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Chapter

Approach to the Difficult Airway in Laryngeal Cancer

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Abstract

The laryngeal cancer is the second most frequent neoplasm of the upper aerodigestive tract. In these patients, the incidence of difficult airway is very high, and sometimes the anatomy can be modified because of the previous treatments like radiotherapy, making difficult intubation and difficult mask ventilation. To prevent an emergency, it is a priority to make an approach plan, appropriate preoperative assessment, have the necessary tools, and work together with the surgical team.

Keywords: airway management, laryngeal neoplasms, laryngectomy, video laryngoscope, difficult airway

1. Introduction

The incidence of difficult airway in patients with head and neck cancer is higher than in the general population. Particularly, cancer of the larynx, which is the second most frequent neoplasm of the aerodigestive tract, represents a real challenge for the anesthesiologist, since he deals with patients with tumors at any stage and in elective or emergency situations.

2. Laryngeal cancer

Of head and neck tumors, laryngeal cancer accounts for 50% with a higher incidence in men than woman with a 4:1 ratio. The three major locations for laryngeal cancer are glottis (59%), followed by the supraglottic area (40%) and the subglottic area (1%) [1]. Laryngeal stenosis, fistula formation, local recurrence, and adjacent lymph node metastasis are some of the complications that the patient can develop in long term [2].

Laryngectomy is an effective cancer procedure and is associated with good functional outcomes. The current UK standard of care for locally advanced malignancy is aimed at organ preservation. This is for patients with T3 tumors on the tumor-nodes-metastases (TNM) scale. For patients with T4 disease invading the laryngeal
cartilages, total laryngectomy is recommended. Although laryngeal preservation may seem preferable, these cases require careful discussion at a regional head and neck cancer multidisciplinary team meeting, as evidence is emerging that patients who undergo primary surgery have improved survival rates. Long-term complications of oncological treatments may ultimately result in a “frozen larynx,” where the patient requires a tracheostomy and gastrostomy, or even ultimately a laryngectomy to prevent aspiration. National guidelines recommend that laryngectomy is performed in specialist centers, as complication rates are lower in departments that perform this procedure frequently [3].

Organ preservation is recommended in patients with T3 tumors on TNM classification (tumor, nodule, metastasis), and total laryngectomy is indicated in T4 patients with invasive disease to laryngeal cartilages. Although preserving surgery may seem better, all cases require careful analysis to perform the procedure that improves survival rates. We can see complications of oncological treatments; for example, “frozen larynx,” in these cases the patient requires tracheostomy and gastrostomy, or even a laryngectomy to prevent aspiration. National guidelines recommend that laryngectomy is performed in specialist centers, as complication rates are lower in departments that perform this procedure frequently [3].

The context in which the anesthesiologist can find the patient is in elective or emergency situations, as well as in early or advanced stages. The most challenging aspect would be the intubation of the post-radiotherapy patient. It is important to understand the disease process and the management of these cancers, because a proper anesthetic management plan will be decisive. There must be open lines of communication with surgeon and wider team for better results [3].

Based on the knowledge of the possible occurrence of difficult ventilation, all the associated necessary equipment should be ready for an instant application, and also, additional measures such as preparation of emergent tracheostomy, cardiopulmonary resuscitation, and airway management following ASA guideline may be implemented [2].

### 3. Difficult airway

Difficult airway is defined as the clinical situation in which a conventionally trained anesthesiologist experiences difficulty with facemask ventilation, difficulty with tracheal intubation, or both. Situations of “cannot intubate and cannot ventilate (CICV)” may occur in 0.01–0.07% of patients undergoing surgery. This is a true emergency situation. This situation must be resolved as soon as possible, so that a harmful outcome does not occur like permanent brain damage or death. Spontaneous breathing must be restored, if is not possible then the surgical access of the airway must be done [4].

The anatomical modifications due to the disease as well as morphological changes by previous treatments (radiotherapy and chemotherapy in the head and neck cancer patients) are responsible for the difficulties in the airway. The incidence of difficult intubation ranges from 0.5 to 2% in the general population, from 8 to 10% in patients having ears, nose, and throat surgery, and rises to 28% in patients with tumors of the airway [1, 5]. Glottic cancers are the commonest (50–60%). These patients present difficulties due to the presence of mass, a receding jaw, restricted mouth opening, and neck movement or due to associated comorbidities. The size and location of tumor are the crucial factors in determining the appropriate approach to the airway [1].
4. Preoperative assessment

The characteristics that are most often observed in the patient who has head and neck cancer are the following: elderly, chronic consumer of ethanol, and/or a smoker. broncho-pneumopathie chronique obstructive, pulmonary emphysema, ischemic coronary heart disease, high blood pressure, chronic hepatopathy with toxic etiology, coagulopathies are associated with the oncological status [6].

