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# Imaging Tests for Predicting the Presence of Difficult Airway in Head and Neck Cancer Patients Undergoing Otorhinolaryngological Surgery

*Juan Gutiérrez Franchi, S. Merino, P. de la Calle, C. Perrino, M. Represa and P. Moral*

## Abstract

Patients with head and neck cancers represent a challenge for the surgical team from many points of view, but, especially, the surgical moment where greater stress generated corresponds to the perioperative management of the airway, because in many occasions we can face unexpected situations, most of the time, incidental findings can hinder ventilation and endotracheal intubation. Gutierrez et al., in 2018, decided to study four tomography measures and their correlation in anesthesia records with airway management difficulties. Material and methods: A retrospective, observational study was carried out in 104 patients operated by head and neck cancers over a period of 36 months, only in those with access to tomographic records. Four tomographic measurements were considered and were statistically related to the extreme degrees of visualization of the glottis (Cormack III–IV) and the presence of the physical examination of Mallampati III–IV. Results: After performing a multivariate model in the group of extreme degrees of visualization of the glottis, the results were not statistically significant ( $p > 0.05$ ; 95% CI: 0.030–2.31: EPI/PPW, 0.018–1.37 TB/PPW). In the Mallampati III–IV group, in the multivariate model only the VC/PPW showed clinically significant results ( $p < 0.05$ ; 95% CI: 0.104–8.53). Conclusions: Tomographic measurements and the physical examination predictors could represent a useful guide in the prediction of the difficult airway in these patients.

**Keywords:** difficult airway, computed axial tomography, predictors

## 1. Prevalence of head and neck cancers

### 1.1 Prevalence

Head and neck cancers represent 5% of all tumors [1]. The most frequent location is the larynx, followed by the oropharynx, oral cavity, and nasopharynx [2].

Squamous cell carcinomas account for 95% of all malignant tumors of the head and neck, while carcinomas of the salivary glands are almost the remaining 5%. They represent 4% of all malignant neoplasms in the USA. Epidermoid carcinomas of the head and neck can be divided into two different groups according to their pathogenesis, biology, and prognosis. The incidence of cancers related to the environment, mainly caused by tobacco and alcohol, has decreased; however, they are still frequent. An increased incidence of oropharyngeal cancers related to human papillomavirus (OHPV) has been observed. The OHPV currently accounts for about 75% of the oropharyngeal cancers seen in the USA and Europe. OHPV affect a younger population (50–60 years) than cancers of environmental origin (55–65 years). Patients with OHPV are generally also healthier and are not prone to comorbidities or the second neoplasms seen in epidermoid tumors related to environmental factors [3].

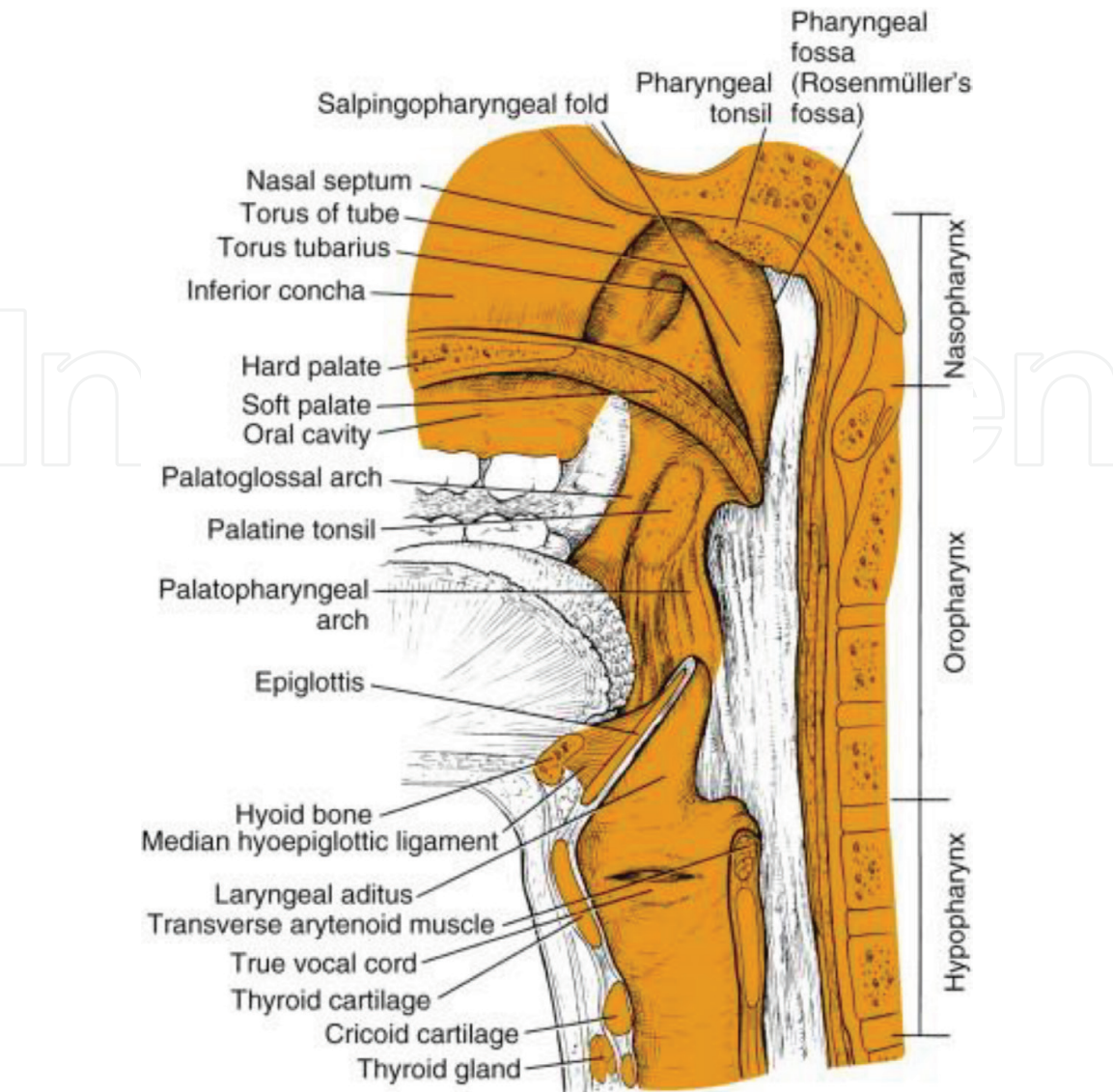
The mucosal surfaces of the head and neck are divided into six anatomical regions: the oral cavity, oropharynx, hypopharynx, larynx, nasopharynx, and paranasal sinuses. The anatomical location of an epidermoid carcinoma of the head and neck has important implications, although not well defined, for diagnosis, pathogenesis, dissemination pattern, prognosis, and treatment. Due to intrinsic differences in the biological characteristics of the mucous cells and posterior tumors' origin, tropisms of the carcinogenic viruses could be different lymphatic and anatomic distributions [3] **Figure 1**.

