East of England Radiotherapy Network:

Lymph Node Stereotactic Ablative Radiotherapy (SABR) protocol V2.0

Contents

1.0 Indications and patient population

This protocol covers treatment in the following situation: patients with metachronous oligometastatic disease meeting the NHSE criteria outlined below, and with at least one lymph node metastasis.

1.1 Treatment eligibility

1.1.1a Inclusion criteria

As per NHS England commissioning document:

- Confirmed histological diagnosis of cancer (haematological malignancies excluded)
- Metachronous disease, with a disease-free interval between primary treatment and manifestation of metastases of at least 6 months
- 1-3 sites of extracranial disease only at the time of disease presentation, confined to one or two of the following organs: bone, spine, lymph nodes, liver, lungs, adrenals
- Maximum of 2 vertebral metastases
- Maximum size of 5 cm for any single metastasis
- Life expectancy of more than 6 months
- WHO Performance Status 0-2

1.1.b Exclusion criteria

As per NHS England commissioning document:

- Haematological malignancies
- Evidence of intracranial disease
- For spine metastases, evidence of spinal cord compression or spinal instability
- For lung metastases, evidence of severe interstitial lung disease
- For liver metastases, poor liver function/Child-Pugh score B
- More than 3 sites of metastatic disease, **or** development of new metastases post treatment of a maximum of 3 lesions
- Patients who require irradiation of a whole nodal field
- Previous SABR to the same site of metastatic disease

1.1.c Essential Pre-Radiotherapy investigations for patients

Patients should have whole body imaging within 6 weeks of MDT discussion, confirming eligibility for SABR.

2.0 Localisation

Localisation	Notes	
Position	Need for patient positioning and immobilisation methods will depend on the site being treated, and should be discussed prior to the CT localisation appointment, to ensure adequate equipment is available.	
Arm/ leg/ head/ thorax position	As above	
Immobilisation and supports	Abdominal compression or other respiratory dampening techniques (such as breath-hold) should be considered for patients where breathing motion may affect the target (e.g. upper abdominal lymph nodes)	Oral preparation (fasting, proton pump inhibitors, water as CT contrast agent) may be needed if compression used
Organ pre-requisites	Bladder or bowel preparation may be used if nodes are near more mobile parts of the bowels. Rectal max diameter ≤4cm Fasting techniques may be considered if nodes near stomach	
Contrast	I.V. contrast is recommended where the lymph node target is close to the corresponding blood vessels, and in selected cases to aid OAR delineation (e.g. brachial plexus)	
CT acquisition	Slice thickness: 1-2 mm for nodes outside the thorax; 2-3 mm for nodes inside the thorax. Scanning limits: At least 10cm superior and inferior to expected PTV.	

Localisation	Notes	
	If part of the liver, kidney, spleen, or lung is likely to receive a clinically significant dose then the entire organ needs to be included in the scan. If multiple metastases that impact on the same organ at risk are being treated, then ONE scan should be taken that covers ALL areas in order that a composite plan can be created For thoracic and upper abdominal lymph node metastases, an additional 4D CT planning scan may be needed	
Additional imaging	Additional dedicated planning scans will usually not be necessary, although a dedicated planning MRI may help with GTV delineation in selected cases. Fusion of diagnostic PET images may also help with GTV delineation, and therefore should be considered, where available.	

3.0 Dose prescription & chemotherapy

Intent	Dose (Gy)/#	#/week	Chemo/ comments
a. Pelvic and lower abdominal nodes	30-40	3	No prior irradiation
	30-40	5	For selected patients where the target is very close to critical organs at risk, or there has been prior irradiation close to target
b. Upper abdominal nodes	30 - 40	5	Dose depends on proximity to OARs and any previous radiotherapy
c. Thoracic nodes	30 - 40	3 - 5	Depends on location in chest, proximity to OARs and previous radiotherapy

4.0 Target volumes

The volumes will be outlined according to local protocols and with reference to The Global Harmonisation Group descriptions.

4.1 3D scanned GTV/CTV/ PTV

- **GTV_3D = all** visible disease as defined on CT, and any additional imaging.
- **CTV _3D**= GTV_3D with no margin in most cases. If there is uncertainty regarding the extent of the tumour on available imaging, or if there is extra-capsular tumour extension, then a CTV margin of up to 5mm can be added to the GTV.
- **PTV** = CTV_3D + 0.5cm.

4.2 4D Scanned (thoracic/ upper abdominal nodal metastases) GTV/ CTV/ PTV

- A 4D GTV is created using the 4DCT dataset.
- **GTV_4D** = all visible disease, covered in all phases of the breathing cycle.
- **CTV_4D** = GTV_4D with no margin in most cases (see 4.1 above)
- **PTV** = CTV_4D + 0.5cm

Note: These are the minimum allowable PTV margins. Larger margins may be used at the clinical oncologist's/local department's discretion where there is more uncertainty in set-up, tumour motion etc.

