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Diagnosis and management of laryngeal squamous cell carcinoma

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Abstract

Laryngeal squamous cell carcinoma (LSCC) is the most prevalent malignant tumor of the larynx and represents a major challenge in head and neck oncology. It commonly affects individuals with a history of tobacco and alcohol use, and its clinical presentation may include hoarseness, dysphagia, and airway obstruction, depending on tumor location and stage. Early and accurate diagnosis is crucial for effective treatment and improved patient outcomes. The diagnostic workup for LSCC involves a detailed clinical history, physical examination, and visualization of the larynx through flexible or rigid laryngoscopy. Imaging modalities such as contrast-enhanced computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography (PET-CT) are essential for tumor staging, assessment of local invasion, and detection of regional or distant metastases. Definitive diagnosis is established through histopathological examination of a biopsy sample. Treatment strategies for LSCC are determined based on tumor stage, anatomical site, and the patient's general condition. Early-stage tumors (T1–T2) can be effectively treated with single-modality therapy, such as transoral laser microsurgery or radiation therapy, with excellent local control and preservation of voice. Advanced-stage tumors (T3–T4) often require multimodal approaches, including total or partial laryngectomy combined with radiotherapy and/or chemotherapy. Recent advances in minimally invasive surgery, organ preservation protocols, and targeted therapies, including immunotherapy, offer promising outcomes while minimizing treatment-related morbidity. The management of LSCC requires a multidisciplinary approach, with emphasis on early detection, precise staging, and individualized treatment planning. Continued research and technological innovation are vital to improving survival rates and maintaining functional outcomes for patients with laryngeal cancer.

Keywords: Laryngeal squamous cell carcinoma; Diagnostic; Staging; Treatment strategies; Multidisciplinary management

1. Introduction

The larynx plays an important role in various vital functions, including breathing, swallowing, and speaking. Because of its important role in producing sound, it is often referred to as the “voice box.” It consists of a cartilaginous framework, extrinsic and intrinsic muscles, and a mucosal layer. Laryngeal cancer is the second most common malignancy of the upper digestive tract, after lung cancer.[1] Over 90% of laryngeal tumors originate from the mucous membrane layer, with the most common cytotype being well-differentiated squamous cell carcinoma.[2] Less commonly, tumors may be chondrosarcoma, leiomyosarcoma, melanoma (2–5% of all laryngeal tumors), or rare neuroendocrine tumors.[3]

Squamous cell carcinoma (SCC) is an epithelial malignancy exhibiting squamous differentiation. Over 95% of laryngeal tumors are SCC, with other variants of laryngeal malignancy including verrucous SCC, papillary SCC, spindle-cell carcinoma, basaloid, acantholytic SCC, and adenosquamous carcinoma. Although not always present, dysplasia is often a precursor. Tumors extending beyond the glottic or supraglottic ventricle are considered transglottic tumors.[4]

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Laryngeal cancer accounts for 0.8% of total cancer risk and is the second most common head and neck cancer. The incidence of new cases or cancer cases ranged from 3.1 per 100,000 per year between 2010 and 2014. In 2016, it was estimated there were 13,430 new cases of laryngeal cancer diagnosed, with approximately 3,620 deaths attributed to the disease.[5] Laryngeal cancer occurs more frequently in men than in women. Additionally, there are racial differences, with African Americans experiencing it at a younger age with higher incidence and mortality rates compared to Caucasians. Approximately 60% of patients present with advanced stages (III or IV) at diagnosis.[6,7]

Given the unique physiological function of the larynx, there are several common early symptoms that require further investigation, such as hoarseness, dysphonia, shortness of breath, and difficulty swallowing. Generally, a medical history and physical examination are supplemented with flexible nasopharyngoscopy to assess the condition of the larynx and mucosal surface. Direct laryngoscopy with biopsy under anesthesia in the operating room is often required. After diagnosis is confirmed, detailed imaging is necessary, typically using computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography (PET) scans. Direct extension to nearby structures or lymphovascular invasion is common, which can lead to lymph node metastasis. Surgery, laser therapy, and radiation remain the primary treatments. Prognosis is significantly influenced by tumor stage, location, age, differentiation, invasion pattern, margin status, and extranodal extension.[8]

Treatment for laryngeal cancer has evolved from radical resection and intensive radiation or chemotherapy. While offering potential for cure, extensive multimodal therapy often results in poor quality of life and further impairment of swallowing, breathing, and voice function. Treatment for laryngeal cancer in recent decades has aimed to preserve the larynx, thereby improving quality of life without compromising survival rates.[9]

