TITLE: Laryngeal Carcinoma 2007: An Overview
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There are around 11,000 new cases of laryngeal cancer per year in the United States accounting for 25% of all head and neck cancers and 1% of all cancers. One-third of these patients will eventually go on to die of their disease. Laryngeal cancer is most prevalent in the sixth and seventh decades of life and has a 4:1 male predilection which is still in the process of shifting downward having been 15:1 post-World War II. This is thought to be due to the changing public acceptance of female smoking. This cancer is also more prevalent among lower socioeconomic classes which in whom it is usually, particularly in supraglottic carcinoma, diagnosed at more advanced stages. Glottic cancer makes up 59% of laryngeal cancers, supraglottic 40%, and the rare subglottic carcinoma the rest. Subglottic masses when seen are most likely direct extensions of glottic carcinoma.

History

The first laryngectomy for cancer of the larynx was performed in 1883 by Billroth. The patient was able to be fed by mouth and was even fitted with an artificial larynx. In fact, laryngeal carcinoma may have led to World War I. In 1886 the Crown Prince Frederick of Germany developed hoarseness as he was due to ascend the throne. He was evaluated by a London physician Sir Makenzie, who was also the inventor of the direct laryngoscope. Frederick's lesion was biopsied and thought to be cancer. Subsequently he refused a laryngectomy and later died in 1888. His successor Kaiser Wilhelm II, along with Bismark, militarized the German Empire and led them into World War I.

Etiology

The primary factors in the development of carcinoma of the larynx are the prolonged use of tobacco, principally cigarettes, and/or alcohol use. The combination of the two having synergistic carcinogenic effects on laryngeal tissues, with over 90% of patients having a history of both. This along with poor access to healthcare may explain its higher incidence in lower socioeconomic classes. Laryngeal cancer is also seen in nonsmokers but this is usually due to their exposure to secondary smoke. Laryngeal

papillomatosis due to infection with human papilloma virus subtypes 16 and 18 have been known to transform into carcinomas. Chronic gastroesophageal reflux and occupational exposures to asbestos, mustard gas, and petroleum products are other risk factors. A prior history of head and neck radiation is also an important risk factor for the development of laryngeal cancers. 85 to 95 percent of laryngeal tumors are squamous cell carcinoma, and is the histologic type linked to tobacco and excessive alcohol use. Squamous cell cancer is on the far end of continuum of change from a normal phenotype and is characterized by epithelial nests surrounded by inflammatory stroma with keratin pearls being pathognomonic. Verrucous carcinoma is a distinct type of squamous cancer with an incidence if 1-2% of laryngeal cancer. It has a warty, exophytic look and is significant in that it is thought to be radiation resistant. Other types of malignant tumors include fibrosarcoma, chondrosarcoma, malignant minor salivary carcinoma, adenocarcinoma, oat cell carcinoma, and giant cell and spindle cell carcinoma.

Anatomy

The larynx lies in the anterior part of the neck at the very top of the trachea. It is the phonating mechanism designed for voice production; it also divides the respiratory and digestive tracts and protects the airway particularly during swallowing. The laryngeal skeleton consists of a framework of nine cartilages connected by ligaments, membranes and muscles and is lined by stratified squamous and respiratory epithelium. Three of the cartilages are singular-thyroid, cricoid, and epiglottic-and three are paired-arytenoids, corniculate, and cuneiform. The thyroid cartilage is the largest of the six different structures; its two laminae are fused along their inferior border in the median plane to form the laryngeal prominence noticeable on the surface of the anterior neck and otherwise known as an Adam's apple. The superior border of the thyroid cartilage is attaches to the hyoid bone by the thyrohyoid membrane. Posteriorly the inferior portion of the thyroid cartilage is attached at the cricothyroid joints to the cricoid cartilage; anteriorly, the thyroid cartilage is attached by the cricothyroid ligament to the cricoid cartilage. This ligament is easily palpated over the surface of the neck and can be used for access when an emergency airway is needed. The cricoid cartilage is the only laryngeal cartilage to form a complete ring. The arytenoid cartilages are pyramids that sit on the superior border of the posterior cricoid cartilage: the true vocal cords extend out anteriorly from these cartilages and meet medially on the thyroid cartilage to form the anterior commissure. The corniculate and cuneiform cartilages are located in the posterior aryepiglottic fold. The corniculate cartilages sit atop the arytenoids, and the cuneiforms sit with in the AE folds and are not attached to other cartilages. Sensation to the larynx is provided by the internal laryngeal nerve a branch of the superior laryngeal nerve which also innervates the cricothyroid muscle by the external laryngeal nerve. The intrinsic muscles of the larynx are innervated by the recurrent laryngeal nerve. The larynx is supplied by the superior laryngeal artery, a branch of the superior thyroid artery, which pierces the thyrohyoid membrane along with the internal laryngeal nerve.

The superior laryngeal supplies the internal surface of the larynx. The inferior laryngeal artery, a branch of the inferior thyroid artery, accompanies the inferior laryngeal nerve, and supplies the mucous membranes and muscles in the inferior portion of the larynx. The superior laryngeal vein joins with the superior thyroid vein and into

the internal jugular vein. The inferior laryngeal vein drains into the middle thyroid and the thyroid plexus of veins. The superior portion of the larynx drains into the superior deep cervical lymph nodes, while the inferior portion of the larynx drains into the inferior deep cervical lymph nodes. These nodal basins eventually drain into levels II, III, and IV of the neck.

The larynx is subdivided into three regions: the supraglottis, the glottis, and the subglottis. The supraglottis is defined by the tip of the epiglottis and vallecula superiorly and the undersurface of the false vocal cords inferiorly. It contains the arytenoids, the aryepiglottic fold, the false vocal cords, and the epiglottis. The glottic larynx houses the true vocal cords and extends from the beginning of the ventricle to 0.5 cm below the inferior edge of the vocal cords. The subglottic larynx extends from the inferior most extent of the glottis to the inferior edge of the cricoid cartilage. Internal ligaments of the larynx also create two spaces surrounding the larynx: the preepiglottic space, and the paraglottic space. The preepiglottic space is bound by the hyoid bone and hyoepiglottic ligament superiorly, the thyrohyoid membrane anteriorly, and the epiglottis posteriorly. This area is filled with fat and connective tissue and may help to prevent external tumor progression, though involvement of this space is often seen in supraglottic carcinoma and may be an indication of bilateral involvement in conjuction with neck metastases. The paraglottic spaces are the lateral pyriform sinuses bordered by the conus elasticus anteriorly and medially and the thyroid cartilage laterally. Invasion of tumor into this space may fix the ipsilateral cord.

Natural History

The natural history of laryngeal cancer varies with the anatomic site of origin. Supraglottic tumors are usually more aggressive in direct extension into the preepiglottic space and lymph node metastasis. The higher incidence of lymphatic spread has to do with the embryologic origin of the region. The supraglottis is derived from midline buccapharyngeal primordium and brachial arches 3 and 4 which have rich bilateral lymphatics. This is in contrast to the glottis which forms from midline fusion of lateral tracheobronchial primordium and arches 4, 5, and 6; here there is a paucity of lymphatics hence glottic cancers have less regional lymphatic spread. In supraglottic carcinomas one third to one half will have lymph node involvement. These lymph channels drain into the internal jugular chain. Direct extension can also occur into the lateral hypopharynx, glossoepiglottic fold and the tongue base.

Glottic carcinomas are usually well differentiated, grow slow, and tend to metastasize late in their course. Due to embryonic reasons mentioned earlier glottic tumors typically metastasize after they have directly invaded adjacent structures with better drainage. These tumors do have early extension toward the anterior third of the vocal cord and the anterior commissure with subsequent spread to the opposite cord or anteriorly invade the thyroid cartilage. This thyroid cartilage invasion may be noted clinically as broadening of the thyroid cartilage. Glottic cancer can also extend superiorly into the ventricular walls or inferiorly into the subglottic space. These tumors can also cause cord fixation, as mentioned previously, owing more often to direct extension than nerve involvement but may be due only to shear bulk of the tumor.

True subglottic carcinomas are uncommon, but can more often be seen in extension from glottic carcinoma which is a sign of poor prognosis. The lymphatic drainage patterns from this area increases the incidence of having bilateral disease and can lead to extension into the mediastinum. Accordingly glottic tumors with subglottic extension require, in addition to a total laryngectomy with ipsilateral thyroidectomy, an extensive lymph node dissection including the superior mediastinal nodes. This rich nodal spread is also thought to play a role in the high stomal reoccurrence after a total laryngectomy.

Presentation

One of the most common presentations of laryngeal cancer is hoarseness. Small irregularities of the vocal fold will change the vibratory pattern of the cord resulting in voice changes. Distinguishing a change in voice may be difficult in patients with chronic hoarseness due to tobacco or alcohol use which unfortunately is a majority of those at risk for laryngeal cancer. Dysphagia is more common in supraglottic carcinoma in which hoarseness would be a late finding due to extension; hemoptysis can also be a common presentation. Other symptoms of laryngeal cancer in general include throat pain, ear pain, airway compromise, aspiration, and a mass in the neck. Everyone who presents with hoarseness should have an indirect mirror exam and/or evaluation with a flexible laryngoscope. Malignant lesions can appear as friable fungating ulcerative masses or can be as subtle as changes in the mucosal color. If necessary a videostrobe laryngoscopy can be employed to evaluate these subtler lesions. Laryngoscopic examination should include the intrinsic larynx, epiglottis, true and false cords, anterior commissure, and mucosa of both pyriform sinuses. A good neck examination looking for cervical lymphadenopathy and broadening of the thyroid cartilage is essential. One should always palpate the base of the tongue for masses as well. Nodes should be felt for size, firmness, mobility, and location. Any restricted laryngeal crepitus can be a sign of postcricoid or retropharyngeal invasion. A biopsy of any laryngeal lesion is necessary to make the diagnosis.

Other benign possibilities for a laryngeal lesion include vocal cord nodules or polyps, papillomatosis, granulomas, granular cell neoplasms, sarcoidosis, or Wegner's granulomatosis. This is usually accomplished in the operating room with the patient under general anesthesia. Direct laryngoscopy utilizing the Dedo or Holinger hourglass speculum is adequate for evaluation. Further visualization with esophagoscopy or bronchoscopy may be required for staging. Biopsy of suspected malignant sites can be done with cup forceps. Also with the patient anesthetized and paralyzed a better neck examination can be performed.

After spread to the regional lymph nodes the next common site is the lungs so a chest x-ray is warranted as part of a metastatic work up, if any abnormalities are present it should be followed up by a CT scan of the chest to further delineate the abnormality. Lung lesions may represent metastasis from the larynx itself or an additional pulmonary primary carcinoma especially since tobacco is a risk factor for both cancers. The liver is another common site for metastases and screening liver function test should be performed with or without additional ultrasound or CT scan of the liver.

For the larynx itself, imaging is not necessary for early glottic cancer without clinically palpable nodes. But it may be needed in early stage supraglottic cancer because of its high incidence of nodal spread. If there is any impaired mobility of the vocal cord imaging should be obtained. Advanced stage laryngeal cancers require imaging, particularly for preoperative planning. Both CT and MRI are useful in evaluation with MRI being more sensitive to soft tissue changes and CT for bony or cartilaginous abnormalities. PET scans can be useful in identifying unknown primaries and occult nodal disease but is not yet the standard of care.

TNM Staging

Staging for laryngeal cancer is based on the TNM classification of the American Joint Committee on Cancer:

Primary Tumor (T)

TX	Minimum requirements to assess primary tumor cannot be met
T0	No evidence of primary tumor
Tis	Carcinoma in situ

Supraglottis

T1	Tumor limited to one subsite of supraglottis with normal vocal cord mobility
T2	Tumor involves mucosa of more than one adjacent subsite of supraglottis or glottis, or region outside the supraglottis (e.g. mucosa of base of the tongue, vallecula, medial wall of pyriform sinus) without fixation
T3	Tumor limited to larynx with vocal cord fixation and/or invades any of the following: postcricoid area, preepiglottic tissue, paraglottic space, and/or minor thyroid cartilage erosion (e.g. inner cortex)
T4a	Tumor invades through the thyroid cartilage and/or invades tissue beyond the larynx (e.g. trachea, soft tissues of neck including deep extrinsic muscles of the tongue, strap muscles, thyroid, or esophagus)
T4b	Tumor invades prevertebral space, encases carotid artery, or invades mediastinal structures

Glottis

T1	Tumor limited to the vocal cord (s) (may involve anterior or posterior commissure) with normal mobility
-T1a	Tumor limited to one vocal cord
-T1b	Tumor involves both vocal cords
T2	Tumor extends to supraglottis and/or subglottis, and/or with impaired vocal cord mobility
T3	Tumor limited to the larynx with vocal cord fixation and/or invades paraglottic space, and/or minor thyroid cartilage erosion (e.g. inner cortex)
T4a	Tumor invades through the thyroid cartilage, and/or invades tissues beyond the larynx (e.g. trachea, soft tissues of the neck including deep extrinsic muscles of the tongue, strap muscles, thyroid, or esophagus)
T4b	Tumor invades prevertebral space, encases carotid artery, or invades mediastinal structures

Subglottis

T1	Tumor limited to the subglottis
T2	Tumor extends to vocal cord (s) with normal or impaired mobility
T3	Tumor limited the larynx with vocal cord fixation
T4a	Tumor invades cricoid or thyroid cartilage and/or invades tissues beyond larynx (e.g. trachea, soft tissues of the neck including deep extrinsic muscles of the tongue, strap muscles, thyroid, or esophagus)
T4b	Tumor invades prevertebral space, encases carotid artery, or invades mediastinal structures

Nodes

N0	No cervical lymph nodes positive
N1	Single ipsilateral lymph node ≤ 3cm
N2a	Single ipsilateral node > 3cm and ≤6cm
N2b	Multiple ipsilateral lymph nodes, each ≤ 6cm
N2c	Bilateral or contralateral lymph nodes, each ≤6cm
N3	Single or multiple lymph nodes > 6cm

Metastasis

M0	No distant metastases
M1	Distant metastases present

Stage Groupings

Stage			
0	Tis	N0	M0
I	T1	N0	M0
II	T2	N0	M0
III	T3	N0	M0
	T1-3	N1	M0
IVA	T4a	N0-2	M0
	T1-4a	N2	M0
IVB	T4b	Any N	M0
	Any T	N3	M0
IVC	Any T	Any N	M1

Treatment

Premalignant lesions or carcinoma in situ can be treated surgically by stripping the entire lesion. Some advocate the use of a CO2 laser to accomplish this but there are concerns about accuracy of review of the pathology. Early-stage laryngeal cancer (T1 and T2) can be treated with either radiation therapy or surgery alone. In this setting they offer about the same 85-95% cure rate. Surgery has a shorter treatment period, saves the option of radiation for reoccurrence, but may have worse voice outcomes. The procedure of choice is usually a partial laryngectomy. Radiotherapy is given for 6-7 weeks, avoids surgical risks, but does have complications including: mucositis, odynophagia, laryngeal edema, xerostomia, esophageal stricture, laryngeal fibrosis, radionecrosis, and hypothyroidism. In advanced-staged lesions patients usually receive surgery and radiation, most often with surgery before adjuvant radiation. For most T3 and T4 lesions

a total laryngectomy is required, some small T3 lesions can be treated with a partial laryngectomy. The adjuvant radiation is started within 6 weeks of the surgery, and with once daily protocols lasts 6-7 weeks. Indications for post operative radiation include: T4 primary, bone/cartilage invasion, extension into soft tissue of the neck, perineural invasion, vascular invasion, multiple positive nodes, nodal extracapsular extension, margins less than 5mm, positive margins, carcinoma in situ at margins, and subglottic extension of primary tumor. A study by Hinerman et al determine the factors that significantly affect disease specific survival in laryngeal cancer are bone/cartilage invasion, four or more indications for radiotherapy, and multiple positive lymph nodes. The primary site is treated with 6000-7000 cGy, while draining nodal areas receive 5000-7000 cGy. In one study of laryngeal cancer with extracapsular extension or positive margins Huang, DT et al demonstrated a two-fold increase in overall survival in the irradiated group vs. surgery alone. Chemotherapy can be used in addition to radiotherapy in advanced stage laryngeal cancers. The two agents typically used are cisplatinum and 5-flourouracil. Cisplatinum, in particular is thought to sensitize cancer cells to external beam radiation, enhancing its effectiveness. A study by Bernier et al demonstrated increased rates of local control, disease-specific survival, and overall survival using high dose cisplatin and radiotherapy concurrently. They did not find an increase in the incidence of late adverse effects over radiotherapy alone. A study by Wolf GT et al looked at using induction chemotherapy and definitive radiotherapy with laryngectomy being saved for salvage surgery. They found that two thirds of patients responded well to the induction chemotherapy and had similar survival as compared to the control arm which received a total laryngectomy with adjuvant radiation. Another similar study by Lefebre J et al showed no significant difference in five year survival between the induction chemotherapy and traditional surgical group. Both of these induction chemotherapy studies did show a lower rate of response with more advanced stage tumors. The role of induction chemotherapy is still under investigation. Radical or modified radical neck dissections are indicated in the presence of positive nodal disease. Patients with Supraglottic or subglottic T2 tumors may need neck dissection even in the absence of nodal disease. For clinically N0 necks a selective dissection can be performed sparing the SCM, internal jugular vein, and the spinal accessory nerve. A modified dissection can be performed for N1 necks usually in levels II-IV.

Surgical options for treatment of the larynx include a partial laryngectomy with a variety of variations, and a total laryngectomy. Lesions confined to the membranous cord can be removed endoscopically using an operating microscope and microlaryngeal instruments or a carbon dioxide laser (though this modality may prevent determination of adequate margins). This is generally only recommended if the lesions do not involve the arytenoids, extend into the ventricle, or involves the anterior commissure. With this method the use of intraoperative frozen sections is necessary to ensure adequate resection. If voice or swallowing changes are anticipated a preoperative consultation with a speech pathologist would be appropriate.

A hemilaryngectomy is typically removal of one vertical half of the larynx though in some cases a portion of the opposite cord is also removed. If more than half of the opposite cord is removed, an epiglottoplexy will be necessary in order to preserve a sufficient airway. Tumors suited for this procedure include those that have no more than

1cm of subglottic extension at the anterior comissure and 5mm posteriorly, a mobile affected cord, unilateral or minimal anterior contralateral cord involvement, no cartilage invasion, and no extralaryngeal soft tissue disease. Cancer involving an arytenoid is resectable as long as the opposite arytenoids can be left intact. Though if the cancer extends over the posterior commissure it is considered unresectable by this procedure for part of the contralateral arytenoid must be resected to provide for adequate margins. In this procedure voice reconstruction can be done by transposing a strap muscle, giving bulk for which the remaining cord can vibrate against. This can improve the breathy voice resulting from dead space in the subglottic region.

For supraglottic tumors, a supraglottic laryngectomy can be considered if: tumors are T stage 1, 2 or 3 if by preepiglottic space invasion only, TVCs are mobile, there is no cartilage involvement, no anterior commissure involvement, the patient has good pulmonary involvement with FEV1 greater than 50%, the base of the tongue is not involved past the circumvallate papillae, and the apex of the pyriform sinus is not involved. This procedure can be performed in patients that failed radiation therapy but is generally not offered because of the difficulty in evaluating the extent of the disease, stiffened laryngeal tissues and healing difficulties which may worsen the degree of aspiration and leave the patient with a non functional larynx. With a supraglottic laryngectomy an ipsilateral radical neck dissection should be employed in patients with a primary lesion of greater than 2cm, lesions extending to the base of the tongue, aryepiglottic fold, false cords, or base of the epiglottis.

In the presence of diseased lymph nodes a bilateral neck dissection should be undertaken; because of the unoperated side of the neck is the most common site of surgical failure. In one study of supraglottic cancers by Sessions et al they concluded that patients with clinically negative neck could be treated by observation alone. The study also showed no benefit to the use of post operative radiation therapy in supraglottic cancers.

A newer modification of the supraglottic laryngectomy is the supracricoid laryngectomy. This procedure is for cancers involving the anterior true vocal cords including the anterior commisure and the supraglottis. In this procedure the TVCs, the supraglottis and the thyroid cartilage are resected leaving the arytenoids and cricoid cartilages. One draw back is reportedly half of patients remain dependent on their tracheostomy. Another procedure a near-total laryngectomy is somewhat like an extended vertical hemilaryngectomy. A small strip of mucosa and a single arytenoid remain behind as a speaking shunt. The patients require a tracheostomy permanently.

The total laryngectomy is the standard therapy and is extremely effective in controlling carcinomas originating in the glottis due to the fact that the area is relatively devoid of lymphatics unlike the supraglottis. This procedure can cure a majority of T3 or less patients. Indications for this procedure include: T3 or T4 cancer unfit for a partial laryngectomy, extensive involvement of thyroid and cricoid cartilages, invasion of the soft tissues in the neck, and tongue base involvement beyond the circumvallate papillae. In this procedure the entire larynx is removed including the hyoid bone, thyroid and cricoid cartilages and a few of the upper tracheal rings. The tracheal stump remaining is

anastomosed to an opening created at the root of the neck, creating a complete separation of the respiratory and digestive tracts. The remaining pharyngeal mucosa if reapproximated with the goal of allowing the patient to continue to ingest nutrients by mouth and swallow normally. If not enough of the pharyngeal mucosa remains; tissue from jejeunum, radial forearm, or anterolateral thigh can be used in the reconstruction.

If the tumor has extended subglottically or invaded through the anterior cartilaginous framework, an ipsilateral thyroid lobectomy with removal of Delphian nodes is indicated. With subglottic extension these nodes are often involved and can lead to stomal recurrence if not addressed initially. Voice rehabilitation is best accomplished by a tracheostomal device which acts as a one way valve directing air from the trachea into the pharynx when the device is digitally occluded in the stoma. The puncture itself is typically placed intraoperatively and kept open with a rubber catheter. Some do prefer to perform this as a secondary procedure, the thought being that it has a lower complication rate. Later in the post operative course the device is actually fitted and placed. Another option is an electrolarynx which generates sounds based on externally created vibrations. It can difficult to learn to operate and those listening must become familiar with the sounds in order for the speech to be understood. Some patients can also learn to utilize pure esophageal speech which involves forcing air from the stomach into the esophagus and out the mouth all the while using the tongue, teeth, cheeks, and lips to produce the speech.

Complications

The list of possible complications in treating laryngeal cancer is long and related to the complex function and anatomy of the larynx and its surrounding structures. The complications themselves depend on the modalities of treatment used. One of the most common problems with laryngeal cancer is staging. Appropriate patient selection is key for good outcomes. Inappropriate staging can lead to unnecessary loss of voice or imminent disease recurrence. Staging requires not only exam under anesthesia, but the combining of information from multiple modalities. Care must be taken to ensure accurate staging and it might be prudent to obtain a consent for total laryngectomy before operating. Infection can be a problem in operations involving the upper aerodigestive tract; typically this is less of a problem if antibiotics are properly administered.

Infections can result from a misplaced tracheoesophageal puncture or inadequate closure of the remaining pharyngeal mucosa leading to chronic drainage. Though a presenting symptom of laryngeal cancer, hoarseness may worsen after treatment, patients can lose a range of voice or have a voice that is easily fatigued. This is a greater problem in a total laryngectomy where the patient has the potential to fail at learning tracheoesophageal speech. Swallowing difficulties are another complication; these can be due to external beam radiation such as mucositis of xerostomia or to an anatomical stricture or stenosis of the neopharnyx. Patients may also lose their sense of taste due either to direct damage from radiation therapy or from anatomic changes surgically in which air no longer flows into the mouth. This lack of airflow may also alter the patient’s sense of smell.

Fistulas can develop with failure of the surgical closure of the neopharnyx, particularly if the edges of the mucosa are not inverted properly. This leads to drainage of oral secretions onto the skin with further breakdown. These fistulas often close on their own with close management but some will require reinforcement with a myocutaneous pectoralis or radial forearm flap. Patients may also remain dependent on their tracheostomy tubes; either because of significant aspiration or laryngeal edema from radiation therapy. The tracheostomy itself can become obstructed due to excessive secretions and crusting of mucus.

The surgical dissection can result in injury to various cranial nerves including: VII, IX, X, XI, XII. Such injuries can be temporary or permanent depending on the whether the nerve was stretched or transected all together. It is also possible that some of the deficits exist due to perineural involvement by the cancer. These injuries can clinically present as asymmetric smile and mouth droop, difficulty swallowing, hoarseness and aspiration, shoulder drop, and loss of tongue mobility. Patients need careful assessment both pre and post operatively and need to be counseled about the possibility of such injuries occurring.

During laryngectomy there is a risk of stroke but it is a rare occurrence; though this risk is increased in those with atherosclerosis or previous radiation. In patients with advanced tumors and necrosis can have "blowouts" of the carotid or internal jugular, when this occurs salvage surgery is attempted by ligating the vessel proximal to the bleed. This procedure results in stroke in greater than 50% of cases but otherwise a "blowout" is a fatal event. Hypothyroidism is yet another potential complication either due to thyroidectomy or to radiation to the anterior neck. It can take up to one year following treatment for this disorder to become apparent so TSH and free T4 should be checked often. Hypothyroidism is easily treated with daily Synthroid. Radiation to the neck can also cause fibrosis to the tissues resulting in neck stiffness, loss of range of motion, and pain.

Prognosis

Five year survival for laryngeal cancer is better than that of other neck cancers owing partly to hoarseness as a clinically detectable symptom leading to early care, and to the fact that most are glottic carcinomas with a low rate of spread. Five year survival for Stage I is >95%, Stage II 85-90%, Stage III 70-80%, and Stage IV 50-60%. After initial treatment these patients are followed at 4-6 week intervals with the goal of searching for remaining disease and second primary lesions. After the first year visit frequency decreases to every 2 months, and during the third and fourth year to every three months with annual follow up after that. Patients are considered cured after five years disease free and most cancer reoccurs in the first two years. Despite advances in detection and treatment options the five year survival has not improved much over the last thirty years.

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