5.0 Organs at risk

- Aim for the use of standard nomenclature as per Global Harmonization Group consensus guidelines: https://www.thegreenjournal.com/action/showPdf?pii=S0167-8140%2820%2930294-2 and the report of the AAPM TG 263
- All organs at risk will be contoured on the 3D planning CT.
- The required organs at risk will depend on the site to be treated.
- Generally, any OARs within 3cm sup-inf from the maximum extent of the PTV will need to be outlined.
- Parallel organs such as lungs, liver and kidney need to be outlined in their entirety.
- Spinal canal should be outlined in all cases.
- When treating lymph nodes very close to the spinal canal then spinal cord/cauda equina should also be outlined using the fused MRI images if available.

5.1 Constraints

		3 Fractions		5 Fractions	
		Objective	Constraint	Objective	Constraint
PTV	V100%	≥95%	-	≥95%	-
	D95%	100%	-	100%	-
	D0.1cc	130-140%	110-140%	130-140%	110-140%
Conformity Index (V100% / PTV V100%)	PTV ≤ 20cc	≤ 1.25 (ideal 1.2)	≤ 1.40	≤ 1.25 (ideal 1.2)	≤ 1.40
	PTV 20-40cc	≤ 1.20 (ideal 1.1)	≤ 1.30	≤ 1.20 (ideal 1.1)	≤ 1.30
	PTV ≥ 40 cc	≤ 1.15 (ideal 1.1)	≤ 1.20	≤ 1.15 (ideal 1.1)	≤ 1.20
Modified Gradient Index (V50% /PTV V100%)	PTV ≤ 20cc	≤ 7.5 (ideal 5.5)	≤ 9.5	≤ 7.5 (ideal 5.5)	≤ 9.5
	PTV 20-40cc	≤ 6.0 (ideal 4.5)	≤ 7.5	≤ 6.0 (ideal 4.5)	≤ 7.5
	PTV ≥ 40cc	≤ 5.5 (ideal 4.5)	≤ 6.5	≤ 5.5 (ideal 4.5)	≤ 6.5
BrachialPlex_L BrachialPlex_R	D0.1cc	-	≤24Gy	≤30.5Gy	≤32Gy
Heart+A_Pulm	D0.1cc	≤26Gy	≤30Gy	≤29Gy	≤38Gy
Lungs (non-lung lesions)	V20Gy	≤10%	≤15%	≤10%	≤15%

		3 Fractions		5 Fractions	
		Objective	Constraint	Objective	Constraint
	Dmean	≤8Gy	-	≤8Gy	-
Chestwall_L, Chestwall_R	D0.1cc	≤36.9Gy	-	≤43Gy	-
	D30cc	≤30Gy	-	-	-
GreatVes (Great Vessels)	D0.1cc	-	≤45Gy	-	≤53Gy
Trachea and Proximal bronchial tree	D0.1cc		≤30Gy	≤35Gy	≤38Gy
SpinalCanal (inc. medulla)	D0.035cc	-	≤20.3Gy	-	≤25.3Gy
CaudaEquina	D0.035cc	-	≤24Gy	-	≤32Gy
	D5cc	-	≤21.9Gy	-	≤30Gy
LumbSacPlex_L, LumbSacPlex_R	D0.1cc	≤24Gy	-	≤32Gy	-
	D5cc	≤22.5Gy	-	≤30Gy	-
Duodenum	D0.1cc	-	≤22.2Gy	≤33Gy	≤35Gy
	D10cc	-	≤11.4Gy	≤25Gy	-
Stomach	D0.1cc	-	≤22.2Gy	≤33Gy	≤35Gy
	D10cc	-	≤16.5Gy	≤25Gy	-
	D50cc	-	-	≤12Gy	-
Bowel_Small	D0.1cc	-	≤25.2Gy	≤30Gy	≤35Gy
	D5cc	-	≤17.7Gy	-	-
	D10cc	-	-	≤25Gy	
Oesophagus	D0.1cc	-	≤25.2Gy	-	≤35Gy
Bowel_Large	D0.1cc	-	≤28.2Gy	-	≤38Gy
Rectum	D0.1cc	-	≤28.2Gy	-	≤38Gy
Liver (non-liver lesions)	Dmean	≤13Gy	≤15Gy	≤13Gy	≤15.2Gy
	V10Gy	-	-	≤70%	-
	D(VTOT-700cc)+	≤15Gy	≤17Gy	≤15Gy	- -
Kidney_Cortex_L, Kidney_Cortex_R,	Dmean	≤8.5Gy	-	≤10Gy	-
KidneyCortex ((combined kidney cortices)	D(VTOT-200cc)+	-	≤16Gy	-	≤17.5Gy
If solitary **Kidney** or if one **Kidney** mean dose ≥optimal constraint	V10Gy[$]	-	≤33%	≤10%	≤45%
Spleen *	Dmean	10Gy	-	10Gy	-
Bladder	D0.1cc	-	≤28.2Gy	-	≤38Gy
Ureter_L Ureter_R	D0.1cc	-	≤40Gy	-	-

		3 Fractions		5 Fractions	
		Objective	Constraint	Objective	Constraint
Urethra	D0.1cc	report			
Testes, Genitals		Avoid beam entry; dose as low as possible			
SkinRind (the 5mm rind within Skin contour)	D0.1cc	≤33Gy	-	≤39.5Gy	-
	D10cc	≤30Gy	-	≤36.5Gy	-
Femur_HeadNeck_L, Femur_HeadNeck_R (Femoral Heads)	D10cc	≤21.9Gy	-	≤30Gy	-

OAR dose constraints as per UK 2022 Consensus publication.

*Splenic constraint is based on recent RCR recommendation.

[+] Cold constraint (V_{TOT} – xcc) is the total volume of organ minus a specified volume).

[$] Of the kidney receiving the lower dose.

6.0 Planning process/ technique

- All patients will be treated using Volumetric Modulated Arc Radiotherapy (VMAT).
- 100% of the dose will be prescribed to at least 95% of the PTV (i.e. DX%=100% where X is ≥95%). Aim to increase PTV coverage (with the prescribed dose) above 95%, while still achieving OAR constraints AND conformity index/modified gradient index objectives.
- For patients with two or more sites for SABR whose dosimetry impacts on the same organs, the total combined doses to these organs must be within the constraints - a composite plan will be created for retreatment or treatments near previously treated areas the dose given previously must be taken into account. For spinal cord tolerance the method described by Sahgal is recommended. This states that the maximum cumulative dose to the thecal sac should not exceed a BED of 140Gy (α/β=2Gy).
- All plans will be approved by the clinical oncologist.

7.0 Peer Review/ Contour QA

- Prospective peer review of target and OARs by a second Oncologist with SABR experience is strongly recommended. A description of the contouring (planning note) and of the peer review process including changes made should be saved in the patient record.
- The peer review process and outcomes should be audited.

8.0 Target verification

Modality	Frequency	Match point	Additional information
CBCT **FBCT**	Daily*	Soft tissue	Consider 4DCBCT for intra-thoracic nodes Smaller nodes may be difficult to visualise so may need matching to other nearby fixed anatomies *Pre and post treatment CBCTs may be taken as required

9.0 Side effects

Please consult side effect information available in protocols relevant to the body site being treated.

9.1 Possible early or short-term side-effects	
	Initial Management (if appropriate)
Fatigue	
Skin reaction	Standard post-radiotherapy skincare
Pain flare	May need short term increase in analgesia
Bowel toxicity or sickness (for abdo/pelvic treatments	

9.2 Possible late or long-term side-effects	
	Initial Management (if appropriate)
Bowel toxicity (for abdo/pelvic treatments	

10.0 References

Clinical Commissioning Policy Stereotactic ablative radiotherapy (SABR) for patients with metachronous extracranial oligometastatic cancer (all ages) (URN: 1908) [200205P]; March 2020. 1908-cc-policy-sbar-for-metachronous-extracranial-oligometastatic-cancer.pdf (england.nhs.uk)

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Center for Innovation in Radiation Oncology; Contouring atlases, templates, and tools. NRG > About Us > Center for Innovation in Radiation Oncology (nrgoncology.org)

Diez P et al (May 2022). UK 2022 Consensus on normal tissue dose-volume constraints for oligometastatic, primary lung, and hepatocellular carcinoma Stereotactic Ablative Radiotherapy. *Clinical Oncology* **34** (2022), 288-300. UK 2022 Consensus on Normal Tissue Dose-Volume Constraints for Oligometastatic, Primary Lung and Hepatocellular Carcinoma Stereotactic Ablative Radiotherapy - Clinical Oncology (clinicaloncologyonline.net)

Incidental irradiation of the spleen - RCR guidance | The Royal College of Radiologists. https://www.rcr.ac.uk/our-services/all-our-publications/clinical-oncology-publications/incidental-irradiation-of-the-spleen-rcr-guidance/

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12.0 Amendment History

A record of changes in this document

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