2. Definition of Larynx and Squamous Cell Carcinoma

The larynx is divided into three sublocations according to embryological development. The supraglottis extends from the tip of the epiglottis to the artificial horizontal plane bilaterally crossing the apex of the laryngeal vestibule. The glottis extends from that plane to 1 cm below the true vocal cords. The subglottis extends from that horizontal plane to the tip of the cricoid cartilage. The glottis includes the true vocal cords and the space between them, the glottic rima. The true vocal cords consist of stratified squamous epithelium lining the lamina propria.[5]

The larynx consists of the thyroid, arytenoid, and cricoid cartilages. The cricoid cartilage is a complete ring and provides support for the functional part of the larynx. The thyroid cartilage is the main cartilage of the larynx, located above the cricoid cartilage. The arytenoid cartilage is located behind the thyroid cartilage, with two attachment points for the laryngeal muscles, namely the vocal process and the muscularis. The vocal process is where the thyroarytenoid and vocal muscles attach to the thyroid cartilage, along with the vocal ligament. These structures form the true vocal folds.[5]

Squamous cell carcinoma (SCC) is a malignant tumor that exhibits squamous differentiation, such as intercellular bridges and/or keratinization. SCC originates from squamous epithelium or from respiratory epithelium that has undergone squamous metaplasia.[10]

3. Epidemiology of Laryngeal Cancer

Laryngeal cancer occurs more frequently in men than in women. However, its incidence is increasing in various countries, including among women, presumably due to increased smoking habits.[9] A total of 210,606 new cases of laryngeal cancer were diagnosed in 2017 (2.76 new cases per 100,000 population) worldwide, with a prevalence of 1.09 million cases (14.33 cases per 100,000 population) in the same year, resulting in 126,471 deaths (1.66 per 100,000 population) and 3.28 million disability-adjusted life years (DALYs) or 0.13% of all DALYs. Incidence and prevalence have increased by 12.0% and 23.8%, respectively, over the past three decades, while mortality rates have decreased by approximately 5%. Among all types of cancer, laryngeal cancer ranks 22nd in terms of incidence (0.89% of all cancer types), 18th in terms of prevalence (1.44% of all cancer types), 18th in terms of DALYs (1.50% of all cancer types), and accounts for 1.39% of all cancer deaths.[11]

4. Risk Factors of Laryngeal Squamous Cell Carcinoma

There are many risk factors associated with laryngeal carcinoma, particularly squamous cell carcinoma. These factors have been shown to play an important role in the development of carcinogenesis. Various agents are involved in this process, causing mutations and the development of cell transformation. The following is a brief overview of the main risk factors for laryngeal SCC.[9]

4.1. Smoking

Tobacco smoking is the most significant risk factor for laryngeal cancer. Extensive research conducted since the 1950s has demonstrated a link between tobacco smoke and the development of head and neck cancers. In the United States, approximately 95% of laryngeal cancer patients are smokers. The carcinogenic effects of smoking on laryngeal cancer are now well established, but the specific risks for different types of cigarettes remain unclear.[9]

4.2. Alcohol

A recent systematic review by Levesque et al.[11] showed that alcohol intake increases the risk of infectious diseases and cancer, including laryngeal SCC, in a dose-dependent manner. In addition, several studies speculate on the possibility of interactions between alcohol consumption and genetic susceptibility, particularly in relation to genetic polymorphisms of the enzymes alcohol dehydrogenase (ADH) and aldehyde dehydrogenase (ALDH).[9]

4.3. Opium

Opium is an illegal substance derived from the opium plant, which contains various alkaloids. The International Agency for Research on Cancer (IARC) has classified opium as a carcinogenic agent for humans when smoked or ingested in various forms, such as raw opium, opium waste, or opium sap.[12]

4.4. Human Papilloma Virus

Although smoking remains the primary risk factor for laryngeal cancer, HPV infection is commonly found in non-smokers and younger patients with laryngeal cancer. Various HPV subtypes have been identified, some of which show a stronger correlation with malignant cellular transformation. Among these subtypes, HPV-16 is frequently found in laryngeal cancer specimens.[9]

Many studies indicate that smoking can lead to persistent HPV infection. This is due to poor oral hygiene, which increases the risk of HPV-positive squamous cell carcinoma. The dangerous types of HPV commonly found in cases of squamous cell carcinoma are HPV-16 and HPV-18, which can cause keratinization, cellular abnormalities, and cancer. Approximately 90% of oropharyngeal cancers are associated with HPV, particularly HPV-16 and HPV-18, which are less commonly found in head and neck cancer cases. It has been reported that patients with HPV-positive squamous cell carcinoma have a lower risk of mortality and recurrence due to better response to chemotherapy and radiotherapy compared to HPV-negative cases.[9]

