Management of Tracheal Neoplasms

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ABSTRACT

Primary tracheal tumors are rare neoplasms which often present with indolent and nonspecific symptoms. Despite a tendency for late presentation, more than half of patients with benign and malignant neoplasms will be candidates for curative resection upon diagnosis. This review describes the diagnostic and staging evaluation of tracheal neoplasms. Curative surgical procedures including laryngotraheal resection, tracheal resection, and carinal resection are discussed. Palliative therapies such as external beam radiation, endoluminal brachytherapy, bronchoscopic laser resection, and endoprosthetic stenting are reviewed. The Oncologist 1997;2:245-253

INTRODUCTION

Primary tracheal neoplasms comprise a rare group of benign and malignant tumors of the trachea (Tables 1 and 2). The rarity of this condition has been estimated to be 0.1% to 0.4% of all malignancies, with an annual incidence of 2.6 new cases per million per year [1-3]. The infrequency of cases creates a low level of suspicion among physicians, thus leading to delays in diagnosis and treatment. The resectability rate of benign and malignant tracheal tumors has been reported as high as 90% for benign lesions and 70% for malignant ones. Our experience with the management of primary tracheal neoplasms at the Massachusetts General Hospital (MGH) was last reviewed in 1990 and now exceeds 300 cases since our first tracheal resection for tumor in 1962 [4]. The present review will provide discussion and guidelines for the diagnosis, staging, and treatment of patients with primary tracheal tumors.

ESTABLISHING THE DIAGNOSIS

The first challenge in treating these patients is to make the diagnosis of a rare condition which presents with common and nonspecific symptoms. The symptoms reported by 240 patients with tracheal neoplasms at MGH are recorded in Table 3. The tumor must generally advance to a size which obstructs more than half of the cross-sectional area of the airway before dyspnea is experienced. Unfortunately, the chest radiograph has proven normal in 30%-75% of patients, causing many who present with dyspnea and a normal radiograph to be treated inappropriately for asthma or chronic obstructive pulmonary disease [3, 5]. It has been common in our experience to see patients with indolent tracheal neoplasms treated for months or even years with bronchodilators and steroids until hemoptysis or obstructive pneumonia leads to a diagnostic bronchoscopy.

Table 1. Primary benign tracheal tumors

<table>
<thead>
<tr>
<th>Carcinoid tumor (typical)</th>
<th>Leiomyoma</th>
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<tr>
<td>Chondroma</td>
<td>Nerve sheath tumor</td>
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<tr>
<td>Fibrous histiocytoma</td>
<td>Papilloma</td>
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<tr>
<td>Granuloma granular cell tumor</td>
<td>Parangangioma</td>
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<tr>
<td>Hamartoma</td>
<td>Pleomorphic adenoma</td>
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<tr>
<td>Hemangiendothelioma</td>
<td>Schwannoma</td>
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<td>Verrucous tumor</td>
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It is also a common occurrence for a patient to be completely asymptomatic when a tracheal neoplasm is discovered serendipitously with a chest radiograph or computed tomography scan performed for some other indication. In nearly all patients, bronchoscopy has led to a definitive diagnosis.

Once the diagnosis is secured, referral should be made for consideration of surgery. Corticosteroids initiated for misdiagnosed “asthma” or “chronic obstructive pulmonary disease (COPD),” should be tapered completely in preparation for surgery. Nearly 20% of the patients treated for tracheal tumors at MGH had been treated for asthma prior to the correct diagnosis of the tumor. Half had been started on corticosteroids. Weaning of steroids may require endoscopic removal of tumor to restore the caliber of the airway and allow clearance of any postobstructive pneumonitis. The combination of steroids and normal postresection anastomotic tension predispose to separation and must be avoided.

The determination of resectability should be made by a thoracic surgeon with experience managing tracheal neoplasms. Pitfalls to be avoided in the early stages of the evaluation include inappropriate tracheostomy and excessive delay of surgical resection. Our experience has noted a tendency to overestimate the severity of airway compromise and thus to perform palliative procedures prior to completing a full assessment of the suitability for curative treatment. Tracheostomy performed distal to an occlusive mass may reduce the risk of airway obstruction, but will do so at the expense of sacrificing a portion of the normal trachea required for eventual reconstruction. Similarly, delay of surgical therapy has occurred during an initial course of palliative laser therapy or radiation, only to find weeks or months later that a tumor which may have been resectable at the time of its discovery had metastasized or spread locally beyond the limits of resectability.

**DETERMINING THE EXTENT OF INVASION OR DISTANT SPREAD**

Prior to surgical resection, a staging workup will provide some assurance that systemic or local spread has not made the primary tumor incurable. A screening chest radiograph is often normal, but it can also identify lung metastases or synchronous primary tumors of the lung. Computed tomography is the most effective method to determine the extent of mediastinal spread of the tumor. Each patient should be evaluated for possible involvement of the vena cava, pulmonary artery, and esophagus. Local mediastinal lymphadenopathy is of uncertain significance and should not preclude an attempt at curative resection. Barium swallow is useful in the evaluation of posterior tracheal masses, but a “positive” barium esophagram is nonspecific and unable to distinguish esophageal invasion from external esophageal compression.

The most important staging test is rigid bronchoscopy performed by the surgeon planning a resection. Regardless of the results of previous diagnostic bronchoscopies, it is absolutely essential that the operating surgeon perform a bronchoscopy to assess the extent of the lesion and the amount of uninvolved trachea available for reconstruction. The rigid bronchoscope is preferred because it allows more accurate measurements than the flexible bronchoscope. In addition, it allows more secure control of the obstructed airway and control of any bleeding that may occur following biopsy. The important measurements include the length of the trachea from the vocal cords to the carina, the distance from the cords to the top of the tumor, the length of the tumor, and the distance from the bottom of the tumor to the carina. It should be remembered that approximately half of the normal adult trachea can be resected and safely reconstructed. In physiologically healthy patients with straightforward tumor histology, this bronchoscopy can be performed as a prelude to the resection under a single general anesthetic. It can, however, be done as a separate outpatient procedure in situations where permanent histology will be required or when the extent of resection may be excessive given the health of the patient. Rigid bronchoscopy allows “coring out” of an obstructing tumor to allow clearing of a postobstructive pneumonia or to allow weaning from corticosteroids prior to definitive resection and reconstruction.

Esophagoscopy should also be performed under the same anesthesia as the bronchoscopy if, based on the size and location of the tracheal tumor, esophageal involvement is suspected. We have found all degrees of esophageal involvement in our series of tracheal tumors, ranging from benign external compression, to partial or full thickness invasion, to primary esophageal lesions masquerading as tracheal tumors. Esophageal invasion is not necessarily a contraindication to tracheal resection, but in a marginal surgical candidate, it may be a deciding factor.

Mediastinoscopy is a valuable part of the assessment of some tracheal neoplasms. Dissection in the pretracheal plane enhances the mobility of the airway to decrease anastomotic tension in most cases. It is also invaluable in the assessment of the mediastinum for lymph node metastases and local invasion. While the significance of a single pretracheal or paratracheal

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**Table 3. Presenting symptoms of 240 tracheal neoplasms at MGH**

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Dyspnea</td>
<td>103</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>90</td>
</tr>
<tr>
<td>Cough</td>
<td>68</td>
</tr>
<tr>
<td>Wheeze</td>
<td>44</td>
</tr>
<tr>
<td>Stridor</td>
<td>26</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>19</td>
</tr>
<tr>
<td>Hoarseness</td>
<td>13</td>
</tr>
<tr>
<td>No symptoms</td>
<td>12</td>
</tr>
<tr>
<td>Weight loss</td>
<td>2</td>
</tr>
</tbody>
</table>
lymph node is questionable, multiple positive lymph nodes or
the presence of a “frozen” mediastinum due to tumor invasion
may contraindicate attempts at surgical resection.

The decision to resect or irradiate a tracheal neoplasm
will depend upon many factors, including the health of the
patient, the histology of the tumor, the location of the
tumor, and the amount of airway that would remain after a
curative resection. Common reasons for deeming a tumor
unresectable are listed in Table 4. Other relative contraindi-
cations to surgical resection include steroids and previous
tracheal or mediastinal radiation therapy.

ANESTHETIC MANAGEMENT

Careful anesthetic management during tracheal resection
and reconstruction is essential. Anesthesiologists must be
familiar with a variety of techniques for anesthesia and air-
way management which have proven indispensable in our
practice. It should be the shared goal of the surgeon and the
anesthesiologist to extubate the patient at the end of the pro-
cedure. Success generally precludes the use of long-acting
muscle relaxants and high-dose narcotics. A major benefit of
immediate postoperative extubation is the opportunity to
assess the adequacy of the airway in the controlled environ-
ment of the operating room. Another benefit of this approach
is the avoidance of the often damaging effects of endotra-
cheal tubes, cuffs, and mechanical ventilators. For all these
reasons, we have favored the use of an inhaled anesthetic
agent such as Ethrane, which allows maintenance of sponta-
neous ventilation. Cardiopulmonary bypass is rarely indicated.

CURATIVE SURGICAL RESECTION

When the decision has been made to proceed with resec-
tion of the tracheal neoplasm, the operation proceeds using
the techniques detailed previously by others [4, 6-8]. The
variety of curative procedures performed is listed in Table 5.

RELEASE MANEUVERS

Most tracheal operations can be performed without
release maneuvers. Of 327 tracheal resections performed
for postintubation stenosis, laryngeal release was required
in only 27 (8.3%). Of 119 tracheal resections performed for
primary and secondary tumors of the trachea, laryngeal
release was required in only 18 (15%).

Careful assessment of each patient’s condition is neces-
sary to establish the safe limits of the extent of tracheal resec-
tion. This aids in planning the incision and positioning the
patient. Previous operations (including mediastinoscopy), dis-
ease process, extent of the lesion, age, and body habitus are
important factors in deciding which patients are likely to
require a release maneuver. The pathologic location is also
important in determining which release procedures will be of
benefit. Certain maneuvers are more effective for achieving
additional length when performed for disease in the cervical
trachea, whereas others are more effective for the intratho-
racic trachea. A release maneuver is primarily performed to
prevent unnecessary tension on the anastomosis and to avoid
the need for extensive mobilization of the trachea which
might jeopardize the lateral blood supply.

CERVICAL TRACHEAL OPERATIONS

The simplest maneuver to gain added length after
tracheal resections is flexion of the neck and mobiliza-
tion of the anterior, and, to a lesser extent, the posterior
surface of the trachea, avoiding the lateral blood supply
to the trachea. Flexion of the neck between 15 and 35
degrees may yield up to 4.5 cm of additional length, or
the equivalent of seven tracheal rings. Flexion beyond
this may achieve up to 1.5 cm of added length. When
these simple maneuvers fail to give sufficient length, a
Montgomery suprahyoid laryngeal release is performed,
generally before the anastomosis is completed. When the
maneuver is performed, an additional 1.5 cm of length
can be obtained.

If additional length is still needed, a partial median ster-
notomy with extension in the right hemithorax or right tho-
racotomy allows access to the right hilum and inferior
pulmonary ligament. Mobilization in such a fashion may
provide an additional 1.5 cm of length. Dissection of the pul-
monary artery and vein intrapericardially adds an additional
1.0 cm. If these procedures fail to allow a safe anastomosis,
a t-tube can be placed between the proximal and distal ends
of the trachea and local muscle flaps rotated in to create a
muscle tube, which establishes an airway.

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**Table 4. Criteria of unresectability/unreconstructability**

- Greater than 50% of tracheal length involved by tumor
- “Frozen” mediastinum
- Poor general condition of the patient
- Distant metastases in squamous cell carcinoma

**Table 5. Curative operations performed for tracheal neoplasms**

- Laryngectomy with upper tracheal resection
- Laryngotracheal resection
- Tracheal resection
- Carinal resection
- Carinal resection with pulmonary resection
- Endoscopic resection of benign lesions (rare)
- Laser or electrocautery fulguration of benign lesions (rare)
**Intrathoracic Tracheal and Carinal Operations**

Flexion of the head and mobilization of the anterior and posterior surfaces of the trachea are also important for these lesions. Even in the intrathoracic position, these procedures allow the trachea to migrate into the thorax. Laryngeal release for intrathoracic tracheal problems has not been helpful in gaining additional length.

Mobilization of the right hilum and inferior pulmonary ligament should be done first. A U-shaped incision in the pericardium inferior to the inferior pulmonary vein allows the hilar structures and bronchus to advance. Additional length may be obtained by completely incising the pericardium around the hilar vessels. We have tried to preserve a posteriorly based pedicle of tissue that includes a bronchial artery and some lymphatics whenever we have completely incised the pericardium in such a fashion. Special mention should be made of those resections involving the carina. Attempting to “recreate” a carina by joining the left and right mainstem bronchus will not allow much, if any, advancement. Length can be obtained only by advancement of the trachea from above.

**Midtracheal Operations**

Lesions located in the midtrachea can benefit from all of the release maneuvers described. Laryngeal release may predispose the patient to aspiration, and there will be more difficulty with liquids than with solid food. In time, this resolves in virtually every patient. We have seen little of this problem since adopting the Montgomery technique of suprahyoid release.

Tracheal resection in general was limited for many years by the belief that only 2 cm of the trachea, about four rings, could be removed and the ends dependably anastomosed by primary suture. The application of various techniques of anatomic mobilization has permitted the resection of approximately half of the trachea with primary resection on a dependable and predictable basis. Simple cervical flexion, which delivers the cervical trachea into the mediastinum, has been the most useful single maneuver for extending the resection of the trachea with primary repair. In a young person who is not obese and who has reasonably supple tissues, more than half of the trachea may frequently be removed with primary reconstruction. With increasing age, kyphosis, obesity, and pathologic changes, the portion of the trachea that can be so removed and reconstructed decreases. If additional length is necessary, the measures mentioned previously in the section on tracheal release maneuvers may be necessary.

In all dissections of the trachea, critical issues are the careful preservation of the lateral segmental blood supply, the gentle and precise handling of all tissues, and precision of anastomosis.

Tumors of the upper portion of the trachea are generally approached through a collar incision with, if necessary, a vertical extension through the upper sternum (Fig. 1). Because the extent of some tumors is not fully predictable even after preoperative radiography and bronchoscopy, it is generally wise to position a patient so that extension of incisions may be made, if necessary. The incisions just described may be extended by carrying the sternal division down farther and then angling it into the right fourth interspace to add a thoracotomy to the cervical and mediastinal exposure. Tumors of the lower portion of the trachea are approached most easily through a posterolateral thoracotomy. Laryngeal release adds no additional length for distal tracheal resection. Flexing the neck and freeing the anterior pretracheal plane have been the most helpful maneuvers to gain additional length, as has intrapericardial release of the pulmonary vessels.

When a tumor involves the carina, various reconstructive techniques are used. Unless the tumor is very small, it is rarely adaptable to reconstruction by approximating the right and left main bronchus to form a new carina and then attaching it to the trachea. Such suturing anchors the carina very low in the mediastinum, and if more trachea has been excised, approximation is not possible. More commonly, either the right or left main bronchus is sutured to the trachea, and a lateral anastomosis of the other bronchus to the lower portion of the tracheal wall above the initial anastomosis is performed.

If a recurrent laryngeal nerve is involved by tumor, the nerve is sacrificed. The nerves are usually identified and carefully saved when possible. Local paratracheal lymph nodes are excised with the specimen when possible. Extensive lymph node dissection cannot be done for fear of destroying the blood supply to the residual portion of the trachea. In tumors high in the trachea, partial removal of the lower part of the larynx may have to be performed. Individually designed procedures are necessary to preserve a functional larynx. Sometimes, portions of the esophagus and other adjacent structures must be resected.

Resection is usually controlled with frozen sections to be certain that the margins are clear. Adenoid cystic carcinoma, in particular, may extend such distances so that total resection of all microscopic disease is not possible and postoperative irradiation must be used.

Lesions which abut or invade the larynx require special management. If the larynx is invaded and a clean margin cannot be obtained, a laryngectomy and upper tracheal resection must be considered. An alternative viewpoint espoused by some is that curative radiation could be given to the glottis in an attempt to cure with voice salvage. Resection would follow if recurrence were to take place. If the larynx is not itself invaded and the cricoid or subglottic mucosa is involved, a laryngotracheal resection can be...
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Figure 1. Reconstruction of the upper trachea. A) Collar incision is often sufficient, but upper median sternotomy improves access to mediastinum. B) Retraction of innominate vein and artery provides working space. C) Division of trachea and intubation across operative field permit dissection of densely adherent lesion. D) Posterolateral sutures are placed. Proximal airway is advanced and anterior sutures are placed. This represents a case of tracheal stenosis, but the same principles apply for tracheal tumors. (Reproduced with permission [9]).

performed using the techniques previously described. Figure 2 shows the method of resection and cricoid resurfacing possible with a beveled resection and reconstruction. The surgical treatment of carinal tumors requires the most challenging of tracheal resections. The specific margins of resection are dictated by the extent of the tumor and the mobility of the remaining airway. There are a variety of reconstructive possibilities for patients requiring carinal resection [4] (Fig. 3).

The technique of airway reconstruction is exacting and requires strict attention to technical detail. Great care must be exercised to avoid devascularization of the airway. This is especially important in diabetic patients in whom microvascular disease interferes with the nutrient blood supply to the airway. Every effort must be expended to minimize anastomotic tension. Excessive tension is, without question, the single greatest reason for failure following tracheal resection. Dissection of the pretracheal plane (avoiding the midlateral blood supply) should routinely be performed to enhance the mobility of the airway. Suprahyoid release procedures are sometimes necessary (15%-20% of cases) to allow a safe resection [10, 11]. Flexion of the neck allows the trachea to devolve into the mediastinum and is the single most important maneuver to reduce anastomotic tension. The patient is held in the “chin-to-chest” position during completion of the anastomosis and “chin stitch” is placed to maintain the desired position of cervical flexion after completion of the operation.

During the reconstruction, traction sutures of 2-0 Vicryl are placed full thickness in the midlateral position of the trachea and are tied to reduce anastomotic tension. We prefer an anastomosis of interrupted 4-0 Vicryl sutures spaced 3 mm apart and 3 mm deep. The use of absorbable suture material has virtually eliminated the problem of suture line granulomas. Tissue wraps around the anastomosis are used routinely for intrathoracic anastomoses, but used in the neck only when the suture line is close to the innominate artery.

Results of Surgical Treatment

The results of surgical treatment of tracheal neoplasms demonstrate the superiority of surgical therapy over nonsurgical modes of primary treatment. The safety of resection and reconstruction is demonstrated by the data of Mathisen and Grillo in 1990 in which there were seven operative deaths in 132 patients subjected to primary resection and reconstruction [4]. This safety is supported by the data of Eschapasse (13 deaths in 121 surgical resections), Perelman and Koroleva (11 deaths in 116 resections), and Pearson and colleagues (two deaths in 44 resections) [7, 13]. Nonfatal complications of tracheal resection and reconstruction occur infrequently and include wound infections, pneumonia, strictures, dehiscence, and glottic dysfunction [14, 15].
The oncologic result after resections for squamous cell carcinoma and adenoid cystic carcinoma is difficult to summarize given the small number of resections performed and the decades required for individual centers to accumulate cases to report. Grillo and Mathisen described 135 patients with tracheal neoplasms of all histologies surviving resection. Of these initial survivors, 70% were alive without recurrence at the time of the report, including 49% of the squamous carcinoma patients, 75% of the adenoid cystic patients and 83% of patients with diverse "other tumors." Of the squamous cell carcinoma patients, 10 were disease-free after more than three years, 10 were disease-free for three or fewer years, four had died of other causes (no recurrence) after five or more years, and four had died of other causes or were lost without evidence of recurrence within three years of resection. Thirteen patients had died of recurrence, all within four years of resection [4]. These data are similar to those of Perelman and Koroleva, who reported survival rates of 27% for three years and 13% for five years after resection of squamous cell tracheal cancer [13].

Conclusions regarding the treatment of adenoid cystic carcinoma are made difficult by the often prolonged time between resection and recurrence. Grillo and Mathisen described one patient in whom a disease-free period of 17 years was followed by a lethal recurrence [3]. This potential for delayed recurrence has led to their recommendation for routine postoperative radiation. The median survival for patients with adenoid cystic carcinoma after resection and reconstruction was 118 months, a figure which is corroborated by the 10-year survival of 55%.

Figure 2. Operative repair of anterolateral stenosis of the subglottic larynx and upper trachea. A) Anteroposterior view. B) Lateral view, showing the extent of disease involvement and the ultimate lines of transection. C and D) Larynx and trachea after removal of the specimen. Recurrent nerves have been left intact. Mucous membrane of the larynx has been transected sharply at some level of division of cartilage. E and F) Anteroposterior and lateral views of reconstruction. G) Thyroid isthmus has been approximated to cover the anastomosis. Strap muscle and occasionally thymus is brought over to shield innominate from an open area of anterior tracheal wall. Area is walled off for possible placement of tracheostomy tube. (Reproduced with permission [12]).
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Palliative Surgical Procedures

Palliative surgical procedures are also possible to lengthen or improve the quality of life of patients with incurable lesions (Table 6). The most common palliative procedure is a “coring out” that can be performed easily with a rigid bronchoscopy and biopsy forceps. In most cases, the surgeon is able to establish a safe airway without the expense of laser equipment. The potential risk of excessive bleeding from a raw tumor surface has not proven to be a problem in the procedures we have performed. In upper tracheal tumors which have been deemed unresectable, a tracheostomy will provide a safe airway while other palliative measures are explored.

Radiation Therapy

Radiation therapy is currently employed both for palliation of unresectable tracheal neoplasms and as an adjunct following resection of malignant neoplasms. Little encouraging information exists regarding radiation as primary therapy for tracheal neoplasms [3, 5, 16-18]. Few conclusions can be drawn because of the small numbers of patients treated and the variations in treatment protocols utilized. Doses below 50 Gy have decreased response rates while doses over 66 Gy are associated with higher rates of complications. Median survival of squamous carcinoma of the trachea treated with primary irradiation is about six months. Median survival for adenoid cystic carcinoma treated with primary irradiation has been reported as high as 120 months in a small group of patients, but few cures have been reported [5].

Figure 3. Modes of carinal resection and reconstruction used. Circled number represents number of patients. Open arrows indicate side of approach when not conventionally right sided. A) Limited resection permits carinal restitution. B) Technique used in initial carinal resection; technique in A would now be used. C) More extensive resection. D) Greater length of trachea. Technique of Barclay and coworkers. E) Involvement of right main bronchus and right upper lobe bronchus required right upper lobectomy. F) Middle lobe also removed. Right lower lobe bronchus may be anastomosed to left main bronchus. G) Right carinal pneumonectomy. H) Left carinal pneumonectomy. I) Resection of carina after previous left pneumonectomy. J) Resection of carina with extra long stump. K) Wedge removal of left main bronchus from the right. L) Tracheocarinal resection with long segment of left main bronchus. Exclusion of remaining left lung from the right. Left pneumonectomy also through bilateral thoracotomy. (Reproduced with permission [4]).
The role of external beam radiation therapy as an adjuvant to surgical resection is better established. Grillo has advocated maximal (4,500–6,500 cGy) radiation therapy after resection of squamous and adenoid cystic carcinomas because of the close margins necessary for resection and the high likelihood of local recurrence [4].

Another role for radiation therapy has been the treatment for local failures with symptomatic airway recurrences of tumor. These additional spot treatments can be given in the form of external beam radiation if maximal tolerable doses have not been given. If additional external radiation is contraindicated, endolumenal brachytherapy can be used as a mode of delivering additional radiation to precise locations of recurrence [19–21]. A variety of specific modalities have been used in brachytherapy including Cs-137 or Ir-192 pellets lowered into endotracheal delivery catheters or Au-198 seeds implanted directly into and around tumors. These therapies are purely palliative attempts to maintain an open airway in patients with otherwise incurable disease. The major potential advantage of brachytherapy is the ability to deliver high-dose radiation directly to the neoplasm without the injury to surrounding normal tissues seen with external beam radiation.

**CHEMOTHERAPY**

There is little defined role for chemotherapy as primary treatment or as adjunct to tracheal resection for the treatment of tracheal neoplasms. In the few reports which describe its use, the results were poor and the conclusion of the authors has been that it was of no use. Clearly, there is no role at all for primary chemotherapy in patients with a surgically resectable lesion. In the less fortunate subgroup of patients with unresectable tumors, distant metastases, or late local recurrences, there may still be a role, but it has yet to be demonstrated [16].

**ENDOPROSTHeses AND STENTS**

There is a palliative role for stents and endoprostheses for patients with tracheal neoplasms. These devices should be reserved for patients with incurable lesions and airway compromise which persist despite treatment with other modalities. There is a variety of prostheses available, and their use should be tailored to the needs of the individual patient [22–24].

**SUMMARY**

Despite the relative paucity of information available, certain conclusions are valid regarding the management of tracheal neoplasms. Surgical resection of “benign” neoplasms is almost always curative. Surgical resection of malignant neoplasms is warranted and offers the best chance at lasting cure or palliation. Resection followed by adjuvant mediastinal irradiation is advised for all malignant tumors of the trachea. Survival is most dependent on cell type and degree of local and systemic spread at the time of presentation. Long-term surveillance is advised for early detection and treatment of recurrences, which can occur years after initial therapy.

**REFERENCES**


