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American Brachytherapy Society consensus guidelines for thoracic brachytherapy for lung cancer

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ABSTRACT

PURPOSE: To update brachytherapy recommendations for pretreatment evaluation, treatment, and dosimetric issues for thoracic brachytherapy for lung cancer.

METHODS AND MATERIALS: Members of the American Brachytherapy Society with expertise in thoracic brachytherapy updated recommendations for thoracic brachytherapy based on literature review and clinical experience.

RESULTS: The American Brachytherapy Society consensus guidelines recommend the use of endobronchial brachytherapy for disease palliation in patients with central obstructing lesions, particularly in patients who have previously received external beam radiotherapy. The use of interstitial implants after incomplete resection may improve outcomes and provide enhanced palliation. Early reports support the use of CT-guided intratumoral volume implants within clinical studies. The use of brachytherapy routinely after sublobar resection is not generally recommended, unless within the confines of a clinical trial or a registry.

CONCLUSIONS: American Brachytherapy Society recommendations for thoracic brachytherapy are provided. Practitioners are encouraged to follow these guidelines and to develop further clinical trials to examine this treatment modality to increase the evidence base for its use.

Keywords: Endobronchial brachytherapy; Interstitial seed brachytherapy; Iodine seeds; Cesium seeds; Lung cancer; Thoracic tumors

Introduction

Lung cancer is the most common cause of cancer and is a leading cause of cancer mortality worldwide. The estimated incidence in the United States in 2013 of lung cancer was 228,190 with 159,480 deaths from the disease (1). Lung cancer is often advanced at diagnosis and many patients present with a poor performance status. These factors may preclude the need for surgery or alter the extent of surgical resection to compensate for poor cardiopulmonary reserve. The risk of close or positive margins increases with limited lung resections. Furthermore, with advanced presentation, the treatment intention may be palliative, with the need to alleviate symptoms from central airway obstruction, such as cough, dyspnea, and hemoptysis.

The use of brachytherapy for thoracic tumors has the potential to improve local control by delivering a highly localized dose of radiation using a conformal technique with normal tissue sparing. Endobronchial brachytherapy can be used in the palliative setting to relieve symptoms in patients with endoluminal lesions, usually non−small cell

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Disclaimer: These guidelines represent the views of the authors regarding currently accepted treatment. The suggested doses result from published evidence and clinical experience. The clinician should use their judgment to select appropriate treatment approaches, including dose and fractionation for their patients. The guidelines will be updated as clinical experience increases.

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Summary of updated recommendations

- CT simulation recommended for endobronchial brachytherapy.
- CT planning with three-dimensional target definition recommended over point prescription for endobronchial brachytherapy.
- High dose rate or pulsed dose rate brachytherapy with the ability to optimize dose are recommended over low dose rate brachytherapy for endobronchial treatment.
- Radical endobronchial brachytherapy (alone or as a boost) is recommended generally within confines of clinical trials.
- Interstitial seed treatment after sublobar lung resection is recommended generally within the confines of clinical trials.
- Postoperative CT planning should be performed for interstitial implants with reporting of dose to organs at risk.
- New dose/fractionation recommendations for thoracic brachytherapy.

lung cancer, but use in other histologic subtypes and in benign conditions has been described (2–5). It has also been described as a boost to radical external beam radiotherapy (EBRT) for patients with central tumors (6, 7). Permanent iodine (^{125}I) seed implantation has been described in the treatment of malignant thoracic tumors when resection margins are macroscopically or microscopically involved with tumor (8–22) and for the palliation of inoperable disease (23). Use of Cesium (^{131}Cs) has also been described (24, 25). Previously irradiated patients with recurrence may benefit from brachytherapy, and it may be useful in selected cases as initial management for patients with a high-performance status and limited disease burden. Members of the American Brachytherapy Society (ABS) with expertise in thoracic brachytherapy examined the evidence base for these treatments and developed recommendations for pretreatment evaluation, treatment, and dosimetric issues. Previous ABS guidelines from 1993 covered aspects of endobronchial brachytherapy (26) with more detailed guidelines on thoracic brachytherapy issued in 2001 (27).

Endobronchial brachytherapy

In 1922, Yankauer (28) described the use of radium placed endobronchially to treat lung cancer. Brachytherapy continues to be used to deliver radical or palliative endoluminal therapy to the bronchus. Local treatment can be important to improve the quality of life for lung cancer patients. Endobronchial brachytherapy can be used as sole treatment, particularly for palliation, or in addition to EBRT, especially when used as radical treatment or if the disease is more bulky. Endobronchial brachytherapy can be combined with other modalities, such as endobronchial resection, laser therapy, stenting, and photodynamic therapy. The 2011 American Society of Radiation Oncology guidelines (29) state that there is currently no evidence to support the routine use of endobronchial brachytherapy as a first-line palliative treatment of endobronchial obstruction. However, brachytherapy was recommended if there is collapsed lung at the first presentation because of improved re-expansion rates using endobronchial brachytherapy over EBRT as observed in a randomized trial (30). Brachytherapy was also recommended in the American Society of Radiation Oncology guidelines for retreatment of patients who previously received EBRT, particularly if there is endoluminal obstruction or hemoptysis.

Patient selection

The presence of endoluminal disease suitable for brachytherapy is determined at bronchoscopy. CT scanning is also recommended to determine whether there is a significant extrabronchial extent of the tumor, in which case brachytherapy may be chosen as a boost to EBRT or held in reserve for future relapse. The bronchoscope is used to traverse the tumor within the trachea or bronchus. It is recommended that the tumor is photographed to aid radiotherapy planning and to assess treatment response. A narrow bore brachytherapy tube is placed using the side port of the bronchoscope with at least 2 cm passing distal to the lesion. If the catheter is not marked externally by the manufacturer, it may help to make 1-cm interval markings at the distal end with indelible ink before insertion into the bronchoscope. The position of the tube in relation to the tumor should be documented in the notes to aid treatment planning. The tube is firmly secured at the nostril with tape and the position of the nostril marked on the tube. A marker wire is placed in the tube to identify the position accurately. For a carinal or nonbulky subcarinal lesion, 2 catheters clearly labeled and with distinct radio-opaque identifiers may be used, one in each bronchus, to give a cumulative dose to the central area. The use of mini-tracheostomy has been described for patients undergoing multiple fractions to decrease the requirement for multiple bronchoscopies (31).

Planning and postimplant management

High dose rate (HDR) endobronchial brachytherapy is often delivered weekly but can safely be delivered as a single fraction or as a fractionated treatment with a single catheter insertion as long as there is a minimum interval of 6 h between fractions (see Table 1). Pulsed dose rate (PDR) treatment can be used (32), although the patient will have the catheter in place for longer. Therefore, a single catheter insertion would usually be preferred when using PDR. Low dose rate (LDR) brachytherapy is very rarely used for endobronchial cancer and an alternative approach with PDR or HDR is recommended to allow the opportunity to sculpt the dose using optimization. All reported HDR and PDR experience for endobronchial brachytherapy is currently using ^{192}Ir.