Stereotactic body radiation therapy versus sublobar resection for stage I NSCLC

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ABSTRACT

Purpose: To compare sublobar resection and stereotactic body radiation therapy (SBRT) in patients with stage I non-small cell lung cancer (NSCLC).

Methods: Patients undergoing sublobar resection or SBRT for stage I NSCLC from 2007 to 2014 at Duke University Medical Center were evaluated. The primary endpoint of interest was freedom from local recurrence. Kaplan-Meier survival estimates and Cox proportional hazards multivariate analyses were performed.

Results: 221 patients with stage I NSCLC undergoing sublobar resection (n = 151; 105 wedge and 46 segmentectomy) or SBRT (n = 70) were evaluated. The majority (89%) of patients receiving SBRT were medically inoperable, and compared with surgical patients, were significantly older (74 vs 70 years, p = 0.019), had higher Charlson Comorbidity Indices (3.7 vs 2.7, p < 0.001), larger tumors (2.4 cm vs 1.7 cm, p < 0.001), and worse baseline pulmonary function. At 3 years, freedom from local recurrence was 90% (95% CI 82–94%) for surgery and 85% (95% CI 65–94%) for SBRT (p = 0.71). While overall survival and disease-free survival were higher in the surgical cohort, no differences were noted in cancer-specific disease-free survival (60% vs. 65%, p = 0.84). On multivariate analysis, higher Charlson Comorbidity Index (HR 1.38, 95% CI 1.19–1.61, p < 0.001) and lower diffusion capacity (HR 0.97, 95% CI 0.96–0.98, p < 0.001) were independently associated with inferior overall survival. No differences in overall survival between surgery and SBRT (HR 1.20, 95% CI 0.74–1.95, p = 0.46) were observed after correcting for baseline imbalances in prognostic factors.

Conclusions: SBRT and sublobar resection provided similar rates of local tumor control and overall clinical outcomes in stage I NSCLC.

1. Introduction

The standard treatment for stage I non-small cell lung cancer (NSCLC) is surgery [1]. Lobectomy with hilar and mediastinal lymph node dissection is preferred given the results of the Lung Cancer Study Group (LCSG) trial [2]. Sublobar resection includes segmentectomy, the anatomical resection of one or more lung segments, and wedge resection, the non-anatomical resection of affected lung tissue. Sublobar resection was shown to have inferior local control and a trend toward decreased survival in the LCSG trial. However, evaluation of sublobar resection in selected patients is currently underway in the Alliance 140,503 and Japan Clinical Oncology Group 0802/West Japan Oncology Group 4607 L randomized trials.

Radiation therapy, ideally stereotactic body radiation therapy (SBRT), is recommended for patients with stage I NSCLC deemed medically inoperable [3]. SBRT is a specialized radiation technique consisting of 1–5 outpatient treatments over a 1–2 week time period. Prospective single arm trials evaluating SBRT have shown the treatment to be tolerable in a frail population with high rates of local control (~90%) [4-6].

Whether SBRT or sublobar resection is preferred for patients who are marginal surgical candidates is controversial. Most studies, both prospective and retrospective, comparing surgery with SBRT have primarily included patients undergoing lobectomy. Fewer studies have specifically evaluated sublobar resection and SBRT [9–11]. We therefore explored our institutional experience with these two treatment options. We hypothesized that local control and cancer-specific disease-free survival would be comparable for patients with stage I lung cancer.
undergoing sublobar resection or SBRT.

2. Materials and methods

In this Institutional Review Board approved retrospective study, all patients undergoing sublobar resection or SBRT at Duke University Medical Center for stage I NSCLC from 2007 to 2014 were evaluated. Patients found to have pathologically involved lymph nodes were excluded. In order to optimally compare the two groups, patients in either cohort with a previous lung cancer or multiple synchronous primary cancers were excluded from the analysis. Patients were treated at the discretion of the treating physicians following multidisciplinary evaluation.

Not all patients in the SBRT cohort underwent a biopsy prior to radiation therapy and some patients were treated based on clinical suspicion. Patients in whom a biopsy was not feasible due to technical or medical issues were treated with SBRT if the clinical scenario was consistent with a stage I NSCLC (e.g., enlarging lesion that was hypermetabolic on PET-CT in a current or former smoker).

The following metrics were collected for all patients: age at diagnosis, sex, body mass index, Charlson Comorbidity Index, smoking history, pulmonary function tests including forced expiratory volume in one second (FEV1) and diffusion capacity for carbon monoxide (DLCO), staging information from PET-CT including SUVmax, tumor size, tumor location, histological subtype, extent of mediastinal sampling, operability, treatment modality, patterns of failure, date of last follow-up, and date of death. For patients receiving sublobar resection, the following additional metrics were collected: date of surgery, type of surgery (wedge resection or segmentectomy), approach (video-assisted thoracoscopic surgery [VATS] or open), mediastinal and hilar lymph node yield, presence of lymphatic or pleural invasion, pathologic tumor size, length of hospital stay, surgical complications, and readmission information. For the SBRT cohort, the following additional metrics were collected: SBRT technique, fractionation scheme, central versus peripheral location, respiratory management, date of first and last treatment, complications related to SBRT, and whether a biopsy was obtained.

In the absence of significant cardiac morbidity, all patients are considered for lobectomy based on overall performance status and objective evaluation of pulmonary function. Patients with predicted postoperative forced expiratory volume in one second (FEV1) and/or diffusion capacity for carbon monoxide (DLCO) less than 60% may undergo additional testing such as a quantitative ventilation-perfusion scan and/or cardiopulmonary exercise testing with measurement of maximal oxygen consumption (VO2max). When lobectomy was not deemed practical, anatomic sublobar resection with mediastinal lymph node dissection was the preferred alternative, but wedge resection was performed in patients with advanced co-morbidity, previous complex resections, or very peripheral lesions. Surgery was performed under general anesthesia with the intention of achieving complete resection thoracoscopically as previously described [12]. In short, the 2-port approach was used, with a 4-cm anterior access incision in the 5th intercostal space and a 5-mm camera port. Thoracotomy was utilized for cases requiring conversion, due to hilar fibrosis, extensive adhesions, or bleeding.

Patients undergoing SBRT were immobilized supine in a BodyFIX (Elekta Oncology, Stockholm, Sweden) or Alpha Cradle (Smithers Medical Products, Canton, OH), typically with their arms above their head. A four-dimensional CT was obtained on either a GE Discovery CT590 RT (Boston, MA), Philips Brilliance CT Big Bore (Best, Netherlands), or Siemens Biograph mCT40 (Erlangen, Germany) scanner. In patients with small tumors or minimal motion from respiration, maximum intensity projection and free-breathing datasets were exported to the treatment planning software (Varian Medical Systems, Palo Alto, California). In patients with excessive motion, particularly with larger tumors, either breath-hold or gating techniques were employed. The primary tumor on the planning CT scan(s) was contoured on lung windows to create a gross tumor volume (GTV). This volume was expanded based on the respiratory management strategy to create an internal target volume (ITV). The ITV was increased in size by 5 mm in all directions to create a planning target volume (PTV). Three-dimensional SBRT was utilized most frequently with occasional use of intensity modulated radiation therapy (IMRT) or volumetric modulated arc therapy (VMAT) to spare critical normal tissues in close proximity to the ITV. SBRT was given every 48-72 h using 3–5 fractions. The fractionation schemes utilized were almost exclusively 10 Gy x 5, 12–12.5 Gy x 4, or 18–20 Gy x 3. The SBRT technique depended upon location of tumor, size of PTV, and radiation exposure to normal tissues.

Following surgery or SBRT, patients typically underwent surveillance with chest CT as per national guidelines [1]. Most patients were seen every 3–6 months for the first 2 years and annually thereafter. Surveillance PET-CT imaging was not routinely ordered but obtained to evaluate suspicious findings on CT.

For patients undergoing sublobar resection, local failure was defined as recurrence along the surgical suture line [9]. For the SBRT group, local failure was defined as recurrence within 2 cm of the original GTV [13]. Intralobar failures were defined as failures contained within the index lobe but not along the surgical suture line or within 2 cm of the original GTV. As local failures are challenging to delineate after SBRT, two authors (BA and CK) reviewed post-SBRT imaging, particularly PET-CT imaging, and other diagnostic studies to score patterns of failure. While most local failures were scored based on radiographic criteria (enlarging, hypermetabolic mass), some recurrences were confirmed with biopsy. Regional failures were defined as disease recurrence in regional lymph nodes and distant failures were defined as the development of distant metastatic disease. Adverse events from surgery and SBRT were collected and graded using Common Terminology Criteria for Adverse Events (CTCAE) Version 5.0.

2.1. Statistics

The primary endpoint was freedom from local recurrence, defined as date of surgery or SBRT to date of local failure with patients censored at the date of last follow-up. Disease-free survival was defined as date of surgery or SBRT to date of any failure, development of a new primary NSCLC, or date of death, with patients censored at date of last follow-up. A second primary tumor was scored when a patient presented with a different histology or the same histology but a clinical presentation that was most consistent with a new primary tumor. Cancer-specific disease-free survival was similar to disease-free survival but deaths without evidence of prior cancer progression were not included as events.

We calculated mean, standard deviation, median, and range for the continuous variables, and provided percentages for the categorical variables at baseline. Equal variance two sample t-test and Chi-Square test were used to test the balance between the two treatment groups (surgery vs. SBRT) for patients’ demographic and clinical characteristics at baseline.

Median survival times (95% CI) were estimated using the product-limit estimate method. Hazard ratios (95% CI) were estimated via univariate Cox proportional hazard model. Kaplan-Meier plots were created to depict freedom from local recurrence, disease-free survival, cancer-specific disease-free survival, and overall survival. Multivariate Cox proportional hazard models were conducted to compare freedom from local recurrence and overall survival between the two treatments (surgery vs. SBRT), adjusting for patients’ demographics and baseline clinical characteristics. For the freedom from local recurrence analysis, smoking status was excluded because all but one patient developing a local recurrence were former smokers leading to instability in the model assessing surgery vs. SBRT for the dependent variable (time to local recurrence). Two-sided p-values less than 0.05 were treated as statistically significant difference for comparisons. All of the analyses
Between 2007 and 2014, 361 patients were treated with SBRT (n = 95) or sublobar resection (n = 266) for stage I NSCLC. Of these, 81 were excluded due to a prior lung cancer diagnosis and 59 due to synchronous primary tumors. Therefore, 221 patients comprise the current analysis (70 SBRT, 151 sublobar resection). Within the SBRT cohort, 53 had biopsy confirmation of NSCLC and 17 were treated based on radiographic suspicion. Median follow-up was 61 months (65 months for the SBRT cohort and 60 months for the sublobar resection cohort) calculated by the reverse of Kaplan-Meier method. Patient characteristics are summarized in Table 1. Of note, patients in the SBRT group were older, with higher Charlson Comorbidity scores, lower FEV1 and DLCO values, higher SUVmax values, and had larger tumors.

### 3. Results

#### 3.1. Surgical patients

Of the 151 patients in the surgical group, 105 underwent wedge resection (70%) and 46 underwent segmentectomy (30%). Females were more likely to undergo segmentectomy than males (39% vs 22%, p = 0.03) but otherwise there were no significant baseline differences between the patients receiving wedge resection and segmentectomy. The majority of patients (n = 143, 95%) underwent video-assisted thoracoscopic surgery (VATS) while a small number (n = 8, 5%) underwent open thoracotomy. Mediastinal lymph node dissection/sampling was performed in 134 patients (89%) with a median of three stations sampled (range, 1–7). Patients undergoing segmentectomy were more likely to undergo mediastinal dissection or sampling than those undergoing wedge resection (100% versus 88%, p = 0.01). None of the surgical patients had positive surgical margins. Median length of hospital stay was four days (range, 1–28), and 20 patients (13%) were readmitted within 30 days due to complications. Thirty-five surgical patients suffered complications (23%). The most common complications were prolonged air leak (n = 10), cardiac arrhythmia (n = 6), pneumonia (n = 3), pulmonary embolism or deep vein thrombosis (n = 2), congestive heart failure (n = 2), postoperative hemorrhage (n = 2), and myocardial infarction (n = 1). Two patients (1%) died in the post-operative period. One developed acute pulseless electrical activity (PEA) arrest on post-op day 4 and expired. The second developed pneumonia and *Clostridium difficile* colitis and sepsis on post-operative day 5, ultimately dying of respiratory failure.

#### 3.2. SBRT patients

All patients underwent multidisciplinary evaluation by a thoracic surgeon and radiation oncologist. Most (89%) patients who received SBRT were deemed medically inoperable by a thoracic surgeon prior to treatment. The most common reasons for inoperability (some patients had more than one reason) included baseline FEV1 or DLCO < 40% (n = 45), predicted post-operative FEV1 < 30% (n = 17), baseline hypoxia (n = 18), and severe cardiovascular disease (n = 17). Eight patients (11%) receiving SBRT were deemed medically operable by a cardiothoracic surgeon but declined surgery. Invasive mediastinal staging was performed via endobronchial ultrasound (n = 5, 7%) or mediastinoscopy (n = 17, 24%). PET-CT staging was obtained in 68/70 patients (97%).

SBRT fractionation scheme consisted of 10 Gy × 5 (n = 8, 11%), 12–12.5 Gy × 4 (n = 34, 49%), or 18–20 Gy × 3 (n = 24, 34%), with 4 patients (6%) receiving less common fractionation schemes. Ten patients had a centrally located tumor defined by RTOG criteria. Most patients were treated with 3D conformal plans (n = 64, 91%), while the remaining six patients were treated with IMRT or VMAT. For respiratory management, all but four patients were treated using a free-breathing technique. Two patients were treated with deep inspiratory breath hold and two with respiratory gating.

One patient died during the course of treatment. A 71 year-old male with coronary artery disease, severe symptomatic aortic stenosis, and transfusion-dependent myelodysplastic syndrome, among other comorbidities, initiated SBRT for a stage I NSCLC of the right lower lobe. After one dose of SBRT (18 Gy), the patient’s performance status deteriorated with fatigue and drowsiness which culminated in sudden death at home. Side effects from SBRT developed in 12 patients (17%), most commonly increased dyspnea and chest wall toxicity. Six patients complained of increased dyspnea after SBRT (grade 1 in four patients; grade 2 in two patients). Chest wall toxicity developed in 6 patients (grade 1 in three patients; grade 2 in three patients). There was one case of grade 1 fatigue and one case of grade 2 odynophagia. No grade 3 or 4 toxicities were encountered.

#### 3.3. Clinical outcomes

The primary outcome of interest was freedom from local recurrence at the primary tumor site. At 3 years, freedom from local recurrence was 90% (95% CI 82–94%) for surgery and 85% (95% CI 65–94%) for SBRT (p = 0.71) (Fig. 1). Local failure was confirmed pathologically in...
10/16 (63%) of surgical patients and 2/6 (33%) of SBRT patients. Local failure occurred in 10/105 (10%) of patients undergoing wedge resection and 6/46 (13%) of patients undergoing segmentectomy.

Both disease-free survival and overall survival were better in surgical patients. Disease-free survival at 3 years was 42% (95% CI 34–50%) for surgery versus 29% (95% CI 18–41%) for SBRT (p = 0.004). Overall survival at 3 years was 63% (95% CI 55–71%) for surgery versus 35% (95% CI 23–47%) for SBRT, (p < 0.001) (Fig. 2). However, no differences were noted between surgery and SBRT for cancer-specific disease-free survival (60%, 95% CI 50–69% versus 65%, 95% CI 47–78%, p = 0.84) (Fig. 3).

On multivariate analysis, no factors were significant for a higher risk of local failure. Specifically, the hazard ratio for SBRT vs surgery was 0.75 (95% CI 0.22–2.5, p = 0.65). With regards to overall survival, higher Charlson Comorbidity Index (HR 1.38, 95% CI 1.19–1.61, p < 0.001) and lower DLCO values (HR 0.97, 95% CI 0.96–0.98, p < 0.001) were associated with inferior overall survival (Table 2). After correcting for imbalances in baseline characteristics, there was no difference in overall survival between surgery and SBRT (HR 1.20, 95% CI 0.74–1.95, p = 0.46).

3.4. Patterns of failure

Among the surgical cohort, 16 (11%) failed along the suture line and one patient failed elsewhere in the index lobe (two patients progressed at both the suture line and elsewhere in the involved lobe). Similarly, six (9%) SBRT patients failed within 2 cm of the GTV and one (1%) failed elsewhere in the index lobe. During the follow-up period, second primary lung cancers were diagnosed in 17% of patients.

Table 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Freedom from Local Recurrence</th>
<th>Overall Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBRT vs Sublobar resection</td>
<td>0.75 (0.22, 2.54) 0.65 1.2 (0.74, 1.9) 0.46</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.95 (0.91, 1.00) 0.053 1.01 (0.99, 1.04) 0.17</td>
<td></td>
</tr>
<tr>
<td>Female vs. Male</td>
<td>1.23 (0.49, 3.10) 0.66 0.71 (0.48, 1.03) 0.07</td>
<td></td>
</tr>
<tr>
<td>Body Mass Index</td>
<td>0.93 (0.84, 1.03) 0.15 0.99 (0.96, 1.03) 0.62</td>
<td></td>
</tr>
<tr>
<td>Charlson Comorbidity Index</td>
<td>1.15 (0.82, 1.61) 0.41 1.38 (1.19, 1.61) &lt; 0.0001</td>
<td></td>
</tr>
<tr>
<td>Current Smoker vs Never</td>
<td>N/A                           0.75 (0.21, 2.65) 0.66</td>
<td></td>
</tr>
<tr>
<td>Past Smoker vs Never</td>
<td>N/A                           1.16 (0.35, 3.81) 0.81</td>
<td></td>
</tr>
<tr>
<td>FEV1 % predicted</td>
<td>1.00 (0.98, 1.03) 0.80 1.01 (1.0, 1.02) 0.08</td>
<td></td>
</tr>
<tr>
<td>DLCO % predicted</td>
<td>0.98 (0.95, 1.01) 0.23 0.97 (0.96, 0.98) &lt; 0.0001</td>
<td></td>
</tr>
<tr>
<td>Tumor Size</td>
<td>1.30 (0.79, 2.19) 0.31 1.07 (0.87, 1.32) 0.55</td>
<td></td>
</tr>
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</table>

FEV1- forced expiratory volume in one second; DLCO- diffusing capacity for the lungs for carbon monoxide.
undergoing sublobar resection and 14% of patients receiving SBRT. Patterns of failure can be found in Table 3.

4. Discussion

This large single-institution study compared patients receiving sublobar resection and SBRT for stage I NSCLC. A detailed patterns of failure analysis and careful assessment of treatment-related complications was performed. Patients who underwent SBRT were significantly older, with higher comorbidity indices, and worse pulmonary function. They also had larger tumors with higher SUVmax values on PET staging, which has been shown in some studies to be associated with a higher risk of disease recurrence [14–16]. While we observed no significant differences in freedom from local recurrence or cancer-specific disease-free survival with either intervention. As expected, given differences in baseline characteristics and competing risks between surgical and nonsurgical cohorts, disease-free and overall survival using Kaplan-Meier analyses favored surgery. This is a consistent finding among retrospective analyses [9,10,17]. However, when corrected for imbalances in prognostic factors using multivariate analyses, no differences were noted between SBRT and sublobar resection for these clinical endpoints. Further, the incidence of complications after either sublobar resection or SBRT were nearly identical. These data suggest that sublobar resection and SBRT may lead to similar outcomes in a population of patients not suited for lobectomy.

When a lobectomy is feasible, we recommend that patients undergo surgery with mediastinal and hilar lymph node dissection. Recent consensus guidelines from the American Society of Radiation Oncology do not recommend SBRT in patients who are suitable for lobectomy [18]. Many patients, however, are not optimal candidates for lobectomy due to advanced age or comorbidities and often undergo sublobar resection. SBRT may be an attractive alternative in such patients leading to similar outcomes.

While several studies have compared SBRT to lobectomy or a combination of all forms of surgery [10,11,19–25], there is a relative paucity of data comparing SBRT to only sublobar resection, all of which are retrospective [9–11]. Grills et al previously analyzed 58 patients undergoing SBRT and 69 undergoing sublobar resection. Similar to our experience, patients receiving SBRT were significantly older and had higher comorbidity scores [9]. They found no significant difference between groups for regional recurrence (18% sublobar resection vs. 4% wedge, p = 0.07) and cause-specific survival (94% vs. 93%, p = 0.53). There was a trend towards significance in local recurrence favoring SBRT (20% vs 4% p = 0.07). They did note that scarring and fibrosis from SBRT may make it more difficult to detect local recurrence, but they used routine follow-up PET-CT in attempt to minimize its impact. They also saw a significant difference in overall survival favoring sublobar resection (87% vs. 72%, p = 0.01), likely due to competing risks of death in the non-surgical cohort.

Matsuo et al compared SBRT to sublobar resection for the treatment of stage I NSCLC [10]. One hundred and fifteen patients received SBRT and 65 underwent sublobar resection. They observed no treatment-related deaths in either group and patients undergoing sublobar resection had a significantly improved overall survival (p = 0.008). However, they did not see a significant difference in cause-specific survival (p = 0.427). After performing propensity score matching of 53 patients with similar ages, tumor sizes, comorbidity indices, and pulmonary function, they found no significant difference between the two groups (p = 0.124).

Finally, Bott et al performed a retrospective secondary analysis of three different multicenter studies to compare short-term morbidity and mortality in SBRT, sublobar resection, and radiofrequency ablation [11]. They compared 55 patients from RTOG 0236 (SBRT), 211 patients from ACOSOG Z4032 (sublobar resection), and 51 patients from ACOSOG Z4033 (radiofrequency ablation). While SBRT patients were older with larger tumors, they interestingly had better baseline pulmonary function compared to sublobar resection. While they found no difference in short-term mortality, they found a significantly higher incidence of grade 3+ events at 30 days in patients undergoing sublobar resection (28% vs. 9.1%, p = 0.004).

Stokes et al recently published a study using the National Cancer Database (NCDB) on post-treatment mortality after surgery and SBRT for early-stage NSCLC [26]. They identified all patients treated from 2004 to 2013 with either surgery (76,623 patients of which 20% received sublobar resection) or SBRT (8216 patients). Of the 15,189 patients receiving sublobar resection, 1.77% had died within 30 days of surgery compared to 0.73% with SBRT. This discrepancy greatly increased in older patients. Patients greater than 70 years of age undergoing sublobar resection experienced a 2.6% crude 30-day mortality compared to 0.79% for SBRT. All surgical approaches were associated with increased mortality on MVA.

There are several open phase III trials comparing surgery with SBRT for stage I NSCLC, including the Veterans Affairs Lung Cancer or Stereotactic Radiotherapy (VALOR) trial (NCT02984761), the SABRTooth study in the United Kingdom (NCT02629458), and the University of Texas Southwestern Medical Center-MATES trial (NCT02468024). Whereas VALOR and SABRTooth are looking at surgery more broadly and include lobectomy, STABLE-MATES seeks to compare only sublobar resection and SBRT. This trial requires all clinically suspicious mediastinal N1, N2, or N3 lymph nodes to be confirmed negative for involvement of NSCLC by lymph node biopsy, regardless of the treatment arm. The primary outcome is three-year overall survival, and estimated enrollment is 258 patients.

As with any retrospective analysis, our study has several limitations, including comparing populations with inherent different baseline characteristics and staging, challenges in scoring local failures as noted previously, and optimally capturing both acute and late side effects of treatment. One notable limitation of our study is that we did not include patients with clinical stage I NSCLC who underwent sublobar resection but were found to have occult hilar or mediastinal nodal involvement. Given significant baseline disparities in staging interventions (PET-CT, mediastinoscopy, etc.) between the surgical and SBRT cohorts, it was challenging to have confidence that the clinical stage would allow for objective analyses. We therefore utilized all clinical and pathological information to create two “stage I” cohorts. If anything, this introduces a pathological staging bias favoring surgery. Interestingly, even though fewer of the SBRT patients underwent nodal evaluation of any kind (31% compared to 89% in the surgical group), the SBRT group had a comparable rate of regional failure (7% SBRT compared to 14% sublobar resection). This was similarly reported by Grills et al [9]. This could be due to lower overall survival in the SBRT group due to competing risks which would underestimate the true risk of regional recurrence.

In the absence of robust randomized data to guide management, judicious clinical decision-making is needful when recommending...
either sublobar resection or SBRT for a patient with clinical stage I NSCLC deemed to be a marginal or poor operative candidate. Factors of particular relevance include age and performance status, baseline comorbidities, size and location of tumor, whether suspicious lymph nodes are apparent on imaging studies, and patient preference. Additional factors, including quantitative imaging applications, may eventually provide discriminatory information that may help in patient selection for different treatment modalities. In particular, radiomics – the transformation of high-throughput imaging data into computational biomarkers – has demonstrated highly promising results regarding SBRT failure rates and patient survival [27–32]. Radiomic features have been shown to be predictive of SBRT outcomes in cases where conventional imaging metrics (e.g., tumor volume, maximum tumor diameter, etc.) have been unsuccessful [27]. Of particular relevance to our study, Yu et al. developed and validated a CT-based predictive radiomic model for NSCLC by training on a surgical cohort and testing on an SBRT cohort [31]. They concluded that mortality risk indices can be predicted, potentially independent of treatment modality.

Conclusion

In conclusion, this study suggests that SBRT and sublobar resection provide similar rates of local tumor control and overall clinical outcomes in stage I NSCLC. Randomized trials will ultimately be required to optimally compare these two modalities.

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Conflicts of interest

There are no conflicts of interest to report for any authors. All authors have approved the final manuscript.

References