The oropharynx is an osteocartilaginous cavity with a content that extends from the lips to the anterior wall of the first cervical vertebrae and a content that includes the tongue, epiglottis, and hard/soft palate. In Europe and the USA, one of the main causal factors is the human papillomavirus. OHPV are produced almost exclusively by HPV-16, a high-risk type of HPV associated with cervical, anal, and vulvar cancers. Other types of high-risk HPV cause 10–15% of new diagnoses. High-risk types of HPV are transmitted through body fluids that infect the surfaces of the squamous mucosa of the anogenital duct and the oropharynx. Although smoking does not increase the risk of OHPV, HPV is the cause in 50% of smokers with oropharyngeal cancer. Compared to environmental neoplasms, OHPV usually presents initially in a low primary T stage (T1 and T2) and a high nodal stage (N2 and N3) and often represents a cause of cancer of unknown primary origin because the tumors primary are small and difficult to identify [3].

The hypopharynx includes the pyriform sinuses, the lateral and posterior walls of the pharynx, and the posterior surfaces of the larynx. These structures surround the larynx from behind and laterally. It can be difficult to detect tumors in this region because sac bottoms and spaces around the larynx exist. As a result, primary hypopharyngeal tumors may be asymptomatic and, like oropharyngeal tumors, may be detected initially in advanced stages or as a primary tumor of unknown origin. These tumors are related to the consumption of tobacco and alcohol [3].

The larynx includes the vocal cords, the subglottis, and the supraglottic part of the larynx, in addition to the thyroid, cricoid, and arytenoid cartilages. Tumors that originate in the true vocal cords often produce symptoms in early stages and rarely extend beyond the boundaries of the larynx, while subglottic and supraglottic tumors may be relatively asymptomatic and have a much higher risk earlier of spread to the lymph nodes and other regional areas. Laryngeal carcinomas have an intense association with tobacco [3].

The nasopharynx includes the mucosal surfaces and structures of the cavity located behind the nasal passages. Nasopharyngeal carcinomas are frequent on the Pacific coast, North Africa, and the Near East. In some regions of China and Southeast Asia, cancers of the nasopharynx have a frequency similar to



**Figure 1.**  
*Malignant neoplasms of the oropharynx. Retrieved from Parul S, Uli H. Cummings Otolaryngology. January 2, 2015. Páginas 1432.e4-1453.e4. © 2015.*

lung cancer. In the USA, approximately 2000 cases occur each year, but this number is increasing in populations with high-risk ethnic origins settling in North America. Nasopharyngeal carcinomas are frequently associated with a latent infection of epithelial tumor cells with EBV, the etiological agent of infectious mononucleosis. Nasopharyngeal carcinomas are also associated with environmental and genetic factors in susceptible populations that have migrated to North America and still have an elevated risk of this disease. Unlike other epidermoid carcinomas of the head and neck, nasopharyngeal carcinomas can appear at an early age, with a maximum incidence evident in adolescents and young adults. Nasopharyngeal carcinomas are divided into three histological types according to the World Health Organization (WHO): the undifferentiated (WHO III) and the non-keratinized (WHO II) have latent infection by EBV in 95% of cases and are the most of the cases in North America and the rest of the world; the well-differentiated form (WHO I) is less frequent and accounts for 5% of cases worldwide, although in North America it represents 15–25% of cancers and is usually associated with traditional risk factors, such as smoking. Nasopharyngeal carcinomas are associated with a high risk of early regional lymph node metastases, prolonged natural evolution, and very high risk of distant dissemination [3].



## 2. Difficult airway

### 2.1 Prevalence

In some cases, friable vocal cord tumors, subglottic stenosis, or tongue-based pathologies represent challenges for even the most experienced anesthesiologist. The incidence of difficult intubation in OC population is 7.1%. The American Society of Anesthesiologists defines “Difficult intubation” as the completion of multiple attempts of intubation in the presence or absence of tracheal disease [4].

