



LARYNGECTOMY

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ABSTRACT

Background: laryngeal cancer is a malignancy that occurs in the larynx and arises from larynx squamous epithelial tissue. Treatment can be done with radiotherapy, chemotherapy, and laryngectomy to control the disease.

Objective: Knowing the indications and types of laryngectomy in laryngeal carcinoma.

Conclusion: Laryngectomy is a surgical procedure to remove part or all larynx. The choice of laryngectomy type is based on tumor stage, equipment availability, and function reservation (speech and swallowing).

Keywords: total laryngectomy, partial laryngectomy, laryngeal carcinoma,

Introduction

Laryngeal cancer is a form of malignant tumor that develops in the larynx, which is the voice box, and originates from the squamous epithelial tissue lining the larynx. This type of cancer ranks as the second most prevalent head and neck cancer globally. It is estimated that there are around 151,000 new cases of laryngeal cancer reported each year, with an annual mortality rate of approximately 82,000 individuals. Notably, there is a significant disparity in the occurrence of laryngeal cancer between males and females, with a ratio of 6 to 1 in favor of males. Furthermore, laryngeal cancer ranks as the 13th most common cancer among men worldwide. It is worth mentioning that the incidence and mortality rates of laryngeal cancer exhibit geographical variations, with certain regions being more affected than others. Regions such as South-Central Asia, East Asia, Central Europe, and Eastern Europe have a higher prevalence of laryngeal cancer cases and deaths compared to other parts of the world. These disparities highlight the importance of understanding the risk factors and implementing effective prevention and treatment strategies in regions with a higher burden of laryngeal cancer. By addressing these regional variations, we can strive to reduce the overall impact of laryngeal cancer on global health. Smoking cessation has resulted in a decrease in incidence in the United States. There were 140 patients with laryngeal carcinoma who visited DR. Hasan Sadikin Bandung Period 2017 – 2019, consisting of 89.13% men and 10.87% women. Squamous cell carcinomas (SCC) are the predominant type of cancer that accounts for over 95% of primary malignant tumors in

the larynx. The remaining cases of laryngeal cancer are attributed to various factors, including minor salivary glands, neuroepithelial tumors, soft tissue tumors, and laryngeal cartilages. Unfortunately, a significant challenge in managing laryngeal cancer lies in the late detection of the disease. Approximately 60% of patients are diagnosed when the cancer has already reached an advanced stage, specifically stage III or IV. This highlights the importance of early detection and screening programs to identify laryngeal cancer at its initial stages when treatment outcomes are generally more favorable. It is disheartening to note that the 5-year survival rate for laryngeal cancer has witnessed a decline over the past four decades. Initially, the survival rate stood at a mere 6%, which indicates the dire consequences of this disease. However, with advancements in medical research and treatment options, the survival rate has improved significantly and currently stands at 63%. This increase in survival rates can be attributed to various factors, including improved diagnostic techniques, better understanding of the disease, advancements in surgical procedures, and the development of targeted therapies and radiation techniques. Despite this progress, it is crucial to continue investing in research and raising awareness about laryngeal cancer. By doing so, we can further enhance treatment outcomes, develop more effective therapies, and ultimately strive towards a higher survival rate for individuals diagnosed with this type of cancer. Additionally, promoting lifestyle changes and educating individuals about risk factors, such as smoking and excessive alcohol consumption, can play a significant role in preventing laryngeal cancer and reducing its incidence. Laryngeal cancer's etiology has been linked to several

risk factors. Alcohol and cigarette use are the two most important of these. Smokers have a risk of developing laryngeal cancer that is 10-15 times higher than that of nonsmokers, and the most heavy smokers have a risk that is 30 times higher.¹⁻³

Selection of Laryngeal Carcinoma Therapy

Controlling laryngeal cancer is the major objective of treatment. Secondary goals include the preservation of swallowing, speech, and the avoidance of a tracheostomy. Surgery, radiation therapy, or a combination of the two is frequently used to treat laryngeal

