MR-guided stereotactic ablative body radiotherapy (MRgSABR) in thoracic tumours

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INTRODUCTION

Stereotactic-ablative body radiotherapy (SABR) is an effective modality for early-stage lung cancer and thoracic metastases (1-3). However, target motion, central or ultra-central location and respiratory comorbidity pose an obstacle for optimal doses with acceptable toxicity (4).

MR-guided-SABR (MRgSABR) provides real-time tracking, beam-gating and daily adaptation based on the tumour or organs at risk (OAR), allowing higher doses compared to conventional SABR. This may improve local control (LC), progression-free survival (PFS), and overall survival (OS) while applying an isotoxic approach, expanding the therapeutic options.

MATERIALS/METHODS

This retrospective study aims to investigate a single-institution experience of the **safety and efficacy of MRgSABR in thoracic lesions** with primary lung histology in terms of toxicity and clinical outcomes. In addition, the change in PTV V(100%) and PTVHigh V(100%) between predicted and reoptimized MRgSABR plans was compared to quantify if there was any **dosimetric benefit of daily adaption**.

Eligibility for MRgSABR was based on risk factors that make the treatment delivery challenging or could predispose to potentially greater toxicity from conventional-SABR following MDT review.

Prior to each fraction, target, and critical OAR contours were adjusted and a reoptimized plan created. Treatment was delivered using respiratory gating with repeated breath-holds under continuous MR-guidance (MRIdian Linac, ViewRay Systems).

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- **33 patients (50 lesions)** with lung cancer histology (***Table 1 summarises patients' characteristics***)
- Risk-adapted dose fractionation schemes were prescribed so PTV V(100%) = 95%
- PTVHigh was defined as PTV - (OARs with 3-5 mm margin)
- UK SABR Consortium OAR constraints were used (5)
- Median dose was **50Gy (range 30-60 Gy) in 3-8 fractions**

Risk-factors included:

- Central/ultra-central location (n=38) ***(Figures 1 and 2)***
- Prior thoracic-radiotherapy (n=15)
- Multiple synchronous lesions (n=10)
- Lung resection history (n=18)
- Respiratory-comorbidity (n=6)

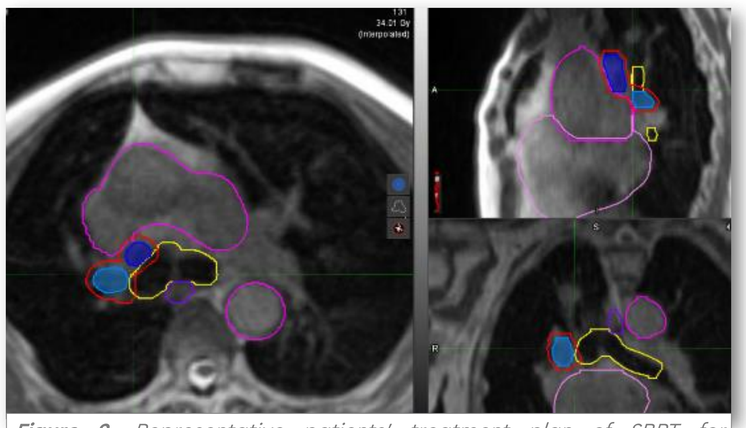

Figure 2. *Representative patients' treatment plan of SBRT for ultracentral mediastinal nodes. The overlap with PBT (yellow), great vessels (pink) and oesophagus (purple) is shown.*

RESULTS

- Daily-adaptation resulted **all OAR dose constraints being met** and a median increase in PTV V(100%) of 2.7% (-15.3 – 34.8%) and PTVHigh V(100%) of 3.7% (-4.0 – 39.6%). Notably PTV coverage was reduced in some cases to ensure OAR constraints were achieved.
- With a median follow-up of 8.5 months (range 2 – 38 months), LC (in-field) was 86% and OS was 69%
- 6% had G2 acute toxicities. There were no G3-5 acute or late G2+ toxicities.
- 6-month PFS 63%, 6-month in-field PFS 94%. Median time to progression was 3 months (range 1 – 16 months).
- ***Figure 3*** shows the progression pattern and ***figure 4*** shows the rates of response by treated lesions.

CONCLUSION

Lung MRgSABR demonstrates **encouraging LC with limited toxicity**, widening the therapeutic window for challenging cases in critical anatomical locations, re-treatments, and respiratory-comorbidities. Adaptive treatment ensures the accumulated dose does not exceed critical OAR constraints and permits optimal PTV coverage. In our study, the median time to progression was short reflecting the number of patients with oligoprogression/oligorecurrence. MRgSABR can be used to delay systemic therapy but the effective use of MRgSABR with systemic treatment will likely result in the longest time to event outcomes for patients. A prospective study is in development.

