nodal basin containing the gross nodal disease as well as the immediately adjacent nodal basins. Oligo-recurrence was defined as any volume of disease that could be safely treated within an involved field. Acute and late toxicity data was defined as any treatment related toxicity occurring ≤ 90 days and > 90 days following treatment, respectively. Toxicity was graded using Common Terminology Criteria for Adverse Events version 4.0. PSA response was defined as any decrease in the PSA following treatment. Local recurrence was defined as any new or growing lesion within the treatment field following treatment. Local control was calculated using the Kaplan-Meier method.

Results: The median pre-salvage PSA was 7.2 ng/ml. The median follow-up for all patients was 25 months (11 − 36 months). The most common acute side effect was grade 1 diarrhea (n = 7, 33%). Acute grade 2 GI toxicity occurred in 14% of patients (n = 3). Two patients had late low grade pelvic pain and 1 patient had late grade 2 lower extremity limb edema. There were no late grade 2+ GI side effects. No grade 3+ side effects occurred at any time following treatment. 88% of patients had a PSA response following treatment. The local control at 1 and 2 years was 100% and 94%, respectively.

Conclusion: With the widespread adoption of novel PET agents the group of patients with oligo-recurrent nodal disease is likely to increase significantly. The optimal combination of local and systemic therapy in this patient population is the subject of ongoing clinical investigation. With a favorable toxicity profile, high rates of local control and PSA response, involved field SBRT represents a feasible as well as convenient local therapy treatment option for an elderly patient population.

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A Prognostic Model for Patients With Oligometastatic Disease Treated With Stereotactic Body Radiation Therapy

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Purpose/Objective(s): Stereotactic body radiation therapy (SBRT) is an increasingly important modality in the management of patients with oligometastatic disease (OMD). Though prospective clinical trials have demonstrated the benefits of SBRT in a variety of oligometastatic settings, there is currently limited data to guide patient selection and provide long-term prognostic information for OMD patients. The purpose of this study was to create a clinical prognostic model for overall survival (OS) for OMD patients treated with SBRT.

Materials/Methods: A large, retrospective multi-institutional database of OMD patients treated with SBRT provided the data for model construction. Recursive partitioning analysis (RPA) was used to generate a prognostic model for OS that could account for complex interactions between baseline patient characteristics. The model was generated using a training set (75% of all samples) and internally validated using the reserved testing set. Model performance in the training and test sets were evaluated using log-rank tests, Harrell's C-statistic and time-dependent area under the receiver operating characteristics curve (AUC). All analyses were carried out in R.

Results: A total of 1,033 patients were included in the analysis. RPA for OS revealed three risk groups. The low-risk group consisted of younger (< 55) patients with favorable primary sites (hormone receptor/Her2-positive breast cancer, colorectal cancer or renal cell carcinoma) as well as any patient with a prostate cancer primary; the high-risk group consisted of patients with any other primary site who presented with non-pulmonary OMD within 24 months of the diagnosis of the primary disease; and the intermediate-risk group consisted of all other patients. The 5-year OS was 77.5 % (95% confidence interval: 63.1-91.9%), 32.3% (25.1-39.5%) and 12.1% (2.9-21.4%), respectively, for the low, intermediate and high-risk groups. Log-rank tests for difference in survival between the risk groups in both the training and test sets were highly significant ($P < 0.0001$). The model possessed good discriminative power with a C-statistic of 0.68 and time-dependent AUC of 0.72 in the training set, and there was an expected small reduction in these statistics in the test set (C-statistic: 0.65, AUC: 0.67).

Conclusion: An internally validated prognostic model for OS with good ability to distinguish between low, intermediate and high-risk OMD patients was generated. Subsequent external validation will be undertaken to demonstrate the robustness of this model to new data.

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Multi-Institutional Outcomes of Stereotactic Magnetic Resonance Image-Guided Adaptive Radiation Therapy (SMART) With Median Biologically Effective Dose of 100 Gy_{10} for Oligometastases

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Purpose/Objective(s): Randomized data show an overall survival (OS) benefit of stereotactic ablative body radiation therapy (SABR) in addition to chemotherapy (CT) in selected patients with oligometastasis (OM). While ablative dose can be safely delivered to some lesions, others in proximity to some organs at risk (OARs) such as bowel may be treated with non-ablative dose to limit toxicity. Stereotactic magnetic resonance image-guided adaptive radiation therapy (SMART) may facilitate the delivery of ablative dose for OM lesions, especially those adjacent to historically dose-limiting OARs, which may improve long-term disease control.

Materials/Methods: The RSSearch Registry was queried for OM patients (1-5 metastatic lesions) treated with SMART. Patients with < 3 months (mo.) follow-up after SMART were excluded. Local control (LC), freedom from distant progression (FFDP), progression free survival (PFS), and OS were estimated using the Kaplan-Meier method. LC was evaluated using RECIST 1.1 criteria. Acute toxicity was defined as within 90 days of SMART and evaluated using CTCAE v4 criteria.