Near Total Laryngectomy

Near-total laryngectomy, or Pearson's procedure, is a voice-preserving operation used for large T3 and T4 lesions of the unilateral larynx for which a supraglottic or supracricoid laryngectomy cannot be performed. During the surgical procedure, a partial removal of one side of the larynx (known as a hemilarynx) is performed, along with the anterior part of the opposite vocal cord. In some cases, it may also involve the removal of a portion of the cricoid cartilage on the same side as the affected larynx and a segment of the proximal trachea. As a result of this surgical intervention, a permanent opening called a tracheostoma is created to facilitate breathing. This opening serves as a new pathway for airflow and replaces the natural function of the removed laryngeal structures. To restore the ability to produce sound, a dynamic tracheoesophageal tract is established. This mechanism allows for the passage of air from the lungs through the trachea and into the esophagus, where vibrations generate speech. A permanent tracheostoma, normal swallowing, and a speech fistula were among the functional outcomes. Although technically difficult, near-total laryngectomy is a viable alternative to total laryngectomy but should not be used for surgical salvage.^{3,9}

Total Laryngectomy

Total laryngectomy is widely regarded as the most effective and preferred treatment option for laryngeal cancer, offering superior oncological outcomes compared to partial laryngectomy procedures. This surgical technique, which involves the complete removal of the larynx, was first successfully performed by Billroth in 1873. However, it was further refined and perfected by Gluck and Sorenson in 1894, leading to its widespread adoption and recognition as the gold standard treatment for advanced cases of laryngeal cancer. Total laryngectomy is primarily indicated for the management of advanced stage laryngeal cancers classified as T3 and T4. These stages typically involve extensive tumor growth and

cancer. Surgery was previously used only as an adjuvant therapy for survival, and early stage tumors were treated with external radiation therapy. Total laryngectomy combined with postoperative radiation therapy, on the other hand, is used to treat advanced supraglottic and glottic malignancies. Improvements in technology and instruments over the last 25 years have given patients with early-stage cancers another treatment option. Experience with concurrent or sequential chemoradiation therapy for laryngeal preservation amply supports its effectiveness.⁴⁻⁶

infiltration beyond the boundaries of the larynx. Additionally, this procedure is considered when other treatment modalities, such as chemotherapy and radiation, have not achieved the desired results or when laryngeal-conserving surgeries have been unsuccessful. Total laryngectomy provides an excellent degree of control but at the expense of a natural voice. This procedure involves en bloc resection of the larynx, including the hyoid bone, thyroid cartilage, and cricoid cartilage to the proximal inferior tracheal ring.¹⁰ Resection of the pharyngeal wall and base of the tongue can be performed in conjunction with this procedure. A tracheostoma is formed by suturing the trachea to the skin.^{3,5,11,12}

The key to total laryngectomy success is to maximize QOL by optimizing laryngeal function. Carefully releasing the sternocleidomastoid head from the sternocleidomastoid muscle and suspending the trachea to prevent traction that could cause stomal stenosis greatly aids patients in managing their stoma and easing the sound of recovery with tracheoesophageal speech. Complete cricopharyngeal myotomy or pharyngeal plexus neurectomy should be performed to improve deglutition and laryngeal voice. If the procedure is not performed properly, the patient may experience swallowing difficulties and may require esophageal dilation or other measures to improve speech and swallowing. Voice restoration is accomplished through the use of tracheoesophageal speech, esophageal speech, or artificial laryngeal speech.³

Studies have reported varying disease-free survival rates for T3 glottic tumors treated with total laryngectomy, ranging from 49% to 80% over a 5-year period. Multiple factors, such as patient characteristics, tumor characteristics, and treatment approaches, contribute to this variation in survival rates. However, it is important to note that the overall 5-year survival rate for T3 glottic tumors after total laryngectomy is estimated to be around 54%.

When considering T4 glottic tumors, the 5-year overall survival rate following total laryngectomy falls within the range of 32% to 63%. These survival rates highlight the challenging nature

of treating T4 tumors, which typically exhibit more advanced disease progression and may have infiltrated nearby structures.

Recurrence rates for Stage III and IV glottic tumors, encompassing both T3 and T4 tumors, indicate that approximately 37% of patients experience recurrence. Among these cases, 19% of recurrences manifest at the primary tumor site, while 17% occur in the neck region.

It is important to interpret these statistics within the context of individual patient factors and the specific characteristics of the tumor. Various variables, including tumor stage, grade, and biological behavior, as well as the adequacy of surgical resection and subsequent adjuvant treatments, can influence survival outcomes. Additionally, advancements in treatment modalities, such as adjuvant therapies and post-operative surveillance strategies, have the potential to further improve survival rates and reduce recurrence rates.

