Brachytherapy for Carcinoma of the Lung

By Subir Nag, MD [2], Jason F. Kelly, MD [3], John L. Horton, PhD [4], Ritsuko Komaki, MD [5], and Dattatreyudu Nori, MD [6]

An estimated 157,000 patients died of lung cancer in the United States in the year 2000.[1] Although surgery can be curative, only about 20% of patients are amenable to complete surgical resection. Most of the other patients are treated with radiation therapy (external-beam irradiation and/or brachytherapy) and/or chemotherapy, with less than 10% surviving to 5 years.

Most patients referred for radiation therapy have large tumor volumes requiring high doses of radiation for control of locoregional disease. Dose escalation with external-beam radiation therapy is limited by tolerance of the surrounding normal structures. Brachytherapy is one method of delivering a higher radiation dose to the tumor while sparing the surrounding normal tissues, in an attempt to improve local control. Small or occult carcinomas of the lung in medically inoperable patients are another subgroup in whom brachytherapy can be used to boost the external-beam radiation dose.

The majority of lung cancer patients eventually have symptoms related to local progression and subsequently die from locoregional failure. Commonly reported symptoms from failure of local control include cough, dyspnea, pain, and hemoptysis, with the majority related to endobronchial disease. Therefore, management of the endobronchial and peribronchial component of lung cancer is quite important, even in patients with metastatic disease. Brachytherapy can be used for palliation in these patients.

Guideline Process

The use of brachytherapy for lung cancer is not new. Even as early as 1922, Yankauer described two cases of lung cancer treated endoscopically with radium (Ra)-226.[2] In 1933, Graham and Singer[3] implanted radon-222 seeds into lung tumors, and Ormerod[4] performed transbronchial brachytherapy in 1937. The use of low-energy iodine (I)-125 reduced the radiation safety problems and regulations associated with the earlier radionuclides. Subsequently, the advent of the fiberoptic bronchoscope and the development of the high-activity iridium (Ir)-192 remote afterloader led to a significant increase in the use of endobronchial brachytherapy.

Brachytherapy may be used alone, in combination with surgery, or with external-beam radiation. The intent of treatment may be cure or palliation of symptoms.

Lung brachytherapy techniques vary widely, and only limited guidelines exist for their clinical use.[5] The American Brachytherapy Society (ABS), therefore, formed a panel to issue guidelines specifically for the use of brachytherapy for lung carcinoma.

Methods

Selected members of the ABS with expertise in lung brachytherapy performed a literature review, which, supplemented by their clinical experience and biomathematical modeling, allowed formulation of specific recommendations and directions for future investigations in lung brachytherapy. These recommendations were made by consensus and supported by evidence in the literature, whenever possible. The consensus levels used by the ABS are similar to those of the National Comprehensive Cancer Network and are defined as follows[6]:

---

1. An estimated 157,000 patients died of lung cancer in the United States in the year 2000. [1] Although surgery can be curative, only about 20% of patients are amenable to complete surgical resection. Most of the other patients are treated with radiation therapy (external-beam irradiation and/or brachytherapy) and/or chemotherapy, with less than 10% surviving to 5 years.

2. Most patients referred for radiation therapy have large tumor volumes requiring high doses of radiation for control of locoregional disease. Dose escalation with external-beam radiation therapy is limited by tolerance of the surrounding normal structures. Brachytherapy is one method of delivering a higher radiation dose to the tumor while sparing the surrounding normal tissues, in an attempt to improve local control. Small or occult carcinomas of the lung in medically inoperable patients are another subgroup in whom brachytherapy can be used to boost the external-beam radiation dose.

3. The majority of lung cancer patients eventually have symptoms related to local progression and subsequently die from locoregional failure. Commonly reported symptoms from failure of local control include cough, dyspnea, pain, and hemoptysis, with the majority related to endobronchial disease. Therefore, management of the endobronchial and peribronchial component of lung cancer is quite important, even in patients with metastatic disease. Brachytherapy can be used for palliation in these patients.

4. Guideline Process

The use of brachytherapy for lung cancer is not new. Even as early as 1922, Yankauer described two cases of lung cancer treated endoscopically with radium (Ra)-226. In 1933, Graham and Singer implanted radon-222 seeds into lung tumors, and Ormerod performed transbronchial brachytherapy in 1937. The use of low-energy iodine (I)-125 reduced the radiation safety problems and regulations associated with the earlier radionuclides. Subsequently, the advent of the fiberoptic bronchoscope and the development of the high-activity iridium (Ir)-192 remote afterloader led to a significant increase in the use of endobronchial brachytherapy.

