graduation rates (OR 0.92, $p<0.001$) were also less likely to die within 30 days of their diagnosis.

Conclusion: Approximately 7% of newly diagnosed NSCLC patients have died within 30 days of their diagnosis over the past decade. The majority of these individuals (65%) present with stage IV disease. Increasing awareness about lung cancer screening programs, improvements in access to care, and better medical optimization especially for elderly patients with multiple comorbidities may help further reduce the rates of early mortality in NSCLC.

Author Disclosure: **A. Amini**: None. **S.M. Glaser**: None. **D. Akhavan**: None. **R. Li**: None. **R. Nelson**: None. **W.A. Stokes**: None. **M. Koczywas**: None. **K.L. Reckamp**: None. **R. Salgia**: None. **L.E. Gaspar**: Honoraria; NCI. member representing the ACR; American College of Surgeons. **B.D. Kavanagh**: Research Grant Janssen Research & Development. **C.G. Rusthoven**: None. **A.K. Liu**: None.

TU_25_3567

Measurements of Substance Densities of Non-Small Cell Lung Cancer Using Dual Energy Computed Tomography Are Useful for Prediction of Local Control and Overall Survival after Stereotactic Body Radiation Therapy

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Purpose/Objective(s): Stereotactic body radiotherapy (SBRT) is considered as an alternative treatment for medically inoperable patients with early-stage non-small cell lung cancer (NSCLC); however, 10−15% of these patients develop local recurrence after high-dose SBRT. Recently, dual-energy computed tomography (DECT) was introduced, and material densities (iodine, water, etc.) become measurable. Reduction in iodine density, suggesting a decrease in blood flow, may reflect hypoxic cell population in the tumor, and the hypoxic microenvironment plays a critical role in the development and progression of tumors. In contrast, the water density is presumed to reflect the cell density and necrosis of cancer cells, however, the study of water density regarding NSCLC is insufficient. The purpose of this study was to investigate impact to prognostic of water and iodine density assessed by DECT for NSCLC treated with SBRT.

Materials/Methods: From March 2011 to December 2017, 153 medically inoperable patients with primary NSCLC underwent DECT prior to SBRT of a total isocentric dose of 50−60 Gy in 5−6 fractions. The median patient age was 78 years (range, 52−91 years). DECT was taken for pretreatment evaluation. Regions-of-interest was set at the maximum cross-sectional diameter of the tumor, and average values of water and iodine density obtained by dedicated imaging software were evaluated with regard to overall survival (OS) rates and local control (LC) rates using Kaplan−Meier method. Cox proportional hazards model was applied for multivariate analysis.

Results: The median values of the average water and iodine density were 968.3 mg/cm^3 (range, 191.9−1036.1 mg/cm^3) and 1.86 mg/cm^3 (range, 0.12−5.52 mg/cm^3), respectively. There was no significant correlation between water density and iodine density. The median follow-up period was 24.6 months (range, 1.5−82.8 months). The 2-year OS rates for the water density in high and low groups were 82.0% and 89.2% (P = 0.011); the corresponding rates for the iodine density in high and low groups were 92.3% and 79.3% (P = 0.019), respectively. The 2-year LC rates for tumors according to the water density in high and low groups were 87.4% and 94.9% (P = 0.197); the corresponding rates according to the iodine density in high and low groups were 98.0% and 82.5% (P = 0.011), respectively. In multivariate analysis for OS, iodine and water density were selected as prognostic factors. In multivariate analysis for LC, iodine density was selected as prognostic factor.

Conclusion: The reduction of the water density had a significant positive impact on overall survival, and the reduction of the iodine density had a significant negative impact on overall survival and local control. Our preliminary results indicated that the water and iodine density assessed by DECT might be a useful, noninvasive and quantitative assessment as a prognostic indicator for NSCLC treated by SBRT. Further study is needed to confirm these results in larger population with longer follow-up.

Author Disclosure: **M. Aoki**: None. **Y. Hatayama**: None. **H. Kawaguchi**: None. **M. Sato**: None. **M. Tanaka**: None. **I. Fujioka**: None. **K. Ichise**: None. **K. Hirose**: None. **Y. Takai**: None.

TU_25_3568

Medically Inoperable Early-Stage Lung Cancer Treated with Stereotactic Ablative Radiation Therapy (SABR): Multicenter Study of Turkish Radiation Oncology Group (TROG)

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Purpose/Objective(s): To review treatment outcomes for SABR in medically inoperable early stage lung cancer (NSCLC) patients treated by Turkish Radiation Oncology Group (TROG) member centers.

Materials/Methods: Between 2009 and 2017, a total of 386 patients with NSCLC treated with SABR in 12 TROG centers. Patient, disease, and treatment related prognostic factors were analyzed. Primary endpoints were, overall survival (OS), progression free survival (PFS), local control (LC) and regional control (RC) and radiation-related toxicities.