Some patients have nutritional disorders due to the difficulty in swallowing due to the presence of the tumor, which leads to weight loss, anemia, and dyselectrolytemia. All these alterations should be corrected as far as possible before undergoing surgery [6].

Preoperative evaluation should include full blood count, clotting screen, biochemical profile with urea and electrolytes, liver function test, blood sugar, and electrocardiography. Other studies that should be considered in some patients are chest X-ray, pulmonary function tests, arterial blood gases, and echocardiogram, because some may have chronic obstructive pulmonary disease or some cardiopathy associated with their risk factors [7].

It is common to find chronic obstructive pulmonary disease (COPD) in head and neck cancer patients so modification of bronchodilator therapy, steroids, and treatment of acute infection can optimize patient conditions [7].

Laryngeal cancer treatment includes surgery, chemotherapy, and radiotherapy, and these treatments may worsen airway management. Radiation therapy after the primary surgery may lead to immobility of the mandible and neck. A careful examination of the area between the hyoid bone and submentum is required, because we can detect risk factors for difficult airway. For some patients, even with normal mentohyoid distance, the larynx might be located much more anterior than normal, due to radiotherapy-induced fibrosis in the submandibular area, and this factor makes intubation difficult. Some side effects of radiation therapy, for example, dermatitis and oral mucositis, can make the tissue more susceptible to infection, and bleeding may occur during airway management. The patient may present local edema due to damage to the lymphatic ducts after radiotherapy. Preoperative tracheostomy sometimes becomes indicated when a difficult airway is evident before surgery or after previously performed laryngeal surgery [2].

We should evaluate the mouth opening, mallampati score, laryngoscopic view at previous operations, neck movement, and prominent teeth, and look for masses in neck, scarring from previous surgery, and immobility of the larynx from previous radiotherapy.

Cross-sectional imaging techniques are the most useful in confirming intrinsic compression of the airways, a feature that may not be appreciated on endoscopic analysis alone [8]. It is indicated to identify the extension of the tumor and the potential obstruction through imaging studies, radiological imaging with computed tomography or magnetic resonance imaging can help. In experienced hands, ultrasonography is useful in identifying the cricothyroid membrane before induction of anesthesia to have identified the surgical access in case of emergency (Figure 1) [7].

Awake nasal endoscopy can be carried out before induction of anesthesia and is especially useful when no other radiological investigations are available. It gives a real-time view of the upper airway and the larynx [7].

Preoperative nasoendoscopy can determine the airway diameter, detailed evaluation of the airway, location, size, nature and mobility of tumor (e.g., pedunculated), bleeding and edema, the epiglottis and glottis, vocal cord movement, pooling of secretions, it does not require more than a simple preparation of the nose with a local
anesthetic and a vasoconstrictor, and it is very important to identify a potential airway obstruction [8] and is useful in identifying patients in whom an awake technique or conscious fibroscopic-assisted intubation is more appropriate [2, 7]. In short, it allows us to examine the condition of larynx and pharynx.

Before starting surgery, the following points should be defined:

i. Ventilation with a face mask will be possible?

ii. Laryngoscopy is going to be difficult?

iii. Intubation (passing the tube through the glottis) is going to be difficult?

iv. An awake technique is more appropriate?

v. It is possible to make a surgical airway and front of neck access (FONA) is feasible?

When you should consider awake intubation? When difficulty in tracheal intubation and bag-mask ventilation is predicted or has been experienced previously. When performing a technique with an awake patient, you have an advantage because you maintain the permeable airway, gas exchange, and protection against aspiration during

Figure 1. A. Computed tomography with axial section showing maximum glottic narrowing caused by tumor. B. Subglottic region, with less compromise in the tracheal diameter.
the intubation process. General anesthesia makes the airway more difficult with more obstruction, making identification of landmarks difficult on endoscopy [7]. It is essential for the anesthesiologist to prevent an emergency situation and make the right decision for the safety of the patient; therefore, a plan must be formulated.

5. Planning airway management

Procedures performed on patients with laryngeal cancer ranges from panendoscopy and biopsy to laryngectomy and occasionally emergency tracheostomy [3]. And the planning of airway management should be performed for elective patient and elective surgery and for those who may present in extremis with stridor.