We know, by difficult airway according to ASA, the clinical situation in which a conventionally trained anesthesiologist has difficulty in ventilating with facial mask, difficulty in tracheal intubation, or both [5]. The intubation failure plus ventilation failure occurs at 0.003%, being the most dramatic situation that can occur [6]. Intubation failure is the inability to place an endotracheal tube. Its incidence is 0.05% in the general population. The estimated incidence of all types of difficulties related to intubation or airway safety is estimated at 1–3% [7].

Currently, there are no generic references for the incidence of difficult intubation, due to the great diversity of material available in terms of video-laryngoscopy, which is nowadays commonly used. The incidence of failed intubation is around 0.05–0.35% [7].

### 2.2 Predictors of difficult airway

The preoperative recognition in physical examination can help to predict life-threatening situations for our patients. The test of Mallampati is considered the gold standard of the predictors, relating to the structures of the base of the tongue with respect to the visibility of the after pharyngeal structures, on a scale from I to IV, in which III–IV associated with other predictors may suggest difficulty [6]. Lee et al. describe that the modified Mallampati test has a sensitivity to predict difficult intubation of 76% and a specificity of 77% [8]. On the other hand, it is suggested that the Mallampati test in the supine position is a better predictor than in the sitting position [9, 10].

Numerous predictive tests of difficult airway can be mentioned with their different sensitivities and specificities that can improve the predictive power of the Mallampati: hyo- and thyromental distance [sensitivity (S) 88%/65% and specificity (E) 60%/81%, respectively], the bite test (S 88% and E 88%), circumference of the neck in the obese population (S 88.2% and E 83%), and mouth opening (S 26–47% and E 94%). Due to the statistical limitations observed in the studied populations, predictive models that seek to improve the statistical power of these physical examination findings have been developed from multivariate analysis. Mainly they can be mentioned: Wilson (S 75% and E 88%), El-Ganzouri (S 65% and E 94%), Arne (S 94% and E 96%), Karkouti (S 86% and E 96%), and Naguib original (S 81% and E 72%) [8]. Recall that Mallampati plus thyromental distance and sternum distance is the combination of physical tests with greater discriminative power, with a sensitivity of 100% and specificity of 92.7% [11].

### 2.3 Radiology in the difficult airway

#### 2.3.1 Ultrasonography

The physical principles of ultrasound consist in the transformation of mechanical energy into electrical and vice versa. The ultrasound wave travels through the tissues undergoing phenomena of scattering, refraction, and reflection, with wave frequencies that oscillate from 2 to 20 MHz and therefore impossible to be heard by the human

ear. The organs of the body have different amounts of water that can help us distinguish the images in the ultrasound monitor. This physical alteration of the wave is known as impedance and is usually measured as the resistance to propagation of sound waves from one medium to another. The greater difference in impedance between two tissues, the easier it will be to distinguish one from the other. The same happens with the air-water interface, and to improve it, we usually place gel in the ultrasound probe to reduce it and optimize the visualization of the tissues. That is why we usually see black (hypoechoic) air in the monitor, solid viscera with high water content in white (hyperechoic), and structures of intermediate echogenicity (isoechoic) [12].

Everything explained previously was not possible without the piezo crystals of the probes. These devices are capable of emitting an electric pulse on their crystals, which is transduced to mechanical energy, generating an “oscillatory” activity in the tissues, and the signal is again received by the probe and transformed into electrical energy giving an image on the monitor. This information is processed in terms of amplitude and time of return of the signal in the ultrasound equipment. Tissues are images interpreted with hypo- (black), iso-, or hyperechoic (white) characteristics in the ultrasound monitor [12].

The resolution of ultrasound devices can be divided into axial, lateral, spatial, and temporal. The axial resolution refers to the ability of the ultrasound probe to define two images. At higher wave frequencies, we will be able to appreciate more superficial structures with greater definition, but not organs that are deeper. The lateral resolution refers to the ability to differentiate two structures perpendicular to the ultrasound probe and depends on the position of the probe with respect to the structure to be evaluated [12].

Spatial resolution is a fixed property of the probe and refers to its ability to solve objects located at the same height or thickness of the ultrasound beam. The number of individual PZT crystals that emit and receive the ultrasound waves and their sensitivity affect the resolution, accuracy, and clarity of the image. The temporal resolution refers to the clarity or resolution of structures in movement [12].

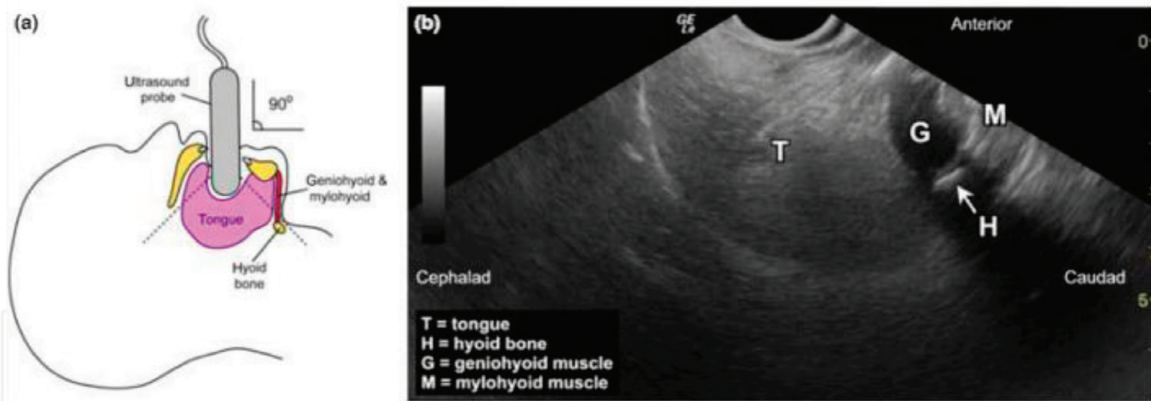
Ultrasounds seem to be beginning to play a role in the perioperative prediction of intubation difficulties. Chou et al. studied hyomandibular distance measured by X-rays and said that it may be increased in patients with difficult airway. The cutoff values described in this study were 33.8 mm in men and 26.4 mm in women. Knowing the limitations of this work, in 2008, it was described that the inability to see the hyoid bone in ultrasound (due to a hypopharyngeal of the base of the tongue or by a short mandibular branch) seems to increase the statistical power in the usefulness of ultrasound in the patient difficult to intubate [13].

