Thermal Ablation Matches Sublobar Resection Outcomes in Older Patients with Early-stage Non–small Cell Lung Cancer

Sharon W. Kwan, MD, Kelly E. Mortell, MD, Adam D. Talenfeld, MD, and Michael C. Brunner, MD

ABSTRACT

Purpose: To compare survival outcomes of sublobar resection and thermal ablation for early-stage non–small cell lung cancer (NSCLC) in older patients.

Materials and Methods: SEER-Medicare linked data for patients with a diagnosis of lung cancer from 2007–2009 were used. Patients $\geq$ 65 years old with stage IA or IB NSCLC who were treated with sublobar resection or thermal ablation were identified. Primary outcome was overall survival (OS), and secondary outcome was lung cancer–specific survival (LCSS). Demographic and clinical variables were compared. Unadjusted OS and LCSS curves were estimated using the Kaplan-Meier method, and multivariate analysis was performed using the Cox model. OS and LCSS curves for propensity score matched groups were also compared.

Results: The final unmatched study population comprised 1,897 patients. Patients who underwent sublobar resection were significantly younger ($P = .006$) and significantly less likely to have a comorbidity index > 1 ($P = .036$), a diagnosis of chronic obstructive pulmonary disease ($P = .017$), or adjuvant radiation therapy ($P < .0001$) compared with patients treated with thermal ablation. Unadjusted survival curves of unmatched groups demonstrated significantly better OS ($P = .028$) and LCSS ($P = .0006$) in the resection group. Multivariate Cox model adjusting for demographic and clinical variables found no significant difference in OS between the treatment groups ($P = .555$); a difference in LCSS (hazard ratio = 1.185, $P = .026$) persisted. Survival curves for matched groups found no significant difference in OS ($P = .695$) or LCSS ($P = .819$) between treatment groups.

Conclusions: After controlling for selection bias, this study found no difference in OS between patients treated with sublobar resection and thermal ablation.

ABBREVIATIONS

COPD = chronic obstructive pulmonary disease, HR = hazard ratio, LCSS = lung cancer–specific survival, NSCLC = non–small cell lung cancer, OS = overall survival, SEER = Surveillance, Epidemiology and End Results program

From the Department of Radiology (S.W.K.), University of Washington Medical Center, 1959 NE Pacific Street, 357115, Seattle, WA 98195; Department of Radiology (K.E.M.), University Hospitals Case Medical Center, Cleveland, Ohio; Department of Radiology (A.D.T.), Weill Cornell Medical Center, New York, New York; and Departments of Radiology (M.C.B.), William S. Middleton Memorial Veterans Administration Hospital and University of Wisconsin–Madison School of Medicine and Public Health, Madison, Wisconsin. Received July 26, 2013; final revision received September 24, 2013; accepted October 13, 2013. **Address correspondence to** S.W.K.; E-mail: shakwan@uw.edu

This project was supported by a Society of Interventional Radiology grant award. S.W.K. receives research funding from the National Institutes of Health. None of the authors have identified a conflict of interest.

Appendix A is available online at *www.jvir.org*.

J Vasc Interv Radiol 2014; 25:1–9

http://dx.doi.org/10.1016/j.jvir.2013.10.018

Lung cancer is diagnosed in at least 220,000 Americans each year and is the most common cause of cancer-related death in the United States (1). The economic burden of lung cancer is proportional to its prevalence. Lung cancer care currently accounts for approximately 20% of total cancer expenditures for Medicare (2). As lung cancer screening with computed tomography is increasingly incorporated into routine medical practice, one can anticipate greater detection of early-stage disease, with an associated increase in health care costs related to treatment and follow-up care (3).

Lobectomy has been the "gold standard" for the treatment of early-stage non–small cell lung cancer (NSCLC) in patients who are medically fit for surgical resection (4,5). However, many patients with NSCLC are poor

candidates for lobectomy because of poor pulmonary reserve, significant comorbidities, or other risk factors such as advanced age. Some of these patients may be candidates for sublobar resection (ie, segmentectomy or wedge resection), but about 25% of patients ≥ 65 years old may be deemed inappropriate to undergo any type of surgical excision (6).

The introduction of thermal ablation therapy has expanded the treatment opportunities for patients with stage I cancers and high surgical risk. The current literature in support of thermal ablation for stage 1 NSCLC comprises mostly retrospective case series with short-term to midterm follow-up (7–10). A single multicenter, prospective, single-arm study of radiofrequency ablation for pulmonary tumors included only 13 patients with stage 1 NSCLC (11). Published literature directly comparing thermal ablation with other techniques is scarce. One nonrandomized cohort study suggested thermal ablation to be similarly efficacious compared with sublobar resection for stage 1 tumors < 3 cm (12), whereas a more recent retrospective study showed poorer overall survival (OS) for thermal ablation compared with sublobar resection. However, in the same study, patients undergoing thermal ablation were older than patients selected for surgery (13).

In the absence of randomized prospective trials, population-based comparative studies may provide a higher level of evidence to guide clinical management decisions. The primary purpose of the present study was to assess the effectiveness of sublobar resection compared with thermal ablation for older patients with early-stage NSCLC. Because previous reports of survival benefit associated with surgery were confounded by baseline differences between patient groups, we specifically sought to control for selection bias in this retrospective study using population-based data.

MATERIALS AND METHODS

Institutional review board approval was obtained for this study. The data were maintained and results reported in accordance with a data use agreement with the National Cancer Institute.

Data Source

The National Cancer Institute Surveillance, Epidemiology and End Results (SEER) program pools clinical, pathologic, and cause of death information from 17 tumor registries and constitutes a nonrandom sample of about 28% of the U.S. population. This database sets the standard for quality for cancer registries worldwide and is considered an accurate representation of the overall U.S. cancer population (14). The SEER-Medicare linked database links SEER registry variables to claims data from the largest health care payer in the United States. SEER-Medicare linked data for patients diagnosed with lung cancer from January 1, 2007, to December 31, 2009, were used. Claims records were derived from the Medicare hospital, outpatient, and carrier files.

Study Population

We identified 20,118 patients ≥ 65 years old diagnosed with stage 1A or 1B lung cancer. Patients with more than one primary cancer were excluded because billing data cannot reliably discern between procedures performed for lung cancer versus other cancers. Patients with small cell lung cancer were excluded because this cancer type has a pattern of progression and prognosis distinct from NSCLC (15). Patients with inadequate Medicare billing records (patients without Part A and Part B Medicare coverage or patients enrolled with a health maintenance organization) in the 6 months before diagnosis were excluded, as were patients with missing date of cancer diagnosis. The study population was limited to patients treated with the two procedure types of interest, sublobar resection or thermal ablation. The codes used to identify these procedures are listed in **Appendix A** (available online at *www.jvir.org*). Inclusion and exclusion criteria and corresponding sample sizes are summarized in **Table 1**.

Outcomes

The primary outcome of interest was OS; secondary outcome of interest was lung cancer–specific survival (LCSS). The cause of death is coded in the SEER database and is based on data from state death certificates. Patients were censored if they lost Part A and Part B coverage, enrolled with a health maintenance organization, or were alive at the end of the study period on December 31, 2009. For determination of LCSS, patients were also censored at the time of death of any cause other than lung cancer. Survival was calculated as the time from diagnosis to time of death or censoring. Because only the month and year of diagnosis is provided by SEER, diagnosis date was recorded as the first day of the month.

Covariates

Demographic variables were obtained from the SEER registry data. Clinical cancer stage, tumor histology, and information about the receipt of adjuvant radiation were obtained from the SEER registry data. Charlson comorbidity index using the Klabunde modification (16) was calculated using Medicare Part A and Part B claims from the 6-month period before cancer diagnosis. Prior diagnosis of chronic obstructive pulmonary disease (COPD) was similarly determined from claims in the 6-month period before cancer diagnosis. Claims data were used to identify the receipt of adjuvant chemotherapy. Patients were considered as having received adjuvant chemotherapy if any one of the billing codes listed in **Appendix A** (available online at *www.jvir.org*)