Brachytherapy may be used alone, in combination with surgery, or with external-beam radiation. The intent of treatment may be cure or palliation of symptoms.

Lung brachytherapy techniques vary widely, and only limited guidelines exist for their clinical use. The American Brachytherapy Society (ABS), therefore, formed a panel to issue guidelines specifically for the use of brachytherapy for lung carcinoma.

Methods

Selected members of the ABS with expertise in lung brachytherapy performed a literature review, which, supplemented by their clinical experience and biomathematical modeling, allowed formulation of specific recommendations and directions for future investigations in lung brachytherapy. These recommendations were made by consensus and supported by evidence in the literature, whenever possible. The consensus levels used by the ABS are similar to those of the National Comprehensive Cancer Network and are defined as follows:
Results

The results of the deliberation of the panel and the ABS recommendations are given in the following sections. Unless specifically noted, these recommendations generally reflect a level 1 consensus.

Endobronchial Brachytherapy Techniques

Bronchoscopic and Catheter Insertion

The ABS made the following recommendations regarding bronchoscopic and catheter insertion techniques. Readers may refer to standard textbooks for procedural details.[7-9]

The ABS recommends that brachytherapy be performed with flexible fiberoptic bronchoscopy via the transnasal approach, with the patient under conscious sedation. Sedation should be administered by individuals who are properly trained and familiar with this approach. Intensive monitoring (eg, of blood pressure, pulse oximetry, and cardiac status) is required, and appropriate medical personnel and monitoring equipment (including electrocardiogram for high-risk patients) must be available.

The tumor should be visualized through the bronchoscope and photographed, if possible, for documentation and comparison on follow-up examination. The tumor location in the tracheobronchial tree, percentage of lumen occlusion, and length of airway involvement should all be recorded for dose prescription purposes.

The catheter tip should be placed at least 2 cm beyond the most distal aspect of the tumor, whenever possible. Localizing the tip in a segmental bronchus helps to hold the catheter in place.[10] It should be noted that the endobronchial lesion is usually well visualized under bronchoscopy but not under fluoroscopy. Conversely, the catheter tip with the guidewire in place can usually be clearly seen under fluoroscopy, but the tip’s position in relation to the distal end of the tumor is harder to verify on bronchoscopy.

Graduated markings on the catheter help determine its location relative to the tumor. If premarked catheters are not available, marking the distal portion of the catheter at 5-cm intervals before insertion provides these visual reference points for catheter placement and treatment planning (category 2). Although the exact length to be treated depends on the extent of bronchial (or tracheal) involvement, lengths of 5 to 7 cm are commonly irradiated.

Centering devices (balloons, cages, and sheaths) can help to reduce dose inhomogeneity in the bronchial wall (category 2).[11] The ABS deems centering devices to be optional, depending on physician preference.

When required by the tumor location, two or more catheters should be used to achieve adequate dosimetric coverage. In this situation, the first catheter is placed through the bronchoscope into the
desired location, and the bronchoscope is withdrawn while the catheter remains in place. The bronchoscope is subsequently reintroduced, and a second catheter is placed in the desired location in the adjacent bronchus. Multiple catheters are commonly used in tumors located at the major or minor carina.

Fluoroscopy should be used to visualize the guidewire during insertion and to confirm that the catheter is not displaced as the bronchoscope is removed. The external end of the catheter should be adequately secured to the patient's nose and marked with an ink pen at the nostril edge to allow an additional visual check that the catheter has not migrated.

Upon treatment completion and catheter removal, the patient and room should be surveyed to rule out any radioactive source misplacement. The patient should be observed after the procedure and discharged only when stable.

**High-Dose-Rate Therapy**

High-dose-rate endobronchial brachytherapy is usually performed under very tight time constraints. These constraints result from a desire to minimize the amount of time the patient must have the treatment catheter in place.

**Individualized Treatment Plans:** Brachytherapy for each patient should be based on source localization x-ray films taken at the time of treatment. For most single-catheter implants, a treatment planner should be able to generate an individual treatment plan in 10 to 15 minutes after the source localization x-ray films are taken. Because this procedure results in only a small increase in time, individual planning is the preferred process.

**Precalculated Single-Catheter Treatment Plans:** In order to minimize the amount of time the patient must have the treatment catheter in place, it is possible to approximate the treatment of single-catheter implants as a straight linear array of dwell positions. Precalculated dwell times based on source strength and length of the array can be used for these treatments.[12] However, this approximation becomes increasingly unreliable as the curvature of the catheter increases.