Based on the previous study, years later Hui et al. recruited 110 patients that were trained in sublingual ultrasounds after a series of simple instructions. The probability of visualizing the hyoid bone by ultrasound was related in patients with Cormack I and II with a positive probability ratio of 21.6, which suggests that it can become a useful tool to predict difficult airway [14] **Figure 2**.

However, the shape and size of the tongue added to the fact that the patients were not in the sniffing position during the measurements may represent some limitations in the interpretation of the results in this study [14].

### *2.3.2 Computed tomography*

The image in computerized axial tomography is an axial and coronal representation of the patient using the physical principles of X-rays. The final reconstruction of the image will generate a series of overlapping structures with attenuations that will depend on the amount of water contained in the tissue under study [15].



**Figure 2.**

Retrieved from [14]. Sublingual ultrasound of the upper airway. (a) Schematic diagram showing placement of the ultrasound probe perpendicular to the face, as instructed by study participants. Indicated are positions of the tongue, geniohyoid and mylohyoid muscles and hyoid bone. The dashed lines indicate the coverage of the ultrasound beam. (b) Representative ultrasound image showing view of the hyoid bone.

The CT image is produced by the process of reconstruction, digitally combining information from X-ray projections through the patient from many different angles to produce the cross-sectional image. Because the image is digital, it is made up of a group of pixels (shortened from “picture elements”). Each pixel has a gray scale value that is displayed to the viewer. The image is 2D, but it represents a 3D volume of tissue with a finite thickness (usually a very small thickness compared to the field-of-view (FOV) size [ $\approx 2\text{--}5\text{ mm}$ ]). Each pixel is the projection, or 2D representation, of the X-ray attenuation of a voxel (shortened from “volume element”) of physical tissue. The size of the pixels and the thickness of the voxels relate to some important image quality features, such as detail, noise, contrast, accuracy of the attenuation measurement (CT number value), and artifacts. These will be discussed in more detail as they relate to the processes of acquiring and reconstructing CT data [15].

In a CT of a single section of tissue using a single detector, the X-ray beam is collimated to the desired image thickness. The detector array has a number of individual detector elements that each records the intensity of the beam passing through the tissue along the path from the X-ray tube to the element. The system captures a simple projection X-ray through the patient, consisting of a thin strip or row of pixels. It can be thought of as a one-dimensional (1D) radiograph. The scanner then rotates the source and detector to capture additional 1D “strip X-rays” through the same section of the patient, viewed from a number of angles. Each strip radiograph (projection) is stored in the computer memory for later reconstruction [15].

In multislice CT, this operation is performed simultaneously for many arrays of detectors stacked side by side along the z-axis (long axis) of the patient. The X-ray beam collimators can be opened so that a wider section of the patient is irradiated, and each row of detectors can measure a separate transmission signal for the tissue section that lies between the detector row and the tube. The width of tissue that is sampled by each detector row is determined by the physical width of the detector elements along the z-axis [15].

According to X-ray absorption, we use the scale of the Hounsfield units (HU) that allows to stratify the pixels of the measurements according to their densities with respect to water. The advantage of the HU scale is that density differences of 1 part in 1000 (0.1%) can be represented by distinct values. The inherent density resolution of CT scanners is about 0.5%, so the HU scale is sufficient to display all attenuation differences the scanner can measure. Increasing the value of K would not improve on the density resolution of the system [15].

Many authors have tried to apply these imaging tests for the study of airway anatomy. Randell et al. in 1998 in Anesthesiology suggested the possibility of



considering by means of NMR and CT studies parameters such as length of epiglottis, length of tongue, and width thereof, as difficulty markers of the passage of the endotracheal tube during intubation with a fiberoptic bronchoscope [16].

### *2.3.3 Computed magnetic resonance*

Understanding the physics of magnetic resonance is a challenge for many medical specialists, as it involves implicit technical knowledge shared with other professional fields; it may even be harder to understand than the basic principles of tomography and ultrasound. The four main points of the process are:

#### *2.3.3.1 Preparation*

The human being is basically composed of water. Hydrogen molecules contained in water when exposed to a “magnet” can be magnetized. Basically the resonator is a magnet, which confers spin to the hydrogen with a resulting vector that oscillates at a frequency called Larmor that is proportional to the magnetic field surrounding it. This vector is going to align with the said field when it is exposed to 1.5–3.0 T. Magnetization can be manipulated with the use of contrasts such as gadolinium through a process called inversion of the image [17].

#### *2.3.3.2 Excitation*

The “spinning” of the hydrogen molecules generates a radiofrequency pulse in the Larmor spectrum, which is received by a coil (electrical conductor) that is transverse to the tissue magnetization under study and transduced by Faraday thermal induction; the previous really will generate the “magnetic resonance signal.” The signal is attenuated by two processes called relaxation. This usually occurs in two times (T). T2 represents the loss of coherence of the spin of the hydrogen molecules over time. T1 represents the time it takes for the vector of the magnetic field to reach equilibrium. The important thing about these last two concepts is that they will determine the resolution of the soft parts during the study [17].