Results: 101 patients with 114 OM lesions were treated on a 0.35T-MR Linac at 2 institutions between 2018-2020. Median age was 62 years (range 23-89), and 99% were ECOG 0-1 performance status. The primary tumor was definitively managed in 34.7%, most commonly in the lung (30.7%), colon/rectum (22.8%), cervix/uterus/ovary (13.9%), or breast (5.9%). About 50% received CT for OM prior to SMART. SMART was delivered to 1 (87.7%) or 2 (10.5%) lesions, mostly involving abdominal/pelvic lymph nodes (40.4%), liver (17.5%), lung (17.5%), or adrenal gland (11.4%). All were treated without fiducial markers and with real-time tissue tracking and automated beam gating, typically in breath hold. The median prescribed RT dose was 45 Gy (range 24-60Gy) in a median 5 fractions (range 3-15). The median biologically effective dose (BED_{10}) was 100 Gy_{10} (range 41.4-180). The median PTV was 14.5 cm^3 (range 1.5-567.8). Median follow-up was 10 months (range 3-25) from SMART. One-year LC, FFDP, PFS, and OS were 88%, 38.2%, 36.1%, and 90.6%, respectively. Median PFS and OS were 9 months and not reached, respectively. No acute/late grade 3+ toxicities were recorded.

Conclusion: To our knowledge, this represents the largest analysis of SMART for OM. A median prescribed BED_{10} of 100 Gy_{10} resulted in excellent early LC and no significant toxicity, likely facilitated by continuous intrafraction MR visualization, breath hold delivery, and online adaptive replanning. These outcomes are noteworthy given the predominance of OM, especially LNs, treated with dose escalation in proximity to gastrointestinal OARs; such lesions are notably underrepresented in SABR OM trials. Prospective evaluation of dose-escalated SMART for OM is warranted.

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Hypofractionated Radiation Therapy for Unresectable or Metastatic Sarcoma Lesions Provides Durable Tumor Control and Effective Palliation

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Purpose/Objective(s): Given the relative radioresistance of sarcomas and their often large size, conventional palliative radiation therapy (RT) provides limited tumor control and poor symptom relief. In select patients that warranted dose-escalated treatment, we have used hypofractionated (HF) RT as a strategy to affect durable control of targeted lesions. We evaluated this treatment approach in a sarcoma cohort.

Materials/Methods: We retrospectively reviewed 73 consecutive patients with sarcoma who received > 10 fractions of HFRT from 2017-2020. Clinical scenarios included: 1) palliative intent (34%), 2) an unresectable primary (27%), 3) or oligometastatic (16%) or 4) oligoprogressive (23%) disease.

Results: The median follow-up was 9 months (m) (interquartile range [IQR] 5-13). The HFRT target was a primary tumor in 64% of patients. Most tumors were of soft tissue origin (73%) and the median target size was 7cm (IQR 4-12). Prior to HFRT, most tumors were radiographically progressing (77%). The median HFRT dose to the GTV was 45 Gy (IQR 42-45) over a median of 15 once daily fractions with 59% of patients receiving ≥45 Gy. For 27% of cases, heterogeneity of dose was planned to increase the central tumor to a median of 52.5 Gy (IQR 48-52.5). The 1-year DSS was 59%, which was more favorable for patients receiving HFRT for oligometastatic (1-y 100%) or oligoprogressive (1-y 73%) disease ($P = 0.001$). The 1-y targeted lesional control (TLC) was 73% with 26% developing progression at a median time of 7.5 m (IQR, 5.5-13). A metastatic target (1-y 95% vs 60% primary, $P = 0.02$; HR 0.27, $P = 0.04$) and soft tissue origin (1-y 78% vs 61% bone, $P = 0.01$; HR 0.33, $P = 0.02$) were associated with better TLC on univariate and multivariable analyses. The rate of distant failure was high with a 6-month DMFS of only 43%. HFRT use for unresectable ($P < 0.001$, HR 0.14) and oligometastatic ($P = 0.003$, HR 0.25) disease were the only factors associated with improved DMFS on multivariable analysis. For patients not planned for adjuvant systemic therapy (n = 53), the median systemic therapy break was 9 m (IQR, 4-23), and notably longer in oligometastatic (13 m), oligoprogressive (12 m) or unresectable (13 m) disease. HFRT provided palliative relief in 95% of cases with symptoms. It was well tolerated; 49% of patients developed acute G1/2 RT toxicities (no acute grade 3-5), most commonly a pain flare (36%). No late grade 2-5 toxicities were observed.

Conclusion: HFRT is an effective treatment strategy for patients with unresectable or metastatic sarcoma to provide durable TLC, symptom relief, and meaningful systemic therapy breaks with limited toxicity. Patients with unresectable or oligo-metastatic/progressive disease benefited from longer systemic therapy breaks and lower rates of distant relapse. If overall disease control is the primary goal for HFRT, patient selection remains crucial as distant relapse is high.

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Optimal Timing of SBRT for Treatment of Oligometastatic Disease: A Single Institution Retrospective Analysis

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Purpose/Objective(s): There is mounting evidence that curative-intent stereotactic body radiation therapy (SBRT) may improve overall survival (OS) in patients with oligometastatic disease. However, the optimal sequencing and timing of radiation in this setting remains unclear. Delaying SBRT in favor of upfront systemic therapy can reduce tumor burden whilst allowing for the oligometastatic state to declare itself. However, there is also data to suggest that early upfront SBRT may confer a survival benefit. In this study, we explored the optimal timing of SBRT in the setting of oligometastatic disease.

Materials/Methods: Patients who were initially diagnosed from 1991-2018 at a single institution and treated with curative intent SBRT to ≤5 extracranial metastatic lesions were included in this study. All primary tumor locations and histologies were included. Chi-squared and Wilcoxon rank-sum tests were used to compare clinical and demographic data. Variables associated with improved OS were examined using univariate and multivariate Cox proportional hazards models.