Evaluation of the airway includes history and bedside examination, review of imaging and nasendoscopy findings as well as discussion with the surgical team. It is essential to bear in mind other rescue oxygenation techniques, in case the primary plan fails. The rescue plans may include ventilation with face mask or supraglottic devices, and also a surgical airway. The team must consider that insertion and placement of supraglottic airway devices are difficult in patients with reduced opening of the jaw, oropharyngeal lesions, and after radiotherapy. In these cases, intubation using a supraglottic airway as a conduit is difficult or even impossible so we must consider these risk factors before performing the anesthetic induction.

Because of the high incidence of anticipated difficult airways in head and neck patients, it is prudent to seek video-assisted laryngoscopy as the primary technique, video laryngoscopes have emerged as a common first-line option for laryngoscopy, and the Difficult Airway Society (DAS) highlights its role in difficult intubation. A 93–96% first-attempt intubation success rate can be achieved with acute-angle video laryngoscopes such as the Glidescope or CMAC Storz systems, reducing the number of patients at risk of intubation failure.

Direct laryngoscopy (DL) exposes the laryngeal inlet under direct vision and requires a direct line of sight to align airway axes (oral-pharyngeal-laryngeal) for optimal glottic visualization. Oftentimes, manipulations to align these axes include head extension, neck flexion, laryngeal manipulation, and other stressful movements [9]. Videolaryngoscopy (VL) optimizes first-attempt success when compared to direct laryngoscopy, and utilizes indirect laryngoscopy via its camera; glottic visualization is better, and the need for a direct line of sight to visualize airway structures is eliminated. VL requires the application of less force to the base of the tongue, reduces time to intubate, and lessens hemodynamic response to intubation when compared with the traditional direct visualization technique [9]. Evidence has made it clearer that videolaryngoscopy eases intubation difficulty and increases first-attempt success rates in the airway predicted to be difficult to intubate by direct laryngoscopy.

Awake fiber-optic intubation is the safest approach to managing difficult airways, and it can be extremely helpful in patients with supraglottic obstruction (e.g., epiglottis, tongue, basal obstructions, intraoral masses), but it is not the first-line option in patients with a narrow laryngeal inlet or with tumors that cause obstruction at the laryngeal level, which may fail due to the inability to displace the tumor or simply because the tube cannot be advanced and thus precipitates a total obstruction [7]. Active oxygenation strategies must be present throughout the difficult airway management process. One of them is apneic oxygenation.
Trans-nasal high-flow rapid insufflation ventilatory exchange or THRIVE is an oxygenation technique that provides heated and humidified oxygen using high-flow nasal cannula. This system has recently been shown to increase the apnea time in head and neck patients including those with stridor. Trans-nasal high-flow rapid insufflation ventilatory exchange combines apneic oxygenation, continuous positive airway pressure and flow-dependent dead space flushing, which overcomes airway obstruction and increases safety margin during sedation. THRIVE provides up to 70 L/min of oxygen and is well tolerated because of humidification. It changes the nature of difficult intubations from a hurried process to a more controlled event, with an extended apneic window and reduced iatrogenic trauma [3].

The mainstay method of increasing the apneic window is through pre-oxygenation, which entails spontaneous facemask ventilation with 100% oxygen [10]. Pre-oxygenation denitrogenises the lungs and creates an alveolar oxygen reservoir. The physiological phenomenon that occurs is called avenitulatory mass flow (AVMF) or apneic oxygenation. A patent air passageway exists between the lungs and the exterior, and the difference between the alveolar rates of oxygen removal and carbon dioxide excretion generates a negative pressure gradient of up to 20 cmH2O that drives oxygen into the lungs. This could extend safe apnea time during prolonged laryngoscopy and intubation.

6. The obstructed airway

Inspiratory stridor suggests a reduction in airway diameter at the supraglottic, periglottic, or glottic level of at least 50%. Expiratory stridor originates at or below the glottis level, which is characteristic of tracheal or tracheobronchial narrowing, while inspiratory-expiratory (biphasic) stridor generally points to obstructive subglottic disease [11].

We have to define the group of patients who are being considered with stridor at rest. In this group, the stridor is due to a reduction in airway diameter of at least 50%. Patients with slow-growing tumors often present late. So when we meet patients classified in this small group, we know that we will face a tumor of important measure. Perilaryngeal tumors include supraglottic, pharyngeal, pyriform fossa, epiglottic, vocal cord, and subglottic lesions.
The patient should be asked whether, in addition to having noisy breathing, he has actually experienced difficulty in breathing; in particular, has he woken at night in a panic. The presence of nocturnal symptoms usually indicates that there is more advanced obstruction [11].

