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EDITORIAL VIEW

Videolaryngoscopes: from a vision problem to a communication problem

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ABSTRACT

Safe airway management is one of the fundamental responsibilities of the anesthesiologist, and oxygenation maintaining through gas exchange must be vital priority. Inability to manage properly the airway can trigger lesions secondary to hypoxia in a few minutes, and is the main cause of anesthesia morbidity and mortality.

When we face a difficult airway the information transmission is essential. Since 2006, Spanish health system has promoted the electronic health record (EHR) as a coordination and cohesion mechanism of safe health care for patients, guaranteeing access to the most relevant medical documentation of each patient.

This EHR will generate an enormous amount of information, data that will be analyzed through Big Data. Anesthesiologists will have access to a lot of data from pre-, intra- and post-operative patient situation, and the ability to analyze efficiently these data will have important implications for the care and treatment provided, especially in the operating room.

Key words: Airway Management; Predictors; Difficult Airway; Preoperative Evaluation; Big Data; Healthcare; Electronic Health Record; Artificial Intelligence; Patient Safety

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As we all know, safe airway management is one of the fundamental responsibilities of the anesthesiologists, and maintaining the gas exchange of the patient is a priority. It will be achieved according to the context, clinical situation, and environment in which you re working, and the airway management devices and the facilities available to you.[1]

Almost two-thirds of the problems related to airway management will occur during anesthesia induction, with the orotracheal intubation failure and the inability to maintain adequate ventilation triggering the after effects of the resultant hypoxia within a few minutes, and it remains the main cause of anesthesia related morbidity and mortality.[2,3]

It is, therefore, the duty of the anesthesiologist to develop skills to be prepared to deal with a difficult airway, whether anticipated or not, thus increasing the margin of safety in their daily practice.[4] This is why, within this safety culture, videolaryngoscopes (VLS) have gradually found their way in clinical anesthesia practice. However, the rigid Macintosh laryngoscope continues to be the gold standard for orotracheal intubation.[5]

Currently, the international guidelines propose to use the VLS when the ventilation with face mask is effective and a previous attempt of intubation with a direct laryngoscope has been failed. From this, it can be extrapolated that the percentage of VLS use would be equivalent to that of difficult intubation in non-urgent situations/scenarios, described around 5.8% (95% CI, 4.5-7.5%).[6]

In the algorithm of the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Practice guidelines for management of the difficult airway: 2013[7]) VLS were included for the first time as rescue devices in case of unanticipted difficult airway and intubation failure, later entering in daily practice. Difficult Airway Society

(DAS) included it in the guidelines issued in 2015, recommending VLS as routine airway devices within Plan A management.

It is impossible to know how many intubations are carried out daily using them,[8]) and clearly the main advantage of these devices depends not only on the "*quantitative*" improvement of laryngoscopy, but on the quality in the imaging and the possibility of facilitating teaching with continuous monitoring of the resident during intubation.[9]

Since the first VLS appeared in 1996 (US patent 5,827,178) to date, devices such as Glidescope (2001), Airtraq (invention of Spanish physician Pedro Acha, Spain, 2005, US Patent 6,843,769) or others (Pentax AWS, C-MAC, Trueview, King Vision, etc.) have emerged, up to the modern TOTALTRACK VLM, a latest generation video laryngeal mask that allows continuous patient ventilation to achieve intubation.

In 2012, Healy et al. performed a systematic review with the aim of organizing the literature of efficacy of modern VLS and then performing a quality assessment and making recommendations about use. The DAS proposed the ADEPT study on "*Evidence of Various Airway Devices*". Moreover, the 4th National Audit Project (NAP4) on major complications in airway management specifically mentioned the theoretical, but not proved, the benefit of VLS, especially Airtraq, although the reported cases where they were used were scarce (12 de 184 cases [7%]),[10] and although these devices improved vision of the larynx, occasionally the endotracheal tube could not be successfully managed.