Results: Median follow-up was 15 months. The median age at diagnosis was 72 years (43-93) and 79% were men. Median tumor size was 30 mm (5 - 78 mm). Seventy-two percent of the patients have histologically confirmed

Abstract TU_25_3568; Table 1 Prognostic factors affecting overall survival and recurrence

	Univariate	Multivariate
Local Control @ 3 years		
BED10 ≥90Gy	BED10 ≥90, 92% BED10 <90, %71 p=0.003	HR:3.6, 95% CI (1.3-9.9) p=0.011
Tumor Size (17mm)	≤17mm, 100% >17mm, 89% p=0.035	p=0.98
Histology (Squamous/ Adeno)	Adeno, 96% Squamous, 88% p=0.006	HR:2.2, 95% CI (1.2-4.0) p=0.008
PET/CT Response (Complete/Partial)	CR, 96% PR, 74% p<0.0001	HR:3.5, 95% CI (1.6-7.5) p=0.002
Regional Control @ 3 years		
Tumor Size (30mm)	≤30mm, 95.5% >30mm, 77.5% p=0.025	HR:2.1, 95% CI (1.1-4.2) p=0.028
PET/CT Response (Complete/Partial)	CR, 87% PR, 62% p<0.033	p=0.06
Overall Survival @ 3 years		
Tumor Size (28mm)	≤28mm, 69,6% >28mm, 59,8% p=0.009	HR:1.6;95% CI (1-2.5) p=0.03

Abbreviations: BED = Biological Effective Dose; HR = Hazard Ratio; CR = Complete Response; PR = Partial response.

diagnosis whereas 28% of patients were treated with clinical and radiological findings only without pathological diagnosis. Staging was as follows; T1N0 in 215, T2N0 in 166, T3N0 in 2 and T4N0 in 3 patients because of bilaterally tumors. Median SABR dose was 54Gy (30-70Gy), corresponding to a biological equivalent dose (BED) of 112Gy (48 - 180Gy) administered in median 5 (1-10) fractions. Response evaluation was made either with PET/CT or CT in median 3 months after SABR and complete response, partial response, stable disease and progression rates were 48%, 36%, 5.7% and 0.5%, respectively. The cumulative locoregional failure rate was 15%. Among these, 23 were local (6%) and 35 regional (9%) failures. Distant failure was reported in 67 (17%) patients. One to 3 years LC and RC rates were 97%, 91% and 93%, 86%, respectively. One and 3 years PFS and OS were 88%, 72% and 90%, 65%, respectively. At their last follow up 271 patients (71%) were alive. Prognostic factors associated with LC, RC and OS were summarized in table 1. No severe acute side effects were observed. Overall 18 patients experienced $\geq$ grade 3 pneumonitis, 11 patients had chest wall pain and 1 patient had rib fracture.

Conclusion: The results of this retrospective study have shown that SABR is a promising technique with satisfactory LC and OS rates and minimal toxicity in patients with medically inoperabl NSCLC.

Author Disclosure: **B. Atalar**: None. **E. Kaytan Saglam**: None. **Z. Akgun**: None. **U. Abacioglu**: None. **A. Arifoglu**: None. **B. Şahin**: None. **E. Ozyar**: None. **G. Yaprak**: None. **N. Ozseker**: None. **E. Kocak**: None. **S. Karaman**: None. **S. Igdem**: None. **U. Selek**: General Secretary & International Relationships Council Member; Turkish Society of Lung Cancer. International Relationships Council Member, Education Council Member; Turkish Society for Radiation Oncology. **H.F. Dincbas**: None. **M. Sengoz**: None. **S.B. Yucel**: None. **A.N. Demiral**: None. **S. Akyurek**: None.

TU_25_3569

Analysis of Changes in Dose Distribution due to Respiration in Stereotactic Body Radiation Therapy (SBRT) for Central Lung Tumors Abutting the Hilar Regions using 4D-CT and Evaluation of the Long-term Clinical Outcomes

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Purpose/Objective(s): Excessive toxicities have been reported among patients treated with stereotactic body radiotherapy (SBRT) for central lung tumors in or near the hilar regions. Respiratory motion affects the dose distribution of not only tumors but also organs at risk (OARs) in that region. Some dose constraints are advocated for OARs of the hilar region. However, they are based on planning CT for dose calculation. The purpose of this study was to analyze changes in dose distribution due to respiration in SBRT for central lung tumors abutting the hilar regions using 4D-CT, and also evaluate the changes in relation to the long-term clinical outcomes.