Patients with significant stridor at rest can be divided broadly into two groups: (1) those in whom intubation is considered possible and (2) those definitely requiring preliminary local anesthetic tracheosomy [11].

The patient, who comes to hospital for the first time as an emergency, is usually the one who will needs a local anesthetic tracheostomy. Severe disease will generally manifest with nocturnal respiratory difficulties and panic attacks [11]. The patient with less severe obstruction is referred to an outpatient clinic (Figures 2 and 3).

7. Other anesthetic considerations

It is required to identify patient at risk of airway obstruction because intravenous or inhalational induction may precipitate airway obstruction due to tumor bulk. Even local anesthesia is not without risk because severe airway obstruction precipitated by laryngospasm has occurred [12].

Is polemical the use of muscle relaxant drugs sometimes facilitates laryngoscopy but in other cases is controversial because of the greater risk of airway obstruction. Current practice has also been influenced by new intubation devices such as video laryngoscopes [12].

If tracheal intubation is considered possible, the main options are an inhalational induction with direct laryngoscopy and tracheal intubation, or an awake fiber-optic intubation. Supraglottic tumors may cause obstruction when intravenous induction and muscle relaxation are used. Intravenous induction of anesthesia and the use of a muscle relaxant are not recommended in this situation [8].
The objective of an inhalational induction is to preserve spontaneous ventilation until adequate depth of anesthesia is obtained and direct laryngoscopy and visualization of the glottis is allowed [8]. Sevoflurane is used and allows rapid, smooth induction of anesthesia, and has the benefit of lack of airway irritation and low blood gas solubility. The disadvantages that can be presented are coughing and laryngospasm upon instrumentation, and sometimes respiratory obstruction when the patient loses consciousness to the beginning of the anesthesia.

When anesthetic depth is adequate, laryngoscopy is undertaken and a rapid decision is made as to whether intubation is possible. If a laryngoscope does not provide an adequate view of the glottis, a second attempt may be made with a different instrument or a different approach, for example, video-laryngoscope. A rigid bronchoscope may be used by an experienced person.

If after laryngoscopy and under direct vision, the anatomy is difficult to visualize or the glottic opening is very small, which is prudent to let the surgeon perform the tracheostomy without haste; but if it is decided to intubate, it must be made a maximum of two attempts. Repeated laryngoscopies have a risk of generating bleeding in necrotic and friable tumors, and this may lead to a total obstruction of the airway, and lead to a situation of “I cannot intubate” “I cannot oxygenate.” If the laryngoscopy fails, the team must be informed and continue with the planned plan [7].

The prolonged manipulation of the upper respiratory tract can cause cardiovascular responses: bradycardia, tachycardia, hypertension, cardiac arrhythmias, and is important to consider.

The way to ensure the airway in the postoperative of head and neck cancer surgery is with a tracheostomy. When orotracheal or nasotracheal intubation is not possible or a major surgical intervention for oral cancer with reconstructive tissue transfer is planned, the better option is an elective tracheostomy in a conscious patient [6].

Tracheostomy as an approach method of the airways is obligated in patients with tumors located in the larynx or below the glottis with obstructive effect, and also in cases of laryngeal stenosis or significant supraglottic edema. Tracheostomy should not be made in pediatric patients because the trachea is small with a soft cartilage and difficult to palpate [6].

8. Postoperative

A careful strategy should be planned for the extubation of those patients who do not require postoperative tracheostomy.

After prolonged surgery, we can find some issues, for example, swelling, bleeding, and airway debris. If tracheal intubation was difficult in the first place, reintubation is likely to be more. Other strategies may also be used: trans-tracheal catheters and airway exchange catheters. An airway exchange catheter is a long, small internal diameter, hollow, semi-rigid catheter that is inserted through an in situ endotracheal tube prior to extubation. The patient tolerates the catheter and facilitates rapid reintubation if needed [8].

It is essential that anesthetists are aware of human factors, maintain situational awareness, avoid task fixation, and do not resort to unfamiliar techniques. A coordinated team approach with clear communication is essential [6].
9. Conclusions

Difficult airway can lead to serious complications in head and neck cancer surgical patients, specifically in cancer of the larynx.

The anesthesiologist should need a careful planning for intubation and extubation of difficult airway depending on surgery and conditions of the patient.

The use of appropriate airway equipment, oxygenation techniques, surgical airway access, all options must be available to rescue a difficult airway.

Intubation of the patient with laryngeal cancer is a challenge that must be addressed through a team approach. Management will depend on clinical presentation, individual experience, and equipment availability.

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Conflict of interest

The authors declare no conflict of interest.

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