First generation of VLS that allows the oxygenation of the patient, and the first model is the TOTALTRACK VLM. The fundamental idea is to ventilate and oxygenate the patient from the beginning at the end, regardless of the maneuver that is decided in the management of the airway, which allows the anesthesiologist to have more time to decide what strategy is the best specifically for that particular patient. It also has a continuous airway vision system with an integrated anti-fog system. All this allows to improve the options of facing that airway management: it can be ventilated in laryngeal mask mode. It can be intubated in VLS mode. It can be a self-rescue airway management by re-ventilating in laryngeal mask mode, or can be ventilated and intubated with a fiberoptic bronchoscope. In this way, TOTALTRACK VLM covers all the plans proposed by the various international guidelines.[7,11]

Nevertheless, regardless of the predictors or the optical device used, failure of endotracheal intubation through direct or indirect laryngoscopy usually occurs unexpectedly. And, despite the high morbidity and mortality associated with an unpredictable difficult airway,[12] relevant information is often deficient or inadequate,[11,13]) for subsequent anesthesiologists. Although the patient are informed of the difficulty encountered in managing his airway, verbally or in writing, up to half of them will forget or lose this information.[14]

Among the systems that have traditionally been proposed for direct laryngoscopy information transmission is, first one is the Cormack-Lehane scale. This scale, proposed in 1984, describes 4 degrees of glottic exposure during direct laryngoscopy, with the patient in a maximal "*sniffing*" position, complete muscle relaxation, firm traction, and firm external laryngeal manipulations. Consequently, it is accepted that the difficulty for intubation can be suspected and even confirmed when direct laryngoscopy qualifies a grade 3 or 4 of this classification.[15] This scale was modified by Cook in 2000, increasing grade 3 in grade 3A and 3B or 3E, depending on whether or not the epiglottis is removed from the posterior wall.[16] However, even in grade 1 or 2 in indirect laryngoscopy is not always reflected in successful intubation. This is relatively frequent in VLS that have the curved blade, especially during the learning stage.[17] In some recent publications, such as the systematic review by Healy et al., the vision of the glottis was a desirable outcome but was not considered a target.

Problem lies in what happens when the approach is performed directly with a VLS and we find a *'difficult unanticipated airway'*. The aforementioned Cormack-Lehane scale are designed and validated for direct laryngoscopy, and the use of this classification to compare with VLS is questionable,[18] although it is used in all studies since there is no other alternative scheme. Therefore, these authors suggested a system that, describing the difficulty (easy, difficult or failed), with a record of the glottic view obtained (a "*modified Cormack-Lehane*"), and the name of the device used, and incorporating the difficulty encountered during the passage of the endotracheal tube should be successfully employed.

That is why different authors have already proposed to integrate those images and/or videos recorded during intubation with the VLS in the system of electronic medical history, along with other descriptors of the airway, for later anesthesiologists to see the data in the future.[8]

In Spain, public health system ensures the right

to health protection and care for all citizens as a constitutional right,[19] configured as a coordinated set of health services of the state administration and the autonomous communities with public financing, which guarantee the universality and free of charge of health services at the time of use.

Through the "*Online Health*" Program, the electronic health record (EHR) of the National Health System has been promoted as a coordination and cohesion mechanism that offers safer health care for patients and with greater margins of efficiency than paper history. The implementation of the EHR of the National Health System began in 2006 with the aim of guaranteeing citizens and health professionals access to the most relevant medical documentation for the health care of each patient. This model, which has more than 45 million histories, has been developed in different autonomous communities in a heterogeneous way.

In the community of Madrid (SERMAS) alone, there are more than 10 million image studies accessible from any of the 30 hospitals. These clinical images are integrated into the Horus web application. Through an image viewer (WADO), we can access to any imaging test stored in the system through a service front architecture (Meta-WADO). Using a DICOM integration engine (HydraDICOM v.2.3 of Metaemotion) connects to retrieve and cache images of more than 28 PACS from different centers and providers (General Electric, Agfa, Siemens, Philips, Indra, DCM4CHEE, etc.).

Integrating images and videos obtained through VLS in HER together with a description of the management of the airway of each patient would allow access to the data generated during the management of the patient's airway in previous interventions and would be included in the software through a form agreed by the Spanish Society of Anesthesia, Reanimation and Pain (SEDAR). It could be reflected the predictors observed during ventilation (HAN scale), vision obtained during intubation (Cormack-Lehane, pogo), the IDS scale, intubation information (tube used, attempts, preoxygenation, position, device, external maneuvers [Sellick, BURP], use of accessory material, such as a bougie, etc.), as well as images and/or videos obtained through VLS.