#### *2.3.3.3 Spatial encoding*

The frequency of the spin of the hydrogen molecules with different spatial location differs from each other. The sum of these frequencies generates a resulting vector causing a force called Lorentz force, which is perceived by the coils and will participate in the genesis of the acoustic signal generated during a resonance.

#### *2.3.3.4 Signal acquisition*

The different spatial location of the hydrogen ions and their individual rotation frequency are analyzed by a Fourier transform, which will generate the different pixels of the image and is stored in the magnetic resonance equipment [17].

The application of these concepts to the perioperative management of the airway can be observed. In the work on predictors of difficulty of endotracheal intubation considered from NMR studies conducted by Samra et al. in 40 patients in 1995, no significant differences were found in the 20/21 parameters studied in soft tissue X-ray imaging. NMR is among the difficult intubation groups not anticipated and achieved. It seems that no radiological study alone is able to predict the difficulty in intubation; one of the reasons is that the exposure of the larynx depends on its compressibility. The tongue and the soft tissue consistency of the floor of the mouth, a



situation that cannot be measured with imaging studies, perhaps dynamic studies, could be useful in these cases [18].

#### 2.3.4 Imaging modalities: weaknesses and strengths

In head and neck cancers, tomography through the use of detectors (64 mid-range) can provide dynamic images to assess phonation or oral cavity tumors. In addition, it is a useful rapid test in claustrophobic patients with respiratory problems [19, 20].

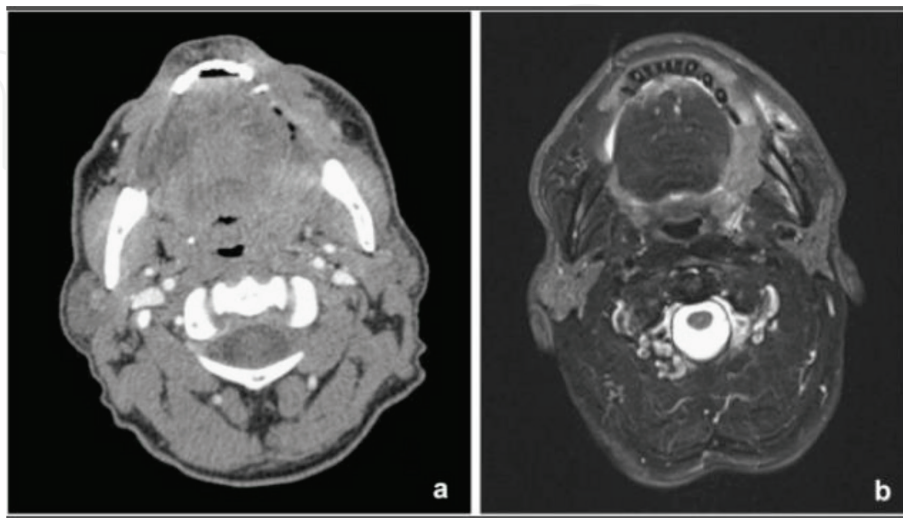
Some authors prefer the use of NMR in their institutions, since it is superior in resolution to delimit tumors and bone/cartilaginous parts and perineural invasion and to reach areas such as the base of the tongue that can be difficult to see in nasofibroscopy [21, 22] **Figure 3**.

The 4–7% of head and neck tumors has lung metastases. Many hospital protocols use CT with low levels of radiation to follow these patients and even to determine responses to treatment, tumor biology, and nodal extension. And we cannot forget how important it is in radiotherapy simulation by tomographic tests. So in this group of patients, it seems that the two tests continue to complement each other [23–27].

Currently, it seems that MRI greatly improves the visualization of the bone and cartilage. The importance of this fact is related to staging and treatment of these patients [28–30] but not so in patients on chemotherapy treatment where positron emission tomography remains a better alternative for follow-up at 3 months [31].

CT protocols are less varied than MRI, but the technique still requires optimization and patient cooperation. Many of these patients need a study that ranges from the base of the skull to the chest with a 1–1.5 mm collimation. The use of contrast offers an important advantage in these patients, and, whenever administered at 1 ml/s, it helps to define better vascular structures and squamous cell tumors. The patient is then asked to raise their arms above their head, and the entire chest is scanned. Dental artifact remains a challenge in a patient group who will often have poor dentition. An additional limited CT with angled gantry can be used to mitigate beam hardening if the tumor is obscured [32].

In summary, CT continues to be used in most head and neck cancer patients. The cost of NRM continues to be a limitation for many centers. The tomography as a basis for