Materials/Methods: Five patients with lung tumors in or adjacent to the right hilar region were included. The prescribed dose was 60 Gy at the isocenter under shallow breathing in two, 57.6 Gy at the isocenter under respiratory gating in one, 57.6Gy at the isocenter under exhalation breath hold in one, and 48.9 Gy at the PTV D95 under exhalation breath hold in one. All doses were delivered in 6 fractions twice a week. Planning CT was performed under exhalation breath hold. 4D-CT images were reconstructed into 10 phases of the respiratory cycle. PTVs, fields and beam arrangements were determined on the planning CT, and were copied onto each 4D-CT image with the same isocenter. GTVs and OARs were delineated on each 4D-CT image. Dose distribution was recomputed on each 4D-CT using the monitor units identical to those on the planning CT. Dose-volume parameters of the GTVs and OARs on each 4D-CT were compared with those on planning CT in each patient.

Results: The ratios of GTV Dmax and GTV D95 to those of planning CT in all patients were 0.99-1.03 and 0.97-1.01, respectively. The ratios of the ipsilateral bronchus Dmax and D4cc in all patients were 0.94-1.03 and 0.78-1.25, respectively. The ratio of the ipsilateral bronchus D4cc of Patient 2 was 0.78-1.25 (mean: 1.06). The ratios of the hilar major vessels Dmax and D10cc in all patients were 0.97-1.01 and 0.55-2.33, respectively. The ratio of the hilar major vessels D10cc of Patient 2 was 1.00-2.33 (mean: 1.55). The ratios of the lung V20 in all patients were 0.96-1.21. The ratio of Patient 1 was 0.98-1.21 (mean: 1.08). The follow-up period for living patients was 24-57 months. Patient 2 died of radiation pneumonitis 5 months after treatment. Patient 1 had grade 2 chronic coughing. Patient 5 had grade 2 radiation pneumonitis 3 months after treatment.

Conclusion: The dose distributions varied with changes of the respiratory phase. The differences may occur between planning CT and 4D-CT. The doses to the GTV were maintained within an acceptable range. However, the doses to the OARs of the hilar region increased compared to the doses on planning CT in some cases. This might be one of the causes of toxicities.

Author Disclosure: **F. Baba**: None. **Y. Shibamoto**: None. **M. Iwana**: None. **K. Nomura**: None. **J. Nagayoshi**: None.

TU_25_3570

Predictive Model of Progression in Early Stage Non Small Cell Lung Cancer Treated with Stereotactic Ablative Radiation Therapy

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Purpose/Objective(s): There is an emerging interest for combining stereotactic ablative radiotherapy (SABR) with immunotherapy in the management of early stage non small cell lung cancer (ES-NSCLC). To help best select which patients may benefit from immunotherapy in future trials, we aimed to determine the predictive factors of progression free survival (PFS) and time to progression (TTP) in a large cohort of ES-NSCLC patients treated with SABR.

Materials/Methods: A retrospective analysis of patients with stage I–II NSCLC treated with SABR from 2004 to 2015 was conducted. SABR doses of 34-70 Gy in 1-10 fractions were delivered. Cox proportional hazard ratio models were used for analysis of potential predictive variables. The following variables were included in the model: patient age, gender, ECOG performance status, Charlson co-morbidity index, pre-treatment pulmonary function tests (percent forced expiratory volume in 1 second [%FEV1]) and percent diffusing lung capacity for carbon monoxide [%DLCO]), tumor stage, size, histology, location and maximum standardized uptake value (SUV_{max}) on FDG/PET. Variables with significant association with PFS and TTP in univariate analysis were used for subsequent recursive partitioning analysis (RPA) to identify appropriate cut-off points.

Results: A total of 912 patients with a median age of 72 years (range, 46-91) were included. Median follow-up was 59.3 months. Local recurrence, regional recurrence, distant metastasis and second primary lung cancer developed in 10.0%, 11.5%, 20.1% and 7.5% of patients, at a median time to recurrence of 14.9 months (range, 1.5–91.9), 10.5 months (range 1.4–70.7), 11.6 months (range, 0.2–91.9 months) and 23.6 months (range, 1.2–122.4), respectively. Actuarial 3- and 5-year PFS were 52.7% and 39.1%, and 3- and 5-year TTP were 72.2% and 66.7%, respectively. On univariate analysis, age ($p=0.0009$), ECOG ($p<0.0001$), Charlson score ($p=0.0001$), %DLCO ($p<0.0001$), %FEV1 ($p=0.007$), non-adenocarcinoma histology ($p<0.0001$), tumor size ($p=0.01$) and tumor SUV_{max} ($p=0.0002$) were associated with PFS, while %DLCO ($p=0.002$), tumor size ($p=0.002$) and tumor SUV_{max} ($p=0.01$) were associated with TTP.