In this system of interconnection, patient privacy must be protected. Spain has legal norms, such as data protection law, biomedical research, patient rights, etc., which adequately regulate these aspects, although there is a need to improve how data management in the medical history will be managed, which define the profiles of the patients. Most health care organizations are developing similar information systems. In Europe, the project called epSOS is in the process of development and standardization. In the United States, where the health system is private, there is the Blue Button, a program that allows citizens to access their clinical information from the website of each health care provider, with the security procedure they determine.

HER will generate an enormous amount of information, data that can be analyzed through Big Data.[20-22] This mass health data management would allow the analysis of information from those millions of electronic medical records, including patient monitoring and telemedicine data, clinical order entry systems and medical prescriptions (electronic prescription, laboratory tests, shunts, etc.), decision supports systems, image storage and communication systems, and a long series of databases built for clinical, administrative or statistical purposes. This is the so-called Real World Data (RWD), which allows us to analyze the benefits and adverse effects of health decisions in daily practice, unlike clinical trials and other studies conducted under controlled conditions, reflecting the patient´s care in each specific context, and the medical outcomes they actually achieve.

The challenge for the analysis of great volumes of data is the development of huge, high-quality, multi-center databases. Investigating small datasets, randomized clinical trial (RCT) results and large amounts of data can identify subgroups of patients who could benefit from a particular intervention, or it may be an alternative in the fields where performing an RCT is not possible.

The differences between "*traditional*" analytical and management applications and the new Big Data concepts are associated with 5 words, the "*5 V*": Volume, Variety and Velocity, Truth and Value of the data.[22]

- The concept of Volume is very variable, and it includes "*large volumes of data*".
- Variety refers to the wide variety of sources of this data.
- Velocity refers to the speed with which data is received, processed and made decisions from it, because the data are out of date and lose their value quickly.
- The concept of Truthfulness reflects confidence in the data, and measures the usefulness of the data. Most of the incoming data are incomplete,

with missing or incorrect fields, and reflects how quality data are extracted, eliminating the inherent unpredictability of some data, and thus achieving correct decision-making.

- Finally, the concept of Value refers to the importance of the data, which are the ones that should be analyzed and which should not.

Big Data analysis provides a layer of intelligence that goes beyond evidence-based medicine (EBM), approaching personalized medicine that predicts and anticipates the health needs of patients and offers them the most appropriate medical care.

Anesthetists will have access to large amounts of data from pre-, intra- and postoperative periods. The ability to analyze efficiently these data has important implications for the care and treatment provided, especially in the operating room, where the condition of a patient may change minute by the minute, and the ability to process data quickly facilitates the identification of pathological states and early treatment.[23]

If we are able to detect risks in the health of patients, not only individually but also the population as a whole, we can use health resources in the most intelligent way and at a lower cost, something crucial in the moment we go through.

In a recent study conducted in 188,064 patients in Denmark that evaluated the airway preoperatively, conclusions regarding the ability of the usual or classic methods to detect the possible difficulty in their management were disappointing. And, perhaps, we should consider the need for a different approach.[24]

However, although the prediction obtained with these isolated tests or multivariate models is poor, all the guides recommend preoperative assessment of airway.[7,10] And the Big Data analysis offers a powerful help system to discern between significant differences and those that are not.[25]

Nevertheless, to infer the value to these data must be applied predictive models that allow us to optimize the care of patients. If we are able to detect risks in the health of patients, not only individually but also the population as a whole, we can use health resources in the most intelligent way and at a lower cost.

RWDs allow the development of sophisticated indicators to compare the quality of care received by patients cared for in different centers or by different physicians and to develop improvement strategies.

However, we must be cautious in substantiating the safety of our patients in clinical data analysis based on Big Data to detect the incidence of rare events, and be aware that most of the *difficult airways* are and will continue to be unanticipated.

Every failed intubation, emergency front-of-neck access, and airway-related unplanned admission should be reviewed and discussed, so that we must provide detailed clinical information with effective communication to other practitioners.

Conflict of interest: None

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