 10 nonillion (10 to the 31st power) individual viruses that exist on our planet—enough to assign one to every star in the universe 100 million times over [1]. Reason enough to believe that this pandemic will not be the last of our generation. A matter to deal with on another occasion.

The pandemic elucidated this virus can attack anyone, irrespective of race, gender, function, or status. Although sickness and death have no bias, one could argue that access to care and health disparities would put a toll on outcomes and safety. News from friends or colleagues succumbing to the disease, affected us deeply: to add to the tragedy, burnout and depression have doubled the burdens.

While science and research endeavours were significantly hampered, apart from SARS-CoV-2 related research, anaesthesiology was positively impacted by COVID-19. In particular, modifications in airway management with the purposes of protecting both patients and healthcare workers, sprouted clinical and technological research.

✉ Tom C. R. V. Van Zundert
tomvanzundert@icloud.com

Sanne Bombeek
bombeek.sanne@gmail.com

Davide Cattano
Davide.Cattano@uth.tmc.edu

1 Department of Emergency Medicine, Onze-Lieve-Vrouw Hospital, Aalst, Belgium

2 Department of Anesthesiology, McGovern Medical School at UT Health, Houston, TX, USA

3 Udayana University, Bali, Indonesia

Diving further into academia, several papers have been published considering the impact of COVID-19 on airway management since it is one of the highest risk procedures for aerosol and droplet dispersion. The emphasis hereby lies on using adequate personal protective equipment to reduce exposure risk to providers and minimalizing aerosolization [2–6]. To accomplish the latter, endotracheal intubation should be performed after preoxygenation with a tight-fitting facemask applied with a two-handed "vice grip" in a spontaneously breathing patient [3–5]. A HEPA filter should be attached directly to any airway adjuncts and especially the airway outlet of a ventilator to prevent the potential spread of infectious respiratory droplets [2–5]. Judicious use of neuromuscular blocking agents (NMBA) is recommended to ensure adequate paralysis [2, 4, 5].

The optimal method for apnoeic oxygenation remains unclear. It has been suggested that nasal oxygen therapy or non-rebreather (NRB) masks increase the risk of aerosolizing viral particles [2, 3, 5]: authors seem divided in those advising to place a surgical mask over the nasal cannula or the NRB [2], while others advise against the use of nasal oxygen therapy or NRB for apnoeic oxygenation altogether [3, 5] and recommend bag-mask ventilation once hypoxemia is present or imminent [3, 4]. Extubation strategies should be carefully premeditated aiming to attenuate emergence-response of airway irritation and agitation by considering the use of antitussive medication [3–5].

Due to the COVID-19 pandemic, patients are increasingly ventilated during anaesthesia and in the ICU for a longer duration, hence adequate pressure in the endotracheal tube (ETT) cuff is of paramount importance. Both over-inflation, as well as under-inflation, are associated with clinically significant complications [7] and insufficient inflation pressure could lead to leaks and the risk of aerosolization [4, 5]. Intracuff pressure should be aimed to be between 40 and 60 cm H_2O to create an adequate seal around the patient's glottic entrance and should be checked whenever feasible, possibly three times daily [7].

As we approach a sustainable practice and become sensible to our carbon footprint, the use of disposable and recyclable equipment is a rising concern [8]. However, videolaryngoscopy (VLS), preferably with a disposable blade, is recommended as a first-line strategy for airway management in COVID-19 patients with progression to second-generation supraglottic airway device (SAD) if endotracheal intubation attempts fail [2–5]. Second-generation SADs provide a higher oropharyngeal leak pressure (OPLP) during positive pressure ventilation, resulting in a decreased risk of aerosolization [2–5].

Currently, first-, and second-generation SADs have a larger global market share than ETTs during surgical interventions [9, 10], yet those markets are territorial and operator/standards dependent and they were definitely modified by the pandemic.