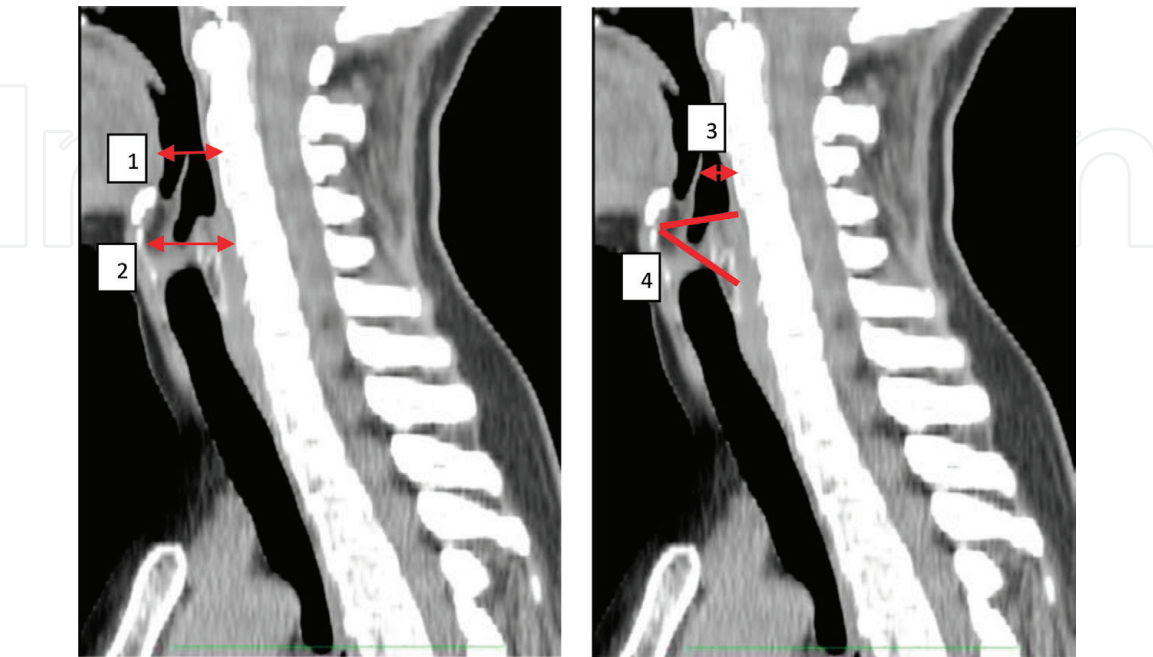
**Figure 3.** Retrieved from [33]. Left oropharyngeal/buccal squamous cell carcinoma on (a) contrast-enhanced computed tomography and (b) T2 axial DIXON-FS magnetic resonance imaging (MRI), showing the benefits of superior contrast resolution in MRI. Head and neck is an area with a difficult anatomy and distortions caused by tumors could compromise imagenologic interpretations. Notice better resolution in image than tomography that could help in staging and surgical decision.

PET and radiotherapy remains a very valuable option in these patients, since it facilitates staging and treatment. It seems that in the future, it is inevitable that the MRI replaces the CT because of its resolution of soft tissue visualization, and therefore it would offer more targeted treatments to this area of such a complex anatomy [33].

### 3. Any place for CT and airway?

Patient intervened for head and neck cancers presents anatomical particularities in the airway, which are probably better described in tests performed routinely in this population as the CT. Comparing the degrees of visualization of the glottis and Mallampati test described in the anesthesia records with four tomographic measurements, the authors of this chapter propose a tool to improve the perioperative management of the airway in this group of patients. A retrospective study was conducted with 104 patients operated for head and neck cancers under general anesthesia and endotracheal intubation in the Otorhinolaryngology department during a period of 36 months. Throughout the selection process, the radiology team reported a number of 15 cases with significant distortion of the airway that are being excluded from the analysis [1].

Based on the findings of the preoperative imaging tests, a multivariate logistic regression analysis was performed, where the dependent variable was the presence of Mallampati III–IV and the extreme degrees of visibility of the glottis (defined as Cormack III–IV). The 89 patients were assigned to the Cormack I–IV and Mallampati I–IV groups in the analysis in equal proportion. A total of four tomographic and clinical factors of difficult airway were introduced into this model. The tomographic predictors considered in the study were the following: distance from the vocal cords to the posterior pharyngeal wall (CVV/PFP) and laryngotracheal angle (Alaring) and distance from the epiglottis to the posterior pharyngeal wall (EPI/PFP) and from the base of the tongue to the posterior pharyngeal wall (BL/PFP). The odds ratio (OR) was 95% with confidence intervals (CI). All the tests were considered statistically significant for all data analyses when  $p < 0.05$  [1] **Figure 4**.



**Figure 4.** Axial CT scan. Measurements made by the Gutiérrez JC et al. [1]. 1. TB/PPW: tongue base distance to posterior pharyngeal wall. 2. VCD/PPW: vocal cords to posterior pharyngeal wall. 3. EPI/PPW epiglottis distance to posterior pharyngeal wall. 4. LTQ: laryngotracheal angle.

The most frequent surgeries performed during the study period were laryngeal microsurgery, total laryngectomy, and laser cordectomy, with percentages of 37.1, 10.1, and 6.7%, respectively.

In the Mallampati III–IV group, the mean in millimeters of distances of CVV/PFP and BL/PFP was 11.89 and 8.82, respectively. In the Cormack III–IV group, the means of EPI/PFP and BL/PFP were 7 and 10.40 mm. The tomographic predictors EPI/PFP and 177 BL/PFP in Cormack III–IV patients show significant results in the univariate model ( $p < 0.05$ , 95% CI: 0.125–3.84 and 0.654–5.915, respectively), but this situation was not repeated in the multivariate model when the variables were analyzed categorically (95% CI: 0.030–2.31 EPI/PFP, 0.018–1.37 BL/PFP). ROC curve was also assessed during the study, with 71 and 69% being observed for EPI/PFP and BL/PFP, respectively [1] **Table 1**.

From the tomographic predictors, the CVV/PFP distance in the Mallampati III–IV patients shows significant results in the univariate model ( $p < 0.05$ , 95% CI: 0.032–3.682), a situation that was repeated in the multivariate model with the same distance ( $p < 0.05$ , 95% CI: 0.104–8.53) The diagnostic yield of CVV/PFP was also assessed during the study, with 64% being observed [1].

