

Exercitation: SBRT planning

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Exercitation: SBRT planning

- Two cases: Lung and Liver
 - Used in two multicentric intercomparison studies promoted by Italian Association of Medical Physics AIFM
- 1) Normal tissue constraint should always be respected
 - 2) Use Homogeneous vs inhomogeneous dose distribution in to the target

Normal Tissue dose constraints

Serial tissue	Max critical volume above threshold	One fraction		Three fractions		Five fractions		End point (≥Grade3)
		Threshold dose (Gy)	Max point dose (Gy) ^a	Threshold dose (Gy)	Max point dose (Gy) ^a	Threshold dose (Gy)	Max point dose (Gy) ^a	
Optic pathway	<0.2 cc	8	10	15.3 (5.1 Gy/fx)	17.4 (5.8 Gy/fx)	23 (4.6 Gy/fx)	25 (5 Gy/fx)	Neuritis Hearing loss
Cochlea			9		17.1 (5.7 Gy/fx)		25 (5 Gy/fx)	Cranial neuropathy
Brainstem (not medulla)	<0.5 cc	10	15	18 (6 Gy/fx)	23.1 (7.7 Gy/fx)	23 (4.6 Gy/fx)	31 (6.2 Gy/fx)	Myelitis
Spinal cord and medulla	<0.35 cc	10	14	18 (6 Gy/fx)	21.9 (7.3 Gy/fx)	23 (4.6 Gy/fx)	30 (6 Gy/fx)	
	<1.2 cc	7		12.3 (4.1 Gy/fx)		14.5 (2.9 Gy/fx)		
Spinal cord subvolume (5–6 mm above and below level treated per Ryu)	<10% of subvolume	10	14	18 (6 Gy/fx)	21.9 (7.3 Gy/fx)	23 (4.6 Gy/fx)	30 (6 Gy/fx)	Myelitis
Cauda equina	<5 cc	14	16	21.9 (7.3 Gy/fx)	24 (8 Gy/fx)	30 (6 Gy/fx)	32 (6.4 Gy/fx)	Neuritis
Sacral plexus	<5 cc	14.4	16	22.5 (7.5 Gy/fx)	24 (8 Gy/fx)	30 (6 Gy/fx)	32 (6.4 Gy/fx)	Neuropathy
Esophagus ^b	<5 cc	11.9	15.4	17.7 (5.9 Gy/fx)	25.2 (8.4 Gy/fx)	19.5 (3.9 Gy/fx)	35 (7 Gy/fx)	Stenosis/fistula
Brachial plexus	<3 cc	14	17.5	20.4 (6.8 Gy/fx)	24 (8 Gy/fx)	27 (5.4 Gy/fx)	30.5 (6.1 Gy/fx)	Neuropathy
Heart/pericardium	<15 cc	16	22	24 (8 Gy/fx)	30 (10 Gy/fx)	32 (6.4 Gy/fx)	38 (7.6 Gy/fx)	Pericarditis
Great vessels	<10 cc	31	37	39 (13 Gy/fx)	45 (15 Gy/fx)	47 (9.4 Gy/fx)	53 (10.6 Gy/fx)	Aneurysm
Trachea and large bronchus ^b	<4 cc	10.5	20.2	15 (5 Gy/fx)	30 (10 Gy/fx)	16.5 (3.3 Gy/fx)	40 (8 Gy/fx)	Stenosis/fistula
Bronchus-smaller airways	<0.5 cc	12.4	13.3	18.9 (6.3 Gy/fx)	23.1 (7.7 Gy/fx)	21 (4.2 Gy/fx)	33 (6.6 Gy/fx)	Stenosis with atelectasis
Rib	<1 cc	22	30	28.8 (9.6 Gy/fx)	36.9 (12.3 Gy/fx)	35 (7 Gy/fx)	43 (8.6 Gy/fx)	Pain or fracture
	<30 cc			30.0 (10.0 Gy/fx)				
Skin	<10 cc	23	26	30 (10 Gy/fx)	33 (11 Gy/fx)	36.5 (7.3 Gy/fx)	39.5 (7.9 Gy/fx)	Ulceration
Stomach	<10 cc	11.2	12.4	16.5 (5.5 Gy/fx)	22.2 (7.4 Gy/fx)	18 (3.6 Gy/fx)	32 (6.4 Gy/fx)	Ulceration/fistula
Duodenum ^b	<5 cc	11.2	12.4	16.5 (5.5 Gy/fx)	22.2 (7.4 Gy/fx)	18 (3.6 Gy/fx)	32 (6.4 Gy/fx)	Ulceration
	<10 cc	9		11.4 (3.8 Gy/fx)		12.5 (2.5 Gy/fx)		
Jejunum/ileum ^b	<5 cc	11.9	15.4	17.7 (5.9 Gy/fx)	25.2 (8.4 Gy/fx)	19.5 (3.9 Gy/fx)	35 (7 Gy/fx)	Enteritis/obstruction
Colon ^b	<20 cc	14.3	18.4	24 (8 Gy/fx)	28.2 (9.4 Gy/fx)	25 (5 Gy/fx)	38 (7.6 Gy/fx)	Colitis/fistula
Rectum ^b	<20 cc	14.3	18.4	24 (8 Gy/fx)	28.2 (9.4 Gy/fx)	25 (5 Gy/fx)	38 (7.6 Gy/fx)	Proctitis/fistula
Bladder wall	<15 cc	11.4	18.4	16.8 (5.6 Gy/fx)	28.2 (9.4 Gy/fx)	18.3 (3.65 Gy/fx)	38 (7.6 Gy/fx)	Cystitis/fistula
Penile bulb	<3 cc	14	34	21.9 (7.3 Gy/fx)	42 (14 Gy/fx)	30 (6 Gy/fx)	50 (10 Gy/fx)	Impotence
Femoral heads (right and left)	<10 cc	14		21.9 (7.3 Gy/fx)		30 (6 Gy/fx)		Necrosis
Renal hilum/vascular trunk	<2/3 volume	10.6	18.6 (6.2 Gy/fx) →			23 (4.6 Gy/fx)		Malignant hypertension