SADs in general are considered easier to insert than ETTs and result in fewer complications and high patient satisfaction [9]. Indications for use include the perioperative and prehospital period, the emergency, obstetric and ICU patient [9–11]. Furthermore, SADs have also been advocated during cardiac resuscitation [9–11].

Several modifications and improvements (i.e., reinforced distal tip, the addition of a bite block and gastric drain tube, anatomically curved tube, use of medical-grade silicone) have been made to the device over the last four decades [9–13].

However, forty years after the introduction of the laryngeal mask airway, we are still using the blind insertion technique and hope for the best to reach a satisfying position [9–11]. Numerous studies consistently showed that 50–80% of all blindly inserted first and second-generation devices, irrespective of SAD type, brand, size, cuffed/non-cuffed, are placed suboptimally in the hypopharynx [9–13]. A long list of indirect subjective observational tests (e.g., bubble test, suprasternal notch test, audible noise detection at the mouth), and measurements of OPLP and intracuff pressure are inadequate to confirm adequate positioning of the SAD [7, 9, 11, 12].

Fibreoptic evaluation of the position of the SAD is an ideal instrument to evaluate the position of the device as it can visualize the glottis entrance, and the entrance to the oesophagus, although it lacks the possibility to manoeuvre the device in case it is not sitting correctly [9, 10]. In addition, VLS can be used to insert SADs in the correct position [10–13]. Original work demonstrated that vision-guided insertion using VLS results in about 95% correct positioning of the SAD into the hypopharynx, whereas the literature shows that 50–80% of 2nd-generation SADs sits suboptimally [13]. The use of VLS allows manoeuvres to correct any malposition and it allows to check whether the correct sizing is applied [10, 11, 13]. Although videolaryngoscopes are useful adjuncts to put the SAD in the correct position, they still have disadvantages such as increased cost, but essentially it adds to an already crowded oropharynx, not leaving much room to insert an extra device [11].

Recently conceptualization and designing of a SAD with an integrated videoscope has regained interest [9, 11]: a combination of a second-generation SAD with a scope is considered a third-generation SAD [9, 11]. Two of these third-generation devices have recently been released and their characteristics and functionality described in this journal [9, 11]. In reality integrated-videoscope for guided intubation through an SAD are not new: the LMA-C Trach and Total-Track VLM were manufactured in the past, although the production of the former has been discontinued since then, but their goal was on intubation of the trachea and not on the successful-insertion of the SAD per se [9, 11].

As we mentioned earlier about the importance and judicious usage of NMBA, few considerations are due: the use of ETT versus SAD during general anaesthesia was recently associated with a higher risk of emergent postoperative intubations [14]. Part of the effect can be explained by using NMBA which eliminated the preventive effects of SAD on emergent intubation risk [14].

It is known that SADs are valued rescue devices for endotracheal intubation and are part of the difficult airway algorithms. Intubation success can be limited by dimensional incompatibilities between devices and even the help of a fibreoptic bronchoscope does not always guarantee a good result. Moser et al. studied the feasibility of intubation and extubation in an airway head manikin and tested more than 1000 combinations [15]. Often the narrow diameter of the ventilation tube of first-generation SADs prevented ETT passage [15]. However, almost all combinations with second-generation SADs permitted passage of the ETT [15]. Removal of the SADs over the ETT was often impossible or not ideal because of the ETT connector that is firmly attached to most reinforced ETTs [15]. Anaesthetists should test the intubation and extubation options of the devices used in their hospital with their specific range of airway devices.

A review article about airway management would not be thorough without a section about difficult airway management. Ultrasonography (USG) has already become a daily practice for anaesthetists and intensivists (vascular access, cardiac explorations, nerve blockade), but is still under-utilised for airway management and assessment. By exploring the entire airway, USG proposes new criteria (a) to assess the risk of difficult laryngoscopy, (b) to anticipate the management of a difficult airway, (c) to confirm the position of the ETT, and (d) to confirm that the lungs are effectively ventilated [16]. Additionally, USG can be used to evaluate a full stomach and to facilitate urgent cricothyrotomies or tracheostomies [16].