Although is important to consider that most of the intubations are performed by residents, there is a possibility that the interpretation of the Cormack degree could be altered. On the other hand, were described must take into account the preferences for airway devices according to the experience of each doctor, since this may condition the analysis of the variables. Discerning the differences between device preferences is beyond the scope of this study [1].

| Difficult for Cormack |    | VCD/PPW<br>(mm) | EPI/PPW<br>(mm) | TB/PPW<br>(mm) | °LTQ   |
|-----------------------|----|-----------------|-----------------|----------------|--------|
| I–II degree           |    |                 |                 |                |        |
| Median                |    | 13.20           | 8.99            | 13.68          | 139.81 |
| Minimum               |    | 6               | 3               | 5              | 119    |
| Maximum               |    | 22              | 16              | 21             | 160    |
| Percentile            | 25 | 10.75           | 7.00            | 11.00          | 135.00 |
|                       | 50 | 13.00           | 9.00            | 13.00          | 141.00 |
|                       | 75 | 16.00           | 11.00           | 17.00          | 145.25 |
| Standard deviation    |    | 3.743           | 2.785           | 3.875          | 9.391  |
| III–IV degree         |    |                 |                 |                |        |
| Median                |    | 12.33           | 7.00            | 10.40          | 141.00 |
| Minimum               |    | 6               | 3               | 5              | 122    |
| Maximum               |    | 22              | 11              | 19             | 155    |
| Percentile            | 25 | 7.00            | 4.00            | 6.00           | 133.00 |
|                       | 50 | 11.00           | 8.00            | 11.00          | 142.00 |
|                       | 75 | 16.50           | 9.00            | 12.25          | 149.50 |
| Standard deviation    |    | 5.454           | 2.625           | 4.195          | 10.548 |

Retrieved from Gutiérrez JC et al. REDAR-913 2018. °LTQ: laryngotracheal angle; EPI/PPW epiglottis distance to posterior pharyngeal wall; TB/PPW: tongue base distance to posterior pharyngeal wall; VCD/PPW: vocal cords distance to posterior pharyngeal parad. Good glottis visualization (Cormack I/II). Extreme degrees of glottis visualization (Cormack III/IV).

**Table 1.**  
Cormack III/IV and tomographic predictors.

Patients undergoing oncological head and neck surgeries receive preoperative radiotherapy and other diagnostic-therapeutic techniques that were sometimes difficult to relate temporally with the CT evaluated. This fact may condition the interpretation of the imaging tests by the expert radiologist [1].

#### 4. Conclusion

In certain patients, it seems that the role of ultrasonography in the prediction of difficult intubation plays an important role [34]. We cannot forget the importance of the predictors to physical examination, and that their sum complements their statistical power. The particularities of airway management in patients with head and neck cancers are well known, and sometimes supporting us in preoperative imaging tests, in conjunction with the interdisciplinary communication of the surgical team, favors the reduction of unwanted events in the management of the airway.

It is useful in these special populations to anticipate a possible difficult airway. Imaging tests, particularly CT, could help in this regard. Gutiérrez et al. described in the group Mallampati III–IV distance measurement CVV/PFP shows significant statistics in the multivariate model ( $p < 0.05$ , 95% CI: 0.032–3.682). However, obtaining images in a reproducible position that recreates the position that the patient will adopt during intubation and prospective evaluation in a larger population can provide more useful preprocedure information for the anesthetist [1].

Knowing the limitations of difficulty predictors of airway, it seems that techniques are necessary alternatives that support doctors and allow us to foresee life-threatening situations.

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## References

- [1] Gutiérrez JC, Merino S, De la Calle P, Perrino C, Represa M, Moral P. Correlation of Preoperative Findings in the Computerized Axial Tomography with the Presence of Via Difficult Airway in Patients Operated Through Otorhinolaryngological Surgery of the Head and Neck. *Rev Esp Anesthesiol Reanim*. 2018 May;**65**(5):252-257. DOI: 10.1016/j.redar.2018.01.013. Epub 2018 Mar 2
- [2] Spanish Society of Medical Oncology. Head and Neck Tumors—O.R.L [consulted 2017]. March 27, 2017. Available at: <http://www.seom.org/es/info-sobre-el-cancer/orl?start=1#content>
- [3] Posner MR. Cáncer de cabeza y cuello. In: Goldman-Cecil. Tratado de Medicina Interna. Vol. 190. España: Elsevier; 2017. p. 1297-1303
- [4] Karakus O, Kaya C, Ustun FE, Koksall E, Ustun YB. Predictive value of preoperative tests to estimate difficult intubation in patients undergoing direct laryngoscopy for ear, nose and throat surgery. *Brazilian Journal of Anesthesiology*. 2015;**65**:85-91
- [5] Apfelbaum JL, Hagberg CA, Caplan RA, Blitt CD, Connis RT, Nickinovich DG, et al. Practice guidelines for management of the difficult airway: An updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. *Anesthesiology*. 2013;**118**:251-270
- [6] Karkouti K, Rose DK, Ferris LE. Inter-observer reliability of ten tests used for predicting difficult tracheal intubation. *Canadian Journal of Anaesthesia*. 1996;**43**:554-559
- [7] Henderson JJ, Popat MT, Latto IP, Pearce AC. Difficult Airway Society. Difficult Airway Society guidelines for management of the unanticipated difficult intubation. *Anaesthesia*. 2004;**59**:675-694
- [8] Lee A, Fan LT, Gin T, Karmakar MK, Ngan Kee WD. A systematic review (meta-analysis) of the accuracy of the Mallampati tests to predict the difficult airway. *Anesthesia and Analgesia*. 2006;**102**:1867-1878
- [9] Bindra A, Prabhakar H, Singh GP, Ali Z, Singhal V. Is the modified Mallampati test performed in supine position a reliable predictor of difficult tracheal intubation? *Journal of Anesthesia*. 2010;**24**:482-485
- [10] Patel B, Khandekar R, Diwan R, Shah A. Validation of modified Mallampati test with addition of thyromental distance and sternomental distance to predict difficult endotracheal intubation in adults. *Indian Journal of Anaesthesia*. 2014;**58**:171-175
- [11] Bhavdip P, Rajiv K, Rashesh D, Ashok S. Validation of modified Mallampati test with addition of thyromental distance and sternomental distance to predict difficult endotracheal intubation in adults. *Indian Journal of Anaesthesia*. 2014 Mar-Apr;**58**(2):171-175. DOI: 10.4103/0019-5049.130821
- [12] Anantham D, Ernst A. Ultrasonography. In: Murray and Nadel's Textbook of Respiratory Medicine. Vol. 20. Elsevier; 2016. p. 348.e2-359.e2
- [13] Chou HC, Wu TL. Mandibulohyoid distance in difficult laryngoscopy. *British Journal of Anaesthesia*. 1993;**71**:335-339
- [14] Hui CM, Tsui BC. Sublingual ultrasound as an assessment method for predicting difficult intubation: A pilot study. *Anaesthesia*. 2014;**69**:314-319