The curvature of the catheter results in the dose delivered to points inside the curve (on the concave side) being greater than the dose to points outside the curve (on the convex side). Ezzell[12] has developed a method by which to approximate the increased dose (on the concave side) resulting from the curvature of the catheter. He has generated charts that display this increased dose as a function of the active length vs the straight-line distance between the two ends of the active length as measured on source localization films. Readers are referred to Ezzell’s paper for full details.[12]

When a single-catheter implant is approximated as a straight linear array, the ABS recommends using a curvature that limits the increase in dose (resulting from the curvature, as compared to a straight linear array) to less than 10% at the prescription point (category 2). The extra time required for individualized dosimetry must be weighed against the difference in the isodose distribution resulting from the use of a linear array approximation.

**Multiple-Catheter Plans:** The ABS recommends individual plans from a computerized treatment planning system for all multiple-catheter implants.

All plans should be verified—whether based on individual plans or straight linear array approximations—by an independent calculation technique. Readers are referred to several independent methods that have been published.[13-17]

**Dose Optimization:** High-dose-rate computerized treatment planning systems enable optimized dose distribution based on constraints supplied by the planner. For a linear array of dwell times, the resultant optimization typically results in dwell times at each end being longer than the central dwell times. This approach compensates for the dose falloff at the ends of the array and provides a more uniform distribution over the length of the implant at the dose optimization points.

However, practitioners should be aware that at points closer than the optimization point, there would
be "hot spots" at both ends.[17a] If equally weighted dwell times are used, the treatment margins should be increased on each end of the treated area to compensate for the dose falloff. The ABS recognizes that either method can be valid if appropriately used.

Prescription Point: Two methods can be used for high-dose-rate endobronchial brachytherapy prescriptions. The first method entails prescribing the radiation dose to a fixed distance—typically 10 mm—from the center of the catheter or catheters. The second method is to prescribe at various distances from the center of the catheter(s), depending on the diameter of the trachea or bronchus at that point.

With this second method, treatments in the trachea and main stem bronchus are prescribed at 10 mm; however, as the treatments become more distal, the prescription distance is reduced to as little as 5 mm at the most distal treatment positions. At intermediate positions, the prescription distance may be 6 to 9 mm, based on an estimate of the diameter of the bronchus at that position. However, when using this second method, the same dose is administered to the prescription distance, ranging from 5 to 10 mm depending on the position in the bronchus.

Because various groups have accumulated many years of experience with their individual prescription methods, the ABS recognizes that these teams will likely continue their current prescription practices. Nevertheless, the ABS recommends that the dose at 10 mm from the center of the catheter and at the center of the active source length also be reported.[5] For computerized treatment plans of a curved catheter, the dose at 10 mm should be an average of the doses in four orthogonal directions at the point of maximum curvature (category 2).

Treatment Margin: In order to adequately treat the tumor and account for microscopic extension, placement uncertainties, optimization methods, and dosimetric considerations, a margin of 1 to 2 cm at each end is recommended.

Palliative Endobronchial Brachytherapy

Patient Selection and Indication

A history and physical examination, including performance status and weight loss, should be obtained. Routine blood work including coagulation panels and complete blood count, lung function tests, and chest x-rays are to be performed when indicated. The radiation oncologist and bronchoscopist should jointly assess the tumor, and the patient’s suitability for palliative endobronchial therapy. Given that patients should be able to tolerate bronchoscopy and should not have a significant bleeding disorder, the ABS recommends considering the following patients for endobronchial brachytherapy as a palliative treatment[8,9,18,19]:

- Patients with a significant endobronchial tumor component, causing symptoms such as shortness of breath, hemoptysis, persistent cough, and signs of postobstructive pneumonitis. Tumors that protrude into the lumen are considered suitable, as opposed to extrinsic tumors that compress the bronchus or the trachea. The catheter should be able to pass into (and preferably past) the obstructed bronchus. Endobronchial brachytherapy can generally give a quicker palliation of obstruction than external-beam radiation therapy (category 2). Furthermore, brachytherapy can be more convenient than 2 to 3 weeks of daily external-beam radiation therapy for many patients.

- Patients who do not undergo resection because of poor lung function or distant metastasis.

- Patients who, because of poor lung function, are unable to tolerate any external irradiation.