4.5. Helicobacter pylori and GERD

Recent research suggests that there may be a correlation between H. pylori infection and laryngeal carcinoma. However, further studies with larger patient populations and more comprehensive data are needed to confirm this relationship conclusively.[9]

4.6. Other factors

Other risk factors that have been less studied and may be less involved in head and neck cancer include genetic susceptibility, certain occupations, exposure to air pollution, and previous exposure to radiation therapy. Certain genetic factors may contribute to a person's susceptibility to head and neck cancer, including laryngeal cancer. Genetic studies have identified specific gene variants that may increase risk, but further research is needed to fully understand the extent of their influence. Individuals who have previously undergone radiation therapy for head and neck cancer may have an increased risk of developing a second primary tumor, including laryngeal cancer. However, the risk is influenced by various factors such as radiation dose, duration since treatment, and individual susceptibility.[9]

5. Histopathological of Squamous Cell Carcinoma

SCC can present as ulcerative, endophytic, flat, exophytic, polypoid, or verrucous lesions, ranging from small mucosal thickening to occlusive masses. The tumor is erythematous to white-brown in color and often hard. SCC consists of varying degrees of squamous differentiation related to invasion. SCC is generally divided into three histological grades (well-differentiated, moderately differentiated, or poorly differentiated), with or without keratinization (see Figure 1). SCC demonstrates desmoplastic stromal reaction, often with perineural or lymphovascular invasion, and disruption of the basal membrane by string, nest, island, or individual cells. There is loss of polarity, disorganization, dyskeratosis, and keratin pearl formation.[13] Intercellular bridges are seen between cells with increased nuclear-cytoplasmic ratio, cytoplasmic basophilic staining, and irregular polygonal shapes. There is irregularity of nuclear chromatin, prominent eosinophilic nucleoli, and increased mitosis, including atypical forms. Well-developed keratinization is not seen in

poorly differentiated tumors. In poorly differentiated tumors or high-grade tumors, immunohistochemical studies for CK5/6, p63, p40, and epithelial membrane antigen (EMA) may help confirm the epithelial nature of the proliferation.[13]

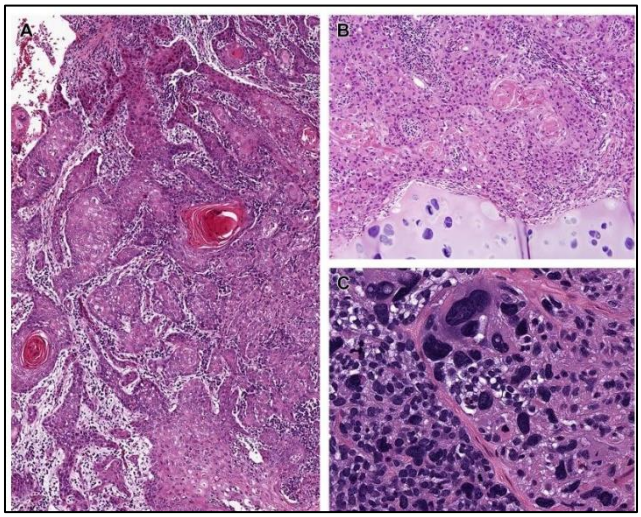

Figure 1 (A) Highly invasive, well-differentiated keratinizing SCC with keratin pearls. (B) Moderately differentiated keratinizing SCC showing invasion of cartilage. (C) Poorly differentiated SCC with marked pleomorphism. **[13]**

6. Diagnosis

The initial evaluation of patients with suspected laryngeal cancer is a detailed medical history. The medical history is taken to identify signs and symptoms of laryngeal carcinoma and to identify any risk factors the patient may have. Additionally, a comprehensive physical examination of the head and neck should be performed, including an examination of the mucosa of other upper aerodigestive tract structures, as multiple primary tumors are commonly found in patients with head and neck tumors. It is also recommended to assess speech and swallowing function, communication needs, nutritional status, health behaviors, and availability of social support. Pre-treatment dental evaluation is also recommended for patients undergoing radiation therapy due to the risk of damage, infection, and osteoradionecrosis from treatment. If there is suspicion of malignant tumor, this must be confirmed with a biopsy of the lesion and histopathological examination. Finally, radiological imaging is performed to obtain precise anatomical details regarding the localization and extent of the tumor.[14]