When compared to traditional USG machines, handheld point-of-care ultrasound (POCUS) provides several potential benefits (lower cost, portability, easier cleaning) in emergency airway management but still lags behind in image quality [17]. However, POCUS shows promise to facilitate rapid screening for difficult laryngoscopy, identifying the cricothyroid membrane, assessment for increased aspiration risk, as well as providing confirmation of ETT placement [17]. Furthermore, a case report in this journal by Kundra et al. described ultrasound-guided tracheal intubation with a styleted ETT as a useful option to the secure the airway in patients with limited head extension [18]. Ahn et al. evaluated a new ultrasound scoring system to identify the position and air leaks during ventilation using i-gel in a paediatric population and demonstrated their usefulness by detecting misplacement in about one-third of the patients [19].

Few more topics of interest are necessary to be mentioned. The first automated, computer-assisted, tracheal device insertion in a manikin was performed: 'robotic endoscope-automated via laryngeal imaging for tracheal intubation' (REALITI). A video-endoscopic stylet that guides a tracheal tube, is mounted over its shaft, into the trachea, whereby the endoscope tip can be controlled manually or, on demand, bends automatically towards the glottic entrance [20]. Clinical studies are eagerly awaited to confirm the promising manikin studies.

Super-obesity (body mass index (BMI) > 50 kg/m^2) and neck circumference greater than 42 cm are independent predictors risk factors of difficult intubation [21, 22]. Preparedness for said difficult intubation is therefore necessary and the use of VLS justified [21, 22]. A recent randomized controlled study in this journal showed that the 'Percentage of Glottis Opening' scale (POGO score) was significantly higher with the use of McGrath Mac when compared to the I-view videolaryngoscope [21]. Nonetheless, I-view still provided sufficient view of the glottis to perform safe and effective endotracheal intubation as published in the 2021 issue of the Journal [21].

Lastly, the Infrared Intubation System (IRRIS) was introduced to facilitate glottis identification in severely obese patients since VLS has certain limitations when performed by less experienced users [22]. IRRIS is a recent revival of retrograde transillumination, a technique in which near-infrared light is applied on the anterior surface of the neck, which in turn, produces a distinctive blinking light within the tracheal lumen on the VLS screen [22]. A recent study in this journal showed that the IRRIS is useful for videolaryngoscopic intubation by clearly distinguishing the airway from the oesophagus and adjacent anatomical structures [22]. Even extreme obesity, with a longer distance from the skin surface to the tracheal lumen, is no hindrance to the functioning of the retrograde transillumination effect [22].

Some closing remarks are important to be discussed. Even in this new era of technology-marvels and exponential growth of new airway devices and gadgets, human judgement remains a fundamental point of safety and quality: unfortunately, there still are judgement errors that lead to fatal and permanent consequences.

Effective airway strategies depend on pre-procedure preparation and anticipation: human factors, skills, situational awareness, communication and teamwork, all play a role in successful and safe airway management [23].

Omission of the preoperative examination, perseveration or fixation bias and the tendency for inaction rather than action are other important factors to consider [23]. Recent studies in the UK, USA and Canada analysing medico-legal claims of anaesthesia airway-related complications still emphasize the need for improvements in difficult airway management despite the widespread dissemination of practice guidelines [23].

However, the recent introduction of visual-cognitive aids integrated into a teamwork approach and perfected into a skill-oriented solution may serve safer clinical practice [23].

In conclusion, we have witnessed worldwide disruption and distress: nevertheless, 2021 was a productive year in airway management-related research to improve the practice of anaesthesia and to make our service to patients better and safer. Anaesthetists are known to be leaders in patient safety, quality management, simulation and they are experts in airway management. Only a continuous strive for excellence can help us to achieve a "no event" culture.

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Declarations

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