Considering the diverse nature of laryngeal cancer and the multifaceted factors that influence treatment outcomes, a personalized approach to patient management is crucial. This involves considering the unique characteristics of each case, tailoring treatment plans to maximize effectiveness, and providing comprehensive follow-up care to monitor for recurrence and address any potential challenges that may arise.⁵

Advanced laryngeal tumors can affect structures other than the larynx. The tumor may grow large enough to directly affect the hypopharynx or oropharynx. Tumors that cross these boundaries frequently necessitate surgical resection, which may include resection of the entire pharynx, i.e. laryngopharyngectomy. Similarly, large tumors of the subglottis or hypopharynx frequently involve the trachea and/or esophagus, necessitating extended excision and, in some cases, esophagectomy to ensure adequate margins.^{11,13}

Salvage Total Laryngectomy

Patients with advanced laryngeal cancer who fail organ-preserving therapy with chemoradiation therapy require surgical salvage. After chemoradiation therapy, patients were only in a minority of cases still candidates for laryngeal conservation surgery, with the vast majority requiring salvage total laryngectomy. Many studies include salvage laryngectomy in their outcome data for patients

Transoral Laser Microsurgery (TLM)

Inadequate transoral access throughout the tumor is the main contraindication to TLM for early-stage supraglottic cancer. Endoscopic access limitations include the 8T: teeth (protruding teeth), trismus, transverse dimension (narrow mandibular arch), tori

receiving chemotherapy and radiation therapy. Surgical complications are more common in patients who require surgical salvage, whether through conservation surgery or total laryngectomy. If the patient fails to undergo laryngeal conservation surgery, a salvage total laryngectomy is frequently required.^{5,9,12,14}

Partial Laryngectomy

Pelletan, a French surgeon, performed a median thyrotomy to remove the portion of the larynx affected by the tumor more than two centuries ago. In 1947, a surgical technique known as supraglottic laryngectomy was introduced by Alonso. This procedure involved the removal of the upper portion of the thyroid cartilage, as well as the supraglottic structures, to address vocal cord and arytenoid-related issues. Over time, this technique gained recognition and popularity in different parts of the world. In Europe, Bocca played a significant role in popularizing the supraglottic laryngectomy procedure. His contributions and advancements in surgical techniques helped refine the procedure and expand its application. Similarly, in the United States, notable surgeons such as Ogura, Som, and Kirchner contributed to the growing popularity of supraglottic laryngectomy by adopting and promoting the procedure within their practices. In 1959, Majer and Reider made a significant breakthrough by broadening the scope of resection in laryngeal cancer surgeries. They introduced a modified technique known as supracricoid partial laryngectomy, which served as an alternative to total laryngectomy for patients with glottic and supraglottic cancers. This approach aimed to preserve a greater portion of the larynx while effectively removing cancerous tissues.^{5,7,15}

Vertical partial laryngectomy

1. Cordectomy

Laryngofisura with cordectomy is another term for minimal surgical resection in the category of vertical partial laryngectomy surgery. After a midline thyrotomy incision, the vocal cords are released. He is indicated for early lesions that do not involve the arytenoid cartilage or extend into the anterior commissure. Postoperative airway management, a tracheotomy may be performed.^{7,15}

(mandibular), tongue (bulk), tilt (atlanto-occipital extension), therapy (previous radio or chemoradiotherapy), and tumor (location and size).^{7,15}

The two most common lasers are the potassium titanyl phosphate laser and the CO2 laser. The CO2 laser has a wavelength

of 10.6 m and works in the infrared (invisible) light spectrum. CO₂ lasers have several benefits, including low scattering, low reflections, and high water absorption. The absorption depth is 0.2 mm, and the surrounding area is less than 0.5 m. A laser-safe double-cuff endotracheal tube with the cuff inflated with saline is typically used. To expose laryngeal structures, operating laryngoscopes with suction tubes, such as adjustable bivalved laryngoscopes, are used. A CO₂ laser and an operating microscope are typically used in surgery. The laser beam is manipulated using a micromanipulator. A fiberoptic laser delivery system, as well as 0-, 30-, and 70-degree laryngeal telescopes, may be useful. This technique requires the use of microlarynx instruments with electrocautery and suction.^{7,15,17}

The European Laryngological Society (ELS) categorizes supraglottic cancer endoscopic resection into four types. Supraglottic cancer of type I is distinguished by small superficial lesion, whereas type II is distinguished by superior hemiepiglotectomy without resection of preepiglottic space. Medial supraglottic laryngectomy with preepiglottic space resection is referred to as type III, while a lateral supraglottic laryngectomy is referred to as type IV.⁷

Following surgery, broad-spectrum antibiotics and anti-reflux medication were given for three weeks. Early supraglottic cancer resection rarely necessitates tracheostomy or prolonged intubation. Nasogastric feeding is usually avoided for small resections, but it may be given in the early postoperative period. Postural modification and a supraglottic diet are used in early intervention

Several studies have discovered that local control rates for T1 lesions exceed 90%. Partial vertical laryngectomy is performed on T1 and T2 glottic carcinoma lesions with anterior commissure. Frontal hemylaryngectomy is a surgical procedure used to treat early-stage glottic cancer of the anterior commissure. When the tumor has invaded the cartilage and endoscopic removal is not possible, a frontal hemylaryngectomy is performed. The entire anterior commissure, as well as the anterior third of the vocal folds and the anterior portion of the thyroid cartilage, were resected. Frontal hemylaryngectomy causes hoarseness but leaves breathing and swallowing functions intact.³

When there is tumor in both anterior commissures and extension posteriorly, a frontolateral hemylaryngectomy is performed. The anterior commissure vocal folds and thyroid cartilage ligaments are removed, either partially or completely. This action exacerbated the hoarseness.^{3,18}

to improve swallowing. Normal swallowing function usually returns within a few days of functional recovery.^{7,15}

2. Hemylaryngectomy

Vertical line hemilaryngectomy is a surgical approach employed for the treatment of larger glottic carcinomas that have extended to the vocal process or involved the ventricular region. It is also used for transglottic lesions that do not exhibit vocal cord fixation. This procedure involves a central incision in the thyroid cartilage, allowing access to the laryngeal lumen at the anterior commissure. During vertical line hemilaryngectomy, a significant portion of the true vocal cords, along with the thyroid cartilage, and any affected false vocal cords, are removed as part of the resection process. This surgical technique aims to achieve adequate tumor removal while preserving as much laryngeal function as possible. By cutting the thyroid cartilage centrally, surgeons can effectively access the anterior commissure and the laryngeal lumen. This approach allows for precise removal of the cancerous tissues while minimizing damage to surrounding structures. The subglottis was longer than 10 mm or 5 mm anteriorly.^{3,7}

There have been several reconstructions proposed. All reconstructions involve a re-approach of the thyroid perichondrium. A common strategy for reconstructing the defect is to use bilateral bipedicle cord muscle flaps. During reconstruction, the epiglottis can also be preserved. To reconstruct the larynx after a vertical hemilaryngectomy, the epiglottis is advanced inferiorly and laterally. Many authors have reported excellent post-vertical partial laryngectomy survival rates.^{3,7,1}

It is possible to achieve a local control rate of 94%. Bakhos recommended SCPL-CHEP over anterior frontal laryngectomy for lesions involving contralateral vocal fold spread.³

When the tumor has reached the vocal processes and it is known that it is a carcinoma, a frontolateral hemylaryngectomy is required. Vocal fold resection extends into the ventricles up to 1 cm below the vocal folds. By removing the arytenoid cartilages, the posterior resection can be extended by 0.5 cm.^{3,7}

Horizontal Partial Laryngectomy

1. Supraglottic Laryngectomy (LSG)

The epiglottis, false cord, aryepiglottic fold, hyoid, and upper half of the thyroid cartilage must be removed during open LSG surgery. The pre-epiglottic space is entirely resected using this approach. This technique, which is essential for phonation, respiration, and deglutition, preserves the vocal cords, at least one arytenoid, and the base of the tongue. It also removes the

requirement for a tracheostomy tube. The basic LSG can be changed in early-stage malignancies to maintain the hyoid bone. Lesions that extend to the vallecula, tongue floor, ipsilateral arytenoids, and medial wall of the piriform sinus may be treated by extended LSG. A tracheostomy is always needed during resection. This treatment is not recommended in the following situations:

- fixation of the cord
- invasion thyroid cartilage
- invasion bilateral arytenoid or interarytenoid space
- extension to the apex of the piriform sinus
- extensive involvement of the base of the tongue
- patients who are unmotivated and have respiratory issues.^{3,7,15}

2. Supracricoid Laryngectomy

This procedure is used in conjunction with the previous supraglottic laryngectomy to remove the supraglottis as well as the true vocal cords and thyroid cartilage. This procedure can clear not only the preepiglottic space but also the paraglottic space. Majer and Rieder described supracricoid laryngectomy as an alternative to total laryngectomy in 1959, and it was popularized in the United States by Laccourreye and Weinstein. Because only one functional arytenoid must be preserved, careful patient selection is required. Vertical line hemilaryngectomy is a surgical procedure that finds indications in various scenarios involving supraglottic cancer. Specifically, it is recommended for cases that exhibit glottic and anterior commissure involvement, ventricular invasion, thyroid cartilage invasion, true vocal cord immobility, paraglottic space invasion, moderate preepiglottic space involvement, and transglottic tumors. Notably, this procedure does not affect the cricoid cartilage, hyoid bone, and at least one arytenoid cartilage. Vertical line hemilaryngectomy serves as an appropriate treatment option for glottic and supraglottic cancers classified as T2, T3, and T4. These tumor stages signify varying degrees of tumor size and extension, indicating a more advanced disease presentation. The decision to perform vertical line hemilaryngectomy is guided by careful evaluation of each patient's specific condition and the extent of tumor involvement. By identifying the indications mentioned earlier, the surgical team can determine the most suitable approach to effectively address the cancer while aiming to preserve vital laryngeal structures and functions.³

This approach allows for effective tumor control while preserving the function of the vocal cords. In cases of T2 vocal cord carcinoma, which presents a variety of symptoms, the choice of treatment depends on the specific characteristics of the tumor.

For T2B stage tumors, radiation therapy has shown beneficial outcomes. This treatment option targets the tumor and surrounding areas to achieve tumor shrinkage and prevent further progression. On the other hand, for exophytic tumors (T2A) that do not significantly interfere with vocal cord function, endoscopic laser resection may be a viable option. This approach involves the precise removal of the tumor using laser technology, aiming to preserve vocal cord function and improve voice quality. The selection of the most appropriate treatment approach for T2 vocal cord carcinoma requires careful evaluation and consideration of various factors, including tumor characteristics, patient preferences, and the expertise of the medical team. The goal is to achieve optimal tumor control while minimizing functional impairments and maintaining a satisfactory quality of life for the patient. Once popular for early-stage laryngeal carcinoma, open voice-preserving partial laryngeal surgery is now only considered in limited circumstances.^{3,7,16,17}

T3 and T4a advanced laryngeal lesions necessitate multidisciplinary treatment. Initial surgery frequently necessitates a total laryngectomy due to the size of the tumor or the expected functional status of the residual organs after an extended partial laryngectomy. In contrast, radiation therapy alone provides a lower

Discussion

Early-stage laryngeal glottic carcinoma offers multiple treatment options, including endoscopic resection and radiotherapy, which have proven to be effective in managing the disease. Endoscopic resection is particularly suitable for T1 lesions that are limited to the mucosa of one vocal cord and do not involve the anterior commissure. However, it is generally not advised for cases of bilateral involvement (T1b). Although endoscopic resection is a quick and cost-effective procedure, it is important to note that the quality of the voice post-surgery may be inferior compared to radiotherapy. On the other hand, radiation therapy is a suitable treatment modality for lesions that involve both sides of the vocal cords, the anterior commissure, and the underlying vocal muscles.

rate of local control, necessitating total laryngectomy to save the majority of patients. Although total laryngectomy followed by postoperative radiation therapy is considered the gold standard of treatment, the loss of the larynx has a significant impact on the patient's post-therapy quality of life.^{3,7,16}

Conclusion

Laryngectomy is the surgical procedure to remove of part or all of the larynx. The type of laryngectomy performed is defined by tumor stage, equipment availability, and function reservation (speech and swallowing).

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