Parallel tissue	Minimum critical volume below threshold	One fraction		Three fractions		Five fractions		End point (≥Grade 3)
		Threshold dose (Gy)	Max point dose(Gy) ^a	Threshold dose(Gy)	Max point dose(Gy) ^a	Threshold dose(Gy)	Max point dose(Gy) ^a	
Lung (right and left)	1500 cc	7	NA-Parallel tissue	11.6 (2.9 Gy/fx)	NA-Parallel tissue	12.5 (2.5 Gy/fx)	NA-Parallel tissue	Basic lung function
Lung (right and left)	1000 cc	7.4	NA-Parallel tissue	12.4 (3.1 Gy/fx)	NA-Parallel tissue	13.5 (2.7 Gy/fx)	NA-Parallel tissue	Pneumonitis
Liver	700 cc	9.1	NA-Parallel tissue	19.2 (4.8 Gy/fx)	NA-Parallel tissue	21 (4.2 Gy/fx)	NA-Parallel tissue	Basic liver function
Renal cortex (right and left)	200 cc	8.4	NA-Parallel tissue	16 (4 Gy/fx)	NA-Parallel tissue	17.5 (3.5 Gy/fx)	NA-Parallel tissue	Basic renal function

^a“Point” defined as 0.035 cc or less.

^bAvoid circumferential irradiation.

Lung

- Dose Prescription (1): **18x3 Gy** at **80%** Isodose Line (dose up to 120% in the PTV are allowed) at **PTV (ITV)**
- Dose Prescription (2): **18x3 Gy** at **90%** Isodose Line (dose up to 110% in the PTV are allowed) at **PTV (ITV)**
- Dose Prescription (3): **10x5 Gy** at **80%** Isodose Line (dose up to 120% in the PTV are allowed) at **PTV (ITV)**
- Dose Prescription (4): **10x5 Gy** at **90%** Isodose Line (dose up to 110% in the PTV are allowed) at **PTV (ITV)**

Liver

- Dose Prescription (1): **20x3 Gy** at **80%** Isodose Line (dose up to 120% in the PTV are allowed) at **PTV** (**CTV**)
- Dose Prescription (2): **20x3 Gy** at **90%** Isodose Line (dose up to 110% in the PTV are allowed) at **PTV** (**CTV**)
- Dose Prescription (3): **10x5 Gy** at **80%** Isodose Line (dose up to 120% in the PTV are allowed) at **PTV** (**CTV**)
- Dose Prescription (4): **10x5 Gy** at **90%** Isodose Line (dose up to 110% in the PTV are allowed) at **PTV** (**CTV**)

Planning

- The plan can be optimized with different techniques:
 - i) 3dCRT, Dynamic Arc, IMRT; VMAT
- Try to use different techniques