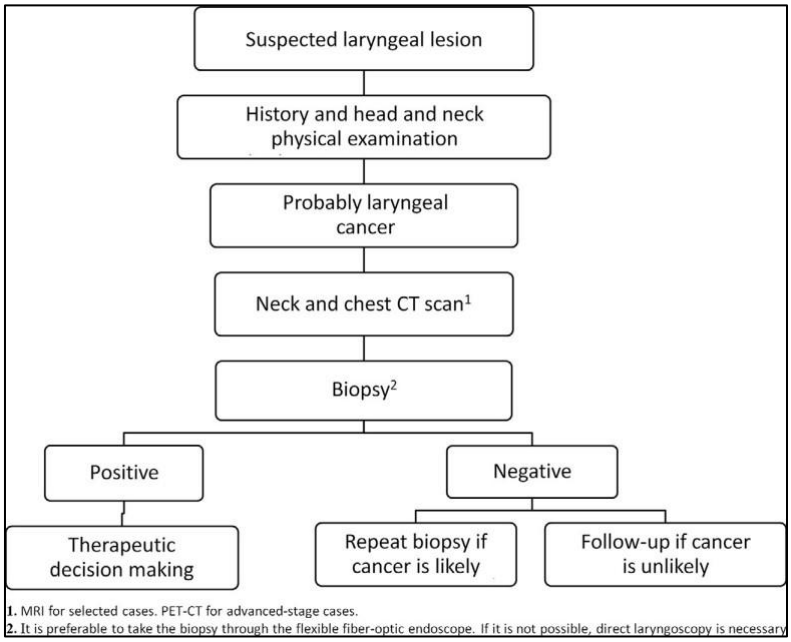

Figure 2 Diagnostic algorithm for laryngeal lesions[14]

The staging of laryngeal carcinoma is determined by the location of laryngeal involvement by the disease, thus requiring a thorough understanding of laryngeal anatomy. The staging classification of laryngeal cancer is determined by the extent of subsite involvement by the primary tumor, vocal cord mobility, extranodal extension, and the presence of metastasis. (see Tables 1 and 2) present the TNM staging system of the American Joint Committee on Cancer, which is divided based on the sublocation of the larynx followed by staging grouping.[15]

Table 1 Primary tumor (T) category

Category	Supraglottic	Glottic	Subglottic
T1	Limited to 1 supraglottic site Vocal cord mobility normal	Only involvement of true vocal cord	Only subglottic involvement
T1a	-	Involvement of single vocal cord	-
T1b	-	Involvement of bilateral vocal cords	-
T2	Invasion of the supraglottic or adjacent glottic regions or areas outside the supraglottic region without fixation larynx	Extension to the supraglottic or subglottic regions and/or impaired mobility of the vocal cords	Extension to the vocal cords
T3	onfined to the larynx with fixation of the vocal cords and/or invasion into the postcricoid region, preepiglottic space, paraglottic space, or inner cortex thyroid	Confined to the larynx with invasion of the vocal cords and/or invasion of the paraglottic space and/or inner cortex thyroid cartilage	Extension to the larynx with fixation of the vocal cords and/or inner cortex involving the thyroid cartilage thyroid
T4a	Invasion through the outer cortex of the thyroid cartilage	Invasion through the outer cartilage	Invasion through the cricoid or thyroid cartilage
T4b	Invasion of the prevertebral space, carotid artery sheath, or invasion of mediastinal structures	Invasion of the prevertebral space, carotid artery sheath, or invasion of mediastinal structures	Invasion of the prevertebral space, carotid artery sheath, or invasion of mediastinal structures

Table 2 Regional nodal (N) category

Category	Regional nodal involvement
N0	No Regional Nodal Involvement
N1	Single Ipsilateral Lymph Node < 3 cm No Extranodal Extension
N2a	Single Ipsilateral Lymph Node, Between 3 cm and 6 cm Without Extranodal Extension
N2b	Multiple Ipsilateral Lymph Nodes, None Larger Than 6 cm No Extranodal Extension
N2c	Multiple Bilateral/Contralateral Lymph Nodes None Larger Than 6 cm No Extranodal Extension
N3a	Any Regional Metastasis Larger Than 6 cm No Extranodal Extension
N3b	Any Regional Metastasis With Extranodal Extension

7. Clinical Manifestation

Patients with early-stage primary tumors arising in the true vocal cords typically present with complaints of dysphonia and hoarseness, sore throat, odynophagia, dysphagia, otalgia, local pain in the thyroid cartilage, hemoptysis, airway obstruction, stridor, and neck adenopathy, which are characteristics of advanced glottic lesions. In general, persistent hoarseness (>15 days) in adult patients requires laryngeal endoscopic visualization to rule out tumors. Supraglottic tumors typically present with more advanced symptoms compared to glottic cancer, including the following: discomfort or a sensation of a lump in the throat (the most common initial symptom), dysphagia, odynophagia, a sensation of something stuck in the throat, respiratory obstruction, hemoptysis, referred pain to the ipsilateral ear (via the vagus and auricular nerves), or a neck mass; however, hoarseness is not the primary symptom of supraglottic cancer until the lesion becomes sufficiently extensive. Primary subglottic tumors are typically asymptomatic in the early stages and do not present until they have grown larger, at which point dyspnea and stridor often occur. Dysphonia is relatively common in advanced subglottic tumors due to involvement of the true vocal cords or direct extension to the recurrent laryngeal nerve. Late symptoms of laryngeal cancer include weight loss, dysphagia, halitosis, and aspiration.[14]

8. Physical Examination

A comprehensive clinical examination with rigid or flexible fiberoptic endoscopy is performed to assess the surface area of the primary tumor, vocal cord mobility, and to perform initial tumor staging. Large lesions may extend beyond the larynx to the adjacent tongue base, piriform sinus, or retrocricoid region, and this must be assessed. Assessment of vocal cord mobility is also necessary. Vocal cord fixation in laryngeal cancer is caused by invasion or damage to the vocal cord muscles, invasion of the cricoarytenoid muscles or joints, or invasion of the recurrent laryngeal nerve. Pain or tenderness on palpation or a small mass above the thyroid cartilage indicates thyroid invasion. Narrow band imaging (NBI) endoscopy should be used as a routine pharyngolaryngeal examination as it can aid in the early diagnosis of laryngeal tumors and post-surgical monitoring for recurrence detection. Other imaging techniques such as automated fluorescence, contact endoscopy, and optical coherence tomography (OCT) are increasingly used in otolaryngology practice. Sometimes, direct laryngoscopy under general anesthesia is required. The ventricle, subglottic area, apex of the piriform sinus, and retrocricoid area must be examined carefully. A detailed neck examination is mandatory whenever laryngeal tumor is suspected. Regional metastasis is the most important negative prognostic factor, reducing survival rates by 50%.[14]

9. Imaging

If malignancy is suspected, computed tomography (CT) scan and/or magnetic resonance imaging (MRI) with contrast should be performed to determine the extent of submucosal involvement and deeper tumor margins. CT is preferred because it takes less time than MRI. Small and superficial mucosal tumors may not be detected on CT or MRI, so endoscopy must be performed before imaging studies. Axial diameter greater than 10 mm, spherical shape, necrotic nodules of various sizes, and nodules with irregular, poorly defined borders are generally accepted radiological criteria for diagnosing malignant nodules on CT and MRI. Common radiological criteria used for tumor involvement include asymmetric soft tissue protrusion or thickening, abnormal contrast enhancement, large masses, loss of normal fat planes and spaces, or a combination of these.[14]

Tumors arising in the aryepiglottic fold present as exophytic or infiltrative masses. These tumors expand the aryepiglottic fold and spread into the paraglottic space, may also spread further anteriorly into the preepiglottic space or posteriorly to invade the piriform sinus. Tumors originating from the false vocal cords are lateral masses with a strong predilection for submucosal spread into the paraglottic space. More extensive tumors may damage the thyroid cartilage and spread transglottically into the glottis and subglottis. Tumor spread to the paraglottic space on CT or MRI appears as tumor tissue replacing normal paraglottic fat. [14]

Glottic tumors generally originate from the anterior half of the vocal cords and spread into the anterior commissure. Anterior commissure abnormalities are seen on CT or MRI as tissue thickening greater than 1–2 mm. Subglottic spread below the anterior commissure is seen as irregular thickening of the cricothyroid membrane. Tumors can gain access to extralaryngeal tissue through the cricothyroid membrane. Subglottic cancer is diagnosed if there is any thickening between the airway and the cricoid ring. Due to its slow presentation, invasion of the cricoid cartilage, trachea, and cervical esophagus with extralaryngeal spread is a common finding on radiological examination of these patients. Additionally, the use of PET scans with 18F-fluorodeoxyglucose (FDG) combined with CT and PET allows for functional and anatomical evaluation. FDG imaging has the potential to distinguish between benign and malignant processes, determine tumor grade, identify metastases, and diagnose tumor recurrence. In head and neck cancer, FDG is useful for

detecting clinically subtle recurrences and determining residual disease after definitive radiotherapy. However, CT-PET is not useful for excluding metastasis in the neck with N0 because PET cannot detect very small tumors (<5-7 mm). [14]

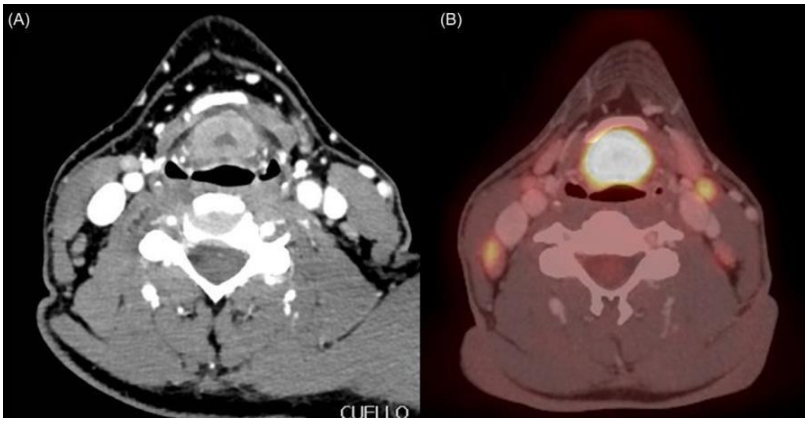

Figure 3 (A) Axial contrast-enhanced CT shows a supraglottic tumor invading the pre-epiglottic space. (B) PET-CT shows a hypermetabolic focus of active tumor occupying the pre-epiglottic space consistent with the abnormality on CT scan. [14]

10. Management

The current treatment paradigm for laryngeal cancer management focuses on cure while preserving the larynx whenever possible and striving for outcomes that provide the best quality of life. For patients with early-stage cancer (T1 and T2), endoscopic resection and open partial laryngectomy are pursued for complete resection while preserving the larynx. For patients with advanced disease (T3 and T4), treatment with chemoradiation has emerged as the standard approach. However, surgery plays an important role in the treatment of carefully selected patients. For those with advanced disease and poor function or those with contraindications to chemoradiation, surgery remains the primary treatment.[16]

Choosing between surgical and non-surgical approaches as initial treatment for laryngeal cancer depends on individual patient factors such as age and comorbidities, primary tumor location, primary tumor size and volume, and the presence of lymph node metastasis or the likelihood of metastasis in lymph node regions at risk of spread, even without evidence of disease. Treatment choices are also influenced by involvement of the anterior commissure and the ability to achieve adequate endoscopic visualization. The availability of surgical oncologists and radiation oncologists, as well as adequate rehabilitation services, are fundamental considerations.[16]

Laryngeal cancer can be treated with various surgical procedures. Although total laryngectomy involves the complete removal of the larynx, the approach in conservative laryngeal surgery aims to preserve the structure and function of the larynx while maintaining speech and swallowing physiology without compromising the chances of cure. Conservative laryngeal surgery is performed on patients with early-stage laryngeal cancer using approaches such as transoral laser microsurgery and open partial laryngectomy. Conservative laryngeal surgery should only be performed if the surgeon can confidently achieve tumor-free margins. The functional outcomes of conservative laryngeal surgery are highly dependent on surgery being the sole modality in treatment, as the use of adjuvant radiation therapy post-surgery after incomplete resection can compromise functional outcomes, particularly after open partial laryngectomy.[16,17]

10.1. Modified Radical Neck Dissection

This procedure removes all lymph nodes in the lateral neck (now known as level IV) and the accessory spinal nerve (CN XI), internal jugular vein (IJV), sternocleidomastoid muscle (SCM), and several other surrounding structures, including the caudal portion of the parotid gland. This method is indicated when the risk of neck lymph node metastasis exceeds 15-20%. However, this procedure results in significant cosmetic abnormalities and loss of function. Over time, the procedure has been modified to reduce morbidity while maintaining oncological efficacy. Modified Radical Neck Dissection (MRND) recommends preserving at least one of the important non-lymphatic structures (CNXI, IJV, or SCM).[18]

For neck dissection to be classified as MRND, level IV must be removed, and at least one of the following structures must be preserved: the accessory spinal nerve, the sternocleidomastoid muscle, and the internal jugular vein. Modified radical

neck dissection is classified into types I, II, or III based on which structures are preserved. In type I, MRND CN XI is spared. In type II, MRND CN XI and IJV are spared. In type III, MRND CN XI, IJV, and SCM are all spared.[19]

Inoperable disease is an absolute contraindication for neck dissection. This includes invasion of the skull base or deep neck muscles. Involvement of the carotid artery may be considered an absolute or relative contraindication to surgery. If the carotid artery may be sacrificed, preoperative evaluation with carotid artery balloon occlusion studies using xenon CT or SPECT-CT imaging should be performed to determine the role of carotid reconstruction. There is no definitive evidence that this procedure improves survival, but it is sometimes performed if the risk of carotid explosion is perceived to be high.[20]

10.2. Total Laryngectomy

Total laryngectomy is a radical surgery that involves the removal of the entire larynx, including the thyroid and cricoid cartilages, the hyoid bone, and part of the thyroid gland.[13] The following are indications for total laryngectomy:[21]

Advanced laryngeal tumors with cartilage damage and anterior extra-laryngeal spread, resulting in a damaged larynx that is unlikely to function again even if anatomically preserved (laryngeal dysfunction, airway obstruction, or severe aspiration); Circumferential submucosal disease with or without bilateral vocal cord paralysis; Bilateral involvement of the cricoarytenoid joint or posterior commissure; Extensive involvement of the thyroid cartilage; Subglottic extension with extensive invasion of the cricoid cartilage; Hypopharyngeal tumors originating from or spreading to the postcricoid mucosa; Extensive pharyngeal or tongue base resection in patients at high risk of aspiration issues; Primary tumor of the cricoid or thyroid cartilage; Radiation necrosis of the larynx that has not received medical management; Chronic aspiration due to glottic incompetence, making the patient unsuitable for conservative treatment; Advanced thyroid cancer with laryngeal invasion. [21]

Although total laryngectomy often offers the best chance for cure, the consequences include permanent tracheostomy and loss of the original voice. The most common complications of this modality are wound infection and pharyngocutaneous fistula, occurring in 50% of patients who previously received radiation. Therefore, vascularized pedicled or free tissue flaps to cover pharyngeal closure may be recommended to reduce the risk and severity of fistulas.[16]

Various incision patterns in Total Laryngectomy are described in Figure 4. A vertical midline incision provides direct access to the larynx but offers limited lateral exposure to the neck. T-shaped and double-Y incisions provide greater exposure to the neck, but these incisions involve trifurcation, resulting in poor blood supply and poor cosmetic outcomes. The trap-door incision has been abandoned and replaced with contemporary single-stage reconstruction. The apron incision is considered the preferred choice for laryngectomy as it provides the best cosmetic results. The extended apron incision is the primary choice for patients with tumors showing lower extension or tumors requiring extended apron neck dissection.[22]

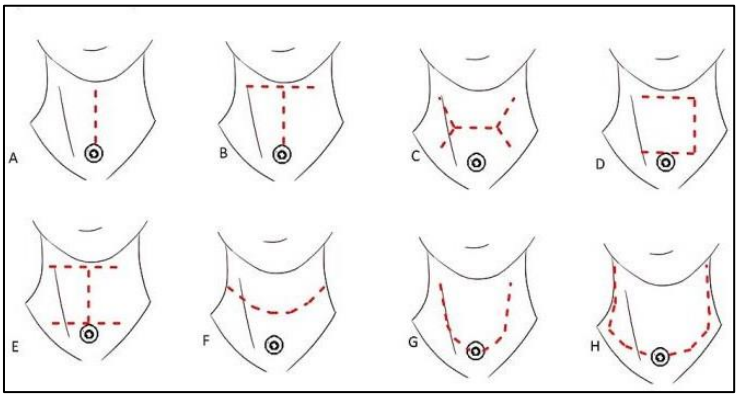

Figure 4 (A) Insisi midline vertical, (B) insisi T-shaped, (C) insisi horizontal double-Y, (D) insisi trap-door, (E) ini double trap-doors, (F) insisi apron (separate tracheostoma), (G) insisi apron (tracheostoma-incorporated), and (H) insisi extended apron. **[22]**

10.3. Fascutaneous Flap

Surgical flaps are usually classified based on their vascularization pattern and proximity to the primary defect. In terms of blood supply, flaps can be classified as random and axial. Random flaps are supplied by the plexus of the subdermal plexus of the skin and are not supplied by specific blood vessels. In contrast, axial flaps are supplied by a specific arteriovenous system. Axial flaps are usually considered more reliable than random flaps on the basis of improved perfusion in the distal portion. [23]

Based on the location of the defect with the flap location, local, regional and free flaps can be distinguished. Local flaps are located adjacent to the defect site. Local flaps include rotation flaps, advancement flaps, and transposition flaps. The survival of local flaps depends on adequate perfusion. Regional flaps and free flaps usually have axial-based vascularization, where these flaps depend on a specific vascular pedicle for survival. An example of a regional flap is the pectoralis major myocutaneus flap, which is supplied by a branch of the thoracoacromial artery. The use of free flaps requires microsurgical techniques and therefore has operator limitations but better function and aesthetics. [23]

The faciocutaneous flap is part of an axial flap whose tissue consists of skin layers, subcutaneous tissue and deep fascia. The faciocutaneus flap on the anterior chest below the clavicula bone or known as the deltopectoralis flap is often used for reconstruction of the head and facial region due to its close location, skin texture and skin color. This deltopectoralis flap gets its blood supply from the internal mammary perforator artery. In this flap there are many arterial and venous supplies that are connected so as not to cause necrosis of the flap. The faciocutaneus flap is also preferred over the myocutaneus flap as it is thinner and easier to use. Another advantage of using the faciocutaneus flap is that it does not require microsurgical tools and techniques, so the time required for surgery is shorter when compared to the use of free flaps, so it is more often chosen in patients with underlying comorbid diseases and patients with severe disease. The deltopectoralis faciocutaneus flap also has disadvantages such as limited rotational range and donor disability especially if a skin graft is required.[23]

Figure 5 Deltopectoral flap. A, Hypopharyngeal defect. B, Deltopectoral flap elevation with split-thickness skin graft. C, deltopectoral flap elevation with skin graft to demarcate the defect site. D, deltopectoral flap with skin graft placed over the donor defect[23]

10.4. Open Partial Laryngectomy

Open Partial Laryngectomy is a conservational laryngeal surgical technique that encompasses a variety of open surgical techniques, ranging from hemilaryngectomy to supracricoid partial laryngectomy. Complications of Open Partial Laryngectomy include bleeding, infection, laryngocutaneous fistula, poor wound healing, airway obstruction requiring tracheostomy, aspiration pneumonia, dysphagia and dysphonia. Open Partial Laryngectomy is sometimes used in the primary treatment of T3 supraglottic cancer for which transoral laser microsurgery is not feasible. In vertical partial laryngectomy, a vertical incision is made through the thyroid cartilage near the anterior commissure and just anterior to the posterior edge of the thyroid cartilage, resecting the true vocal cords and nearby subglottis, ventricles, false vocal cords, and aryepiglottic folds. Vertical partial laryngectomy is currently reserved for only a small proportion of patients

with small T1 or small T2 tumors involving the anterior commissure. Horizontal partial laryngectomy, or supraglottic laryngectomy, consists of resecting the entire part of the larynx that lies above the glottis, including the epiglottis and preepiglottic space, while preserving the native vocal cords and arytenoids. Horizontal partial laryngectomy may be offered to select patients with tumors that extend beyond the traditional borders, which include T3 and T4 supraglottic tumors involving 1 vocal cord and 1 arytenoid and extending to the sinus piriformis or base of the tongue.[16]

10.5. Transoral Laser Microsurgery

Transoral Laser Microsurgery (TLM) is a minimally invasive endoscopic approach that combines the use of suspension laryngoscopy with an operating microscope, tissue-cutting laser and microsurgical instruments to resect primary tumors. Carbon dioxide and Nd:YAG lasers produce beams with light frequencies that are absorbed by water, thus minimizing tissue damage. The concept of TLM is different from the open partial surgery approach. In Open Partial Laryngectomy, resection is performed in a systematic manner, removing certain anatomical structures according to a well-reported standardized approach (e.g. systematic resection of thyroid cartilage in supracricoid laryngectomy), whereas in TLM, resection is based on the location and invasion of the tumor. The surgeon removes the abnormal tissue with its periphery and preserves the normal structures to ensure an adequate functional outcome. TLM is mainly indicated for early-stage vocal cord cancer (Tis, T1, and T2).[24]

11. Conclusion

Based on histological features, one of the most common types of laryngeal carcinoma is squamous cell carcinoma (SCC). SCC is a malignant epithelial tumor that shows evidence of squamous differentiation and is the most important and most common malignant neoplasm of the larynx. Several risk factors have been shown to increase the risk of Laryngeal SCC incidence, one of the most important of which is smoking. The clinical features of patients with laryngeal carcinoma depend on the anatomical region of the larynx affected. Current management of laryngeal SCC consists of surgical and non-surgical procedures. Choosing a surgical versus non-surgical approach as initial treatment for laryngeal cancer depends on individual patient factors such as age and comorbidities, location of the primary tumor, extent and volume of the primary tumor, and presence of lymph node metastases. Some of the surgical methods currently in use are Modified Radical Neck Dissection, Total Laryngectomy, Fasciocutaneous Flap, Open Partial Laryngectomy, Transoral Laser Microsurgery.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

This study did not require ethical approval or informed consent, as it is based solely on a review of existing literature.

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