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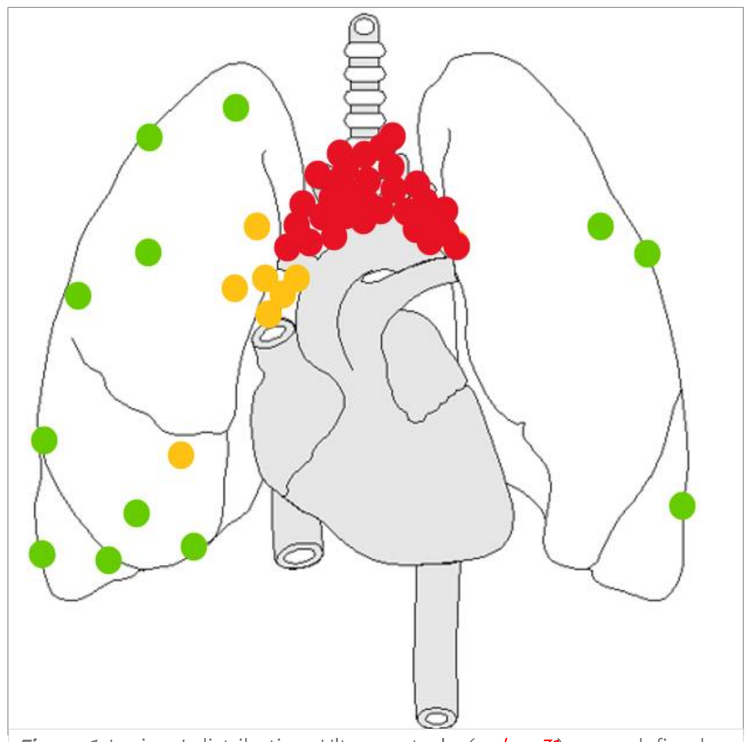


Figure 1. Lesions' distribution. Ultra-centrals *(red--n 31)* were defined as PTV overlapping the proximal bronchial tree (PBT), oesophagus or great vessels. Centrals (*yellow– n 7*) were defined as tumour within or touching 2 cm around PBT or adjacent to mediastinal/pericardial pleura. Peripheral lesions are highlighted in *green (n=12).*

Table 1. Demographic and dosimetric parameters

Patients (lesions)	33 (50)
Age, median (range)	70 (46 – 90)
Sex, n (%)	
Male	13/33 (39%)
Female	20/33 (61%)
Primary lung, n (%)	12 (24%)
Mets, n (%)	38 (76%)
Diagnosis, n (%)	
PET-CT	33 (100%)
Biopsy	18 (55%)
Histology, n (%)	
NSCLC	24 (73%)
SCLC	5 (15%)
Mesothelioma	3 (9%)
No histology-proven	1 (3%)

Figure 3. Progression pattern for all cases

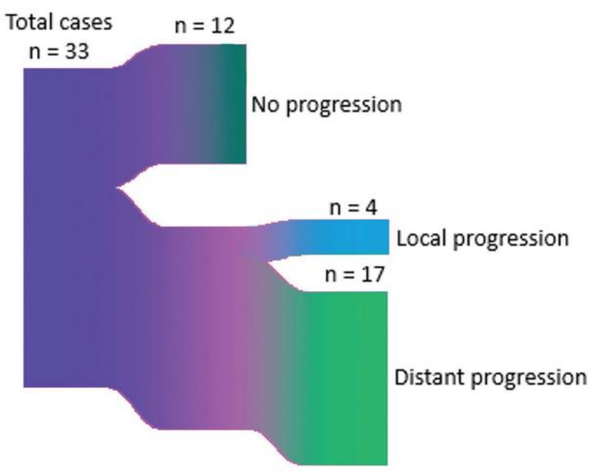
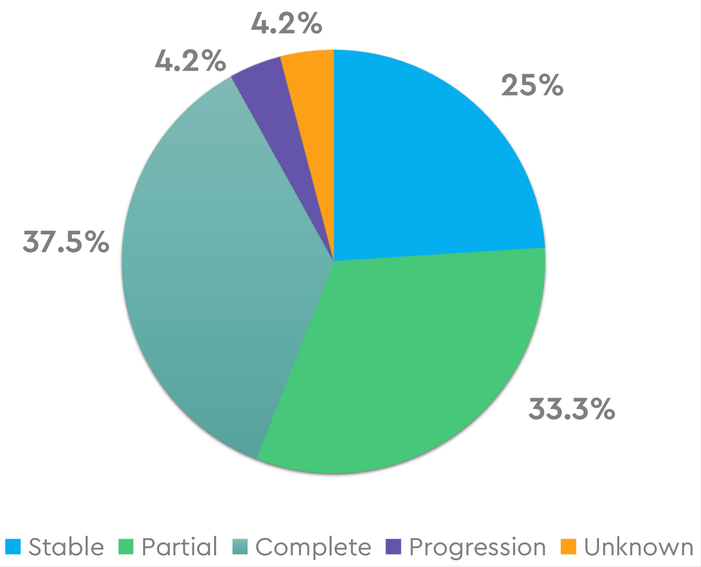


Figure 4. Response by treated lesions



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