- Patients with previous external-beam radiation therapy of sufficient total dose to preclude
Brachytherapy for Carcinoma of the Lung

Published on Physicians Practice (http://www.physicianspractice.com)

further external-beam radiation therapy.

- Patients with sufficient life expectancy (usually > 3 months) to benefit from palliation.

Suggested Dosages

**Brachytherapy Alone:** A variety of doses have been successfully used by various centers. In order to give some guideline to the individual practitioner, the panel has made the following suggestions regarding dosages of brachytherapy for palliation.

The ABS suggests administering 30 Gy at 1.0 cm in one treatment when low-dose-rate endobronchial brachytherapy is used as the sole modality for palliation (category 2). Dose rates of greater than 1 Gy/h are often used to complete the treatment within 1 day. Among 324 patients reported, the symptomatic improvement ranged from 53% to 92% ([Table 1]).[20-26] It is recognized that a low dose rate is not commonly used nowadays due to the availability of high-dose-rate therapy, as discussed below.

For high-dose-rate brachytherapy, total doses ranging from 15 to 47 Gy in one to five fractions calculated at 1.0 cm have been reported. High-dose-rate series in 1,299 patients showed symptomatic improvement ranging from 50% to 99% ([Table 2]).[10,27-37]. The ABS suggests 3 weekly fractions of 7.5 Gy each, two fractions of 10 Gy each, or four fractions of 6 Gy each (prescribed at 1.0 cm) when high-dose-rate therapy is used as a sole modality for palliation (category 2).

These fractionation regimens have similar radiobiological equivalence using the linear quadratic model,[38] and there is no evidence of the superiority of one regimen over the other. Practitioners should weigh the benefits of fewer bronchoscopic applications with the risks of higher dose per fraction. Additional treatments or doses higher than those suggested can be considered for unirradiated patients and for those who have received limited irradiation (category 2).

**Brachytherapy as a Boost:** It should be recognized that the combination of brachytherapy and external-beam radiation therapy is not commonly used for palliative purposes. However, combined therapy can be used in cases where it is felt that prolonged palliation is achievable (category 2).

The ABS suggests low-dose-rate endobronchial brachytherapy of 20 to 25 Gy at 1.0 cm when given as a boost to external-beam radiation therapy (category 2). Two fractions of 7.5 Gy each, three fractions of 5 Gy each, or four fractions of 4 Gy each (prescribed at 1.0 cm) should be given when high-dose-rate therapy is used as a planned boost to supplement palliative external-beam radiation therapy of 30 Gy in 10 to 12 fractions, when patients have no previous history of radiation treatment to the chest (category 2). The interval between fractions is generally 1 to 2 weeks.

The brachytherapy dose should be reduced when aggressive chemotherapy is given. Concomitant chemotherapy should be avoided during brachytherapy, unless it is in the context of a clinical trial.

**Alternative Palliative Methods**

Endobronchial brachytherapy is one of several palliative methods for overcoming endobronchial obstruction. Other endoscopic techniques that may be used alone or in combination with endobronchial brachytherapy should also be considered. These methods include:

**Laser Therapy:** Neodymium: yttrium-aluminum-garnet (Nd:YAG) laser therapy controls bleeding and rapidly debulks obstructive airway lesions. However, the laser only treats the intraluminal component of the tumor. Hence, laser therapy and endobronchial brachytherapy can complement each other to prolong palliation.

The laser can open a completely occluded bronchus to allow passage of the endobronchial brachytherapy catheter beyond the tumor site, and endobronchial brachytherapy can address tumor
Brachytherapy for Carcinoma of the Lung
Published on Physicians Practice (http://www.physicianspractice.com)

beyond the bronchial lumen. Some series report on using laser and radiation treatment at the same time, while others advocate a recovery interval in between.[33,39] Hemorrhage and hypoxemia are risks associated with laser treatment.[40]

**Cryotherapy:** Cryotherapy kills tumor cells by freezing them repeatedly to -80°C with liquid nitrogen or nitrous oxide. The cryoprobe must be able to reach the tumor through the bronchoscope. Reported outcomes are similar to laser therapy results, but treatment times are longer due to the multiple freeze-thaw cycles.[41]

**Stenting:** Silicon or metal airway stents mechanically maintain patency of the trachea and major bronchi[42,43] but do not address tumor regrowth. Metal stents may induce inflammation and additional scarring, while silicon stents may become occluded with secretions. Stents may also migrate or require removal or replacement, which can be problematic if they are fixed to underlying tumor or scar. Supplemental endobronchial brachytherapy can address some of these limitations.

