Radiocirugía para lesiones pulmonares centrales en pacientes no operables

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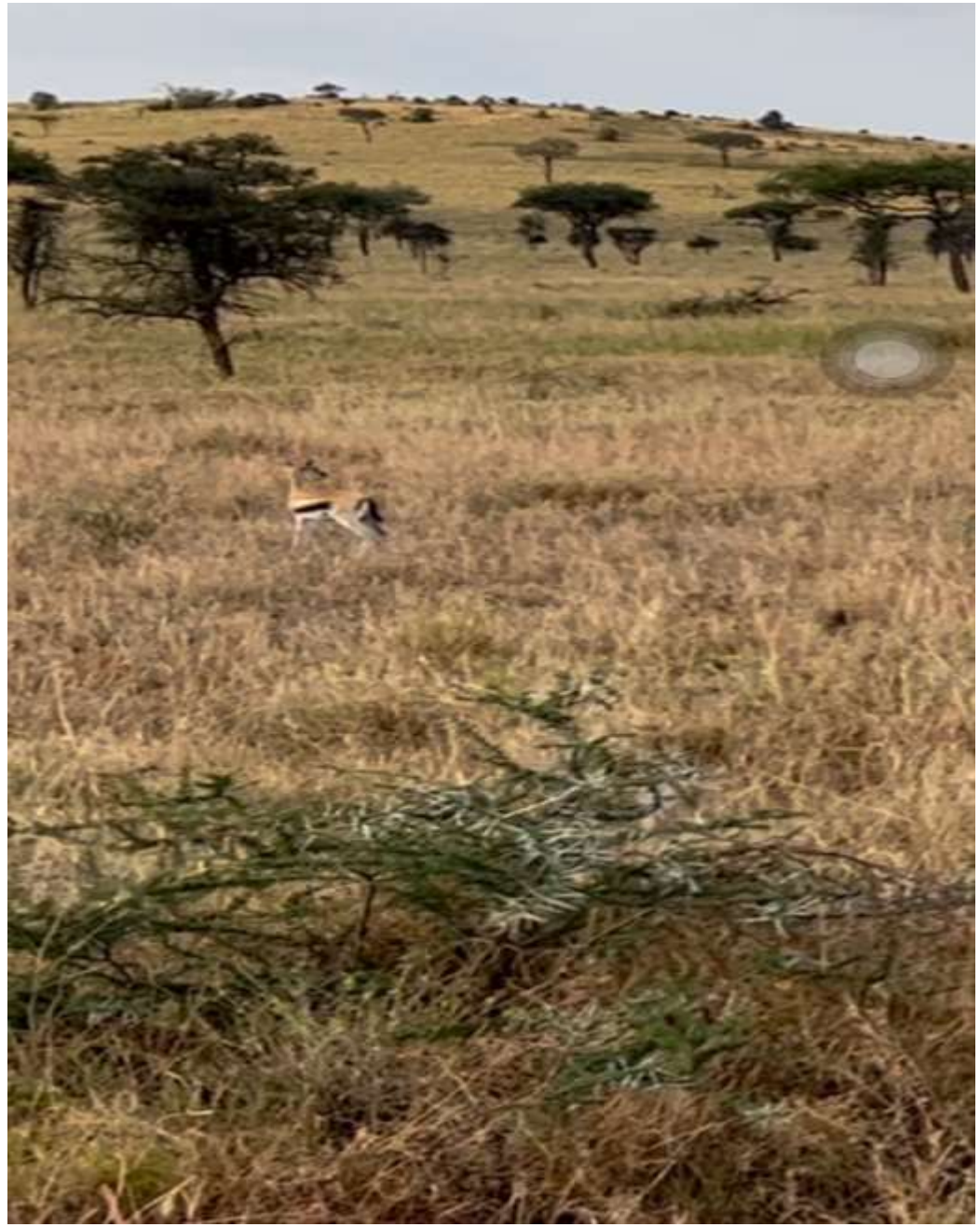


- Precisión
- Conformación de la dosis
- Control del movimiento

Objetivos de aprendizaje

- Definición de lesiones centrales y ultracentrales
- Determinar la toxicidad de la radiocirugía
- Estudios claves para la radiocirugía de lesiones centrales

Introducción

- Radiocirugía tiene una radiobiología diferente a la radioterapia convencional
- Alteración del endotelio
- Daño vascular: Esfingomielasa acidica que hidroliza esfingomielina produciendo ceramida pro-apotótica.
- Efecto abscopal e inmune