- [15] Jordan DW, Haaga JR. Imaging principles in computed tomography. In: CT and MRI of the Whole Body. Vol. 1. Elsevier; 2017. p. 3-30
- [16] Randell T, Hakala P, Kyttä J, Kinnunen J. The relevance of clinical and radiological measurements in predicting difficulties in fiberoptic orotracheal intubation in adults. *Anaesthesia*. 1998;**53**(12):1144-1147
- [17] Roth CG, Deshmukh S. Fundamentals of Body MRI, Introduction and Physics of Body MRI. Chapter 12017. Elsevier; 2017. p. 1-44
- [18] Samra S, Schork M, Guinto FA. A study of radiologic imaging techniques and airway grading to predict a difficult endotracheal intubation. *Journal of Clinical Anesthesia*. 1995;**7**(5):373-379
- [19] Wear VV, Allred JW, Mi D, et al. Evaluating 'eee' phonation in multidetector CT of the neck. *AJNR. American Journal of Neuroradiology*. 2009;**30**:1102-1106
- [20] Weissman JL, Carrau RL. Puffed-cheek CT improves evaluation of the oral cavity. *AJNR. American Journal of Neuroradiology*. 2001;**22**:741-744
- [21] Chan AT, Grégoire V, Lefebvre JL, et al. Nasopharyngeal cancer: EHNS-ESMO-ESTRO clinical practice guidelines for diagnosis, treatment and follow-up. *Annals of Oncology*. 2012;**23**:vii83-vii85
- [22] Gregoire V, Lefebvre JL, Licitra L, et al. Squamous cell carcinoma of the head and neck: EHNS-ESMO-ESTRO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Annals of Oncology*. 2010;**21**:v184-v186
- [23] Leon X, Ferlito A, Myer CM, et al. Second primary tumors in head and neck cancer patients. *Acta Oto-Laryngologica*. 2002;**122**:765-778
- [24] Kim EB, Park Y, Park SJ, et al. Clinical factors related to suspected second primary lung cancer development in patients with head and neck cancer. *Cancer Research and Treatment*. 2008;**40**:178-183
- [25] Kuriakose MA, Loree TR, Rubenfeld A, et al. Simultaneously presenting head and neck and lung cancer: A diagnostic and treatment dilemma. *Laryngoscope*. 2002;**112**:120-123
- [26] Church TR, Black WC. Reduced lung-cancer mortality with low-dose computed tomographic screening. *The New England Journal of Medicine*. 2011;**365**:395-409
- [27] Wender R, Fontham ET, Barrera E, et al. American Cancer Society lung cancer screening guidelines. *CA: A Cancer Journal for Clinicians*. 2013;**63**:107-117
- [28] Becker M, Zbären P, Casselman JW, et al. Neoplastic invasion of laryngeal cartilage: Reassessment of criteria for diagnosis at MR imaging. *Radiology*. 2008;**249**:551-559
- [29] Curtin HD. The 'evil gray': Cancer and cartilage. *Radiology*. 2008;**249**:410-412
- [30] Li B, Bobinski M, Gandour-Edwards R, et al. Overstaging of cartilage invasion by multidetector CT scan for laryngeal cancer and its potential effect on the use of organ preservation with chemoradiation. *The British Journal of Radiology*. 2011;**84**:64-69
- [31] Dixit R, Weissfeld JL, Wilson DO, et al. Incidence of head and neck squamous cell carcinoma among subjects at high risk of lung cancer: Results from the Pittsburgh Lung Screening Study. *Cancer*. 2015;**121**:1431-1435
- [32] Keberle M, Tschammler A, Hahn D. Single-bolus technique for spiral CT

of laryngopharyngeal squamous cell carcinoma: Comparison of different contrast material volumes, flow rates, and start delays. *Radiology*. 2002;**224**:171-176

[33] Burkill GJ, Evans RM, Raman VV, Connor SE. Modern radiology in the management of head and neck cancer. *Clinical Oncology*. 2016;**28**(7):440-450. Copyright © 2016 The Royal College of Radiologists

[34] Fristcherova S, Admaus M, Dostalova K, et al. Can difficult intubation be easily and rapidly predicted? *Biomedical Papers of the Medical Faculty of Palacky University in Olomouc*. 2011;**155**(2):165-172