**Photodynamic Therapy:** Photodynamic therapy exploits the interaction between hematoporphyrin compounds and light to produce free radicals to kill tumor cells. The hematoporphyrin derivative is administered intravenously, and 1 to 2 days later, the tumor is exposed to the appropriate wavelength of light for several minutes during bronchoscopy. Potential side effects include skin reaction from bright light exposure, hemoptysis, and persistent airway obstruction from necrotic tissue. Photodynamic therapy is often used to treat early-stage or minimally invasive tumors.[44]

**Curative Endobronchial Brachytherapy**

It is recognized that the standard, definitive therapy for unresectable lung cancer is a combination of chemotherapy and external-beam radiation. Selected patients (those with predominantly endobronchial tumor) may benefit from endobronchial brachytherapy, either alone or as a boost to external-beam radiation therapy. However, the curative potential of endobronchial brachytherapy needs to be further explored. It can be used in various different settings, as summarized below.

The ideal patients for curative endobronchial radiation alone are those with occult carcinomas of the lung confined to bronchus or trachea. Preliminary results of the few reported series are encouraging (see Table 3).[45-49]

Endobronchial brachytherapy can be used as a boost treatment for selected patients with inoperable non-small-cell lung carcinoma, in combination with external-beam radiation (see Table 4).[22,27,50-53] Brachytherapy boost is especially advantageous in cases of postobstructive pneumonia or lung collapse to overcome bronchial obstruction, so that the lung is aerated and the tumor volume is better defined. This allows some sparing of normal lung from the external-beam radiation field.

In addition, endobronchial brachytherapy with curative intent is indicated in early-stage patients who are medically inoperable because of decreased pulmonary function, advanced age, or refusal of surgery. Marsiglia et al reported a survival rate of 78% at a median follow-up of 2 years in 34 patients treated with high dose rates of 30 Gy in six fractions (ie, a 5-Gy fraction given once a week).[54]

Endobronchial brachytherapy can be used as adjuvant treatment after surgical resection with minimal residual disease. Macha et al[32] reported on 19 patients with doses of 5.0 Gy prescribed at 1 cm from the source axis. A total dose of 20.0 Gy was delivered in four fractions. The tumor-free survival time was up to 4 years.

**Suggested Dose**

The ABS suggests a high dose rate of three fractions of 5 Gy each or two fractions of 7.5 Gy each as a boost to external-beam radiation given as 60 Gy in 30 fractions or to 45 Gy in 15 fractions (category 2). The high-dose-rate dose should be prescribed at a distance of 1.0 cm from the central axis of the catheter and given weekly. If endobronchial brachytherapy is used alone (in previously
unirradiated patients), doses of five fractions of 5 Gy each or three fractions of 7.5 Gy each prescribed to 1 cm can be used (category 2).

**Interstitial Brachytherapy**

Interstitial brachytherapy is more invasive than endobronchial brachytherapy, but can better encompass the clinical target volume. Interstitial brachytherapy usually requires open thoracotomy, although video-assisted thoracoscopy or percutaneous computed tomography (CT)-guided techniques have also been used.[7,55,56] Considerable expertise is required to avoid trauma to the adjacent critical normal structures (aorta, vena cava, bronchus, heart, esophagus).

Table 5 shows that good results can be obtained with interstitial brachytherapy in lung cancer.[55-64] The ABS recommends considering interstitial brachytherapy when endobronchial techniques would be expected to inadequately encompass the tumor (category 2). However, few centers have expertise with this technique; therefore, its use should be restricted to those centers experienced in using it.

In general, the indications for interstitial brachytherapy include [7,8,59,65-67]:

- Patients with limited pulmonary reserve and in whom adequate resection requires the removal of lung tissue beyond patient tolerance. Interstitial irradiation in these patients has an advantage over external-beam radiation therapy in that less lung volume is irradiated.

- Patients with tumors attached to chest wall, spine, trachea, esophagus, heart, or major vessels, precluding complete excision. Interstitial brachytherapy can supplement the dose that can be delivered by external-beam radiation therapy.

Interstitial brachytherapy can be performed using the following techniques:

- Permanent implantation is used for gross tumors, delivering 144 Gy with I-125 (per the American Association of Physicists in Medicine’s Task Group [TG]-43) or 125 Gy with palladium (Pd)-103 (per the National Institute of Standards and Technology’s NIST-99).[8,47,48,67-70] The radioactive seeds are inserted into the tumor using 17-gauge needles. It should be noted that the previously used 160 Gy with I-125 is replaced by 144 Gy when using TG-43 recommendations[69,70] and the previously used 115 Gy with Pd-103 is replaced by 125 Gy when using NIST-99 standards.[68]

- Permanent vicryl suture or gelfoam impregnated with I-125 or Pd-103 seeds is used for tumor beds after resection for treatment of microscopic disease, with doses similar to those described immediately above.[8,56,67]

- Temporary implants with Ir-192 (low dose rate or remote-afterloading high dose rate) or high activity I-125 are useful in the treatment of mediastinal, paravertebral, or chest wall tumor beds after resection.[7,8,65,66] The radioactive sources are afterloaded into the catheters 3 to 5 days after surgery to allow wound healing and to facilitate nursing care. A minimal peripheral dose of 30 Gy is recommended for low-dose-rate therapy; this is supplemented with 45 to 50 Gy of external-beam radiation. Doses of 15 to 20 Gy in three to four fractions can be given if high-dose-rate therapy is used.

- Intraoperative high-dose-rate brachytherapy of 10 to 15 Gy delivered in 3 to 4 minutes while the patient is still under anesthesia can be used to boost 45 to 50 Gy of external-beam...
radiation. The afterloading catheters can be placed directly on the tumor bed or can be incorporated in a surface template; these are removed immediately after the treatment. This technique has the added advantage that normal radiosensitive tissues (eg, heart, lung) can be temporarily displaced or shielded during the irradiation.[67,71,72]

Complications

Review of the literature shows fatal hemoptysis rates of 0% to 32% in treated patients (Table 6).[10,22,27,28,33,36,49,52,73-79] A direct comparison between the series is difficult because of variability in patient populations and therapy. Attempts have been made to correlate risk of complications with tumor location, number of catheters, dose, frequency of application, or prior therapy; however, no clear prognostic factors have been identified. Furthermore, it is unclear whether the hemoptysis occurs as a result of the radiation or tumor progression.

The high radiation doses to the bronchial mucosa can cause bronchitis and bronchial stenosis. For example, Furuta et al.[45] reported bronchial stenosis at 6 months, which appeared to be related to the dose given to the bronchial mucosa. However, the patients were asymptomatic and required no further treatment. In the pilot series reported by Perol et al.[46] two patients developed severe necrosis of the bronchial wall and one died with hemoptysis. Cotter et al.[51] reported a complication rate of 14% (9/65), including 4 of 9 patients with superficial bronchial wall necrosis, 1 of 9 with bronchial wall stenosis, and 3 of 9 with tracheoesophageal fistulae. Analysis of the complications with respect to the combined doses of external and intraluminal brachytherapy showed no complications with doses of 70 Gy or less, a 10% complication rate with doses of 70 to 85 Gy, and a 24% complication rate with doses greater than 85 Gy.

Grading of Symptoms, Response, and Complications

The symptoms, tumor response, and severity of complications need to be graded quantitatively to allow interinstitutional comparison of results. The ABS suggests using uniform grading systems based on symptomatic response, and bronchoscopic finding. The symptom index suggested by Speiser and Spratling[78] is given in Table 7. The bronchoscopic tumor response can be graded from “excellent” to “poor” based on criteria given in Table 8.[80] Finally, Table 9 summarizes a uniform grading system for bronchial radiation complications that is modified from Speiser and Spratling,[34] adding a grade 5.

Conclusions

Brachytherapy can play an important role as a component of the multimodality treatment of lung cancer. Endobronchial brachytherapy has a well-defined palliative role; however, its curative potential alone or as a boost to external-beam radiation therapy needs further exploration. Technical innovations intended to improve dose distribution (eg, centering catheters) need further development. Interstitial brachytherapy is used infrequently, but its use in selected patients appears to be promising.

Adherence to the recommendations given here regarding techniques, doses, and reporting of results will allow future interinstitutional comparisons and may also improve results and reduce complications. However, the responsibility for medical decisions ultimately rests with the treating radiation oncologist.

These guidelines will be modified as further clinical results become available. Randomized prospective multicenter trials are needed to better define the dose size, fractionation schedule, total dose, and patient selection.

References:


75. Hennequin C, Tredaniel J: Predictive factors for late toxicity after endobronchial brachytherapy: A


Source URL: http://www.physicianspractice.com/printpdf/brachytherapy-carcinoma-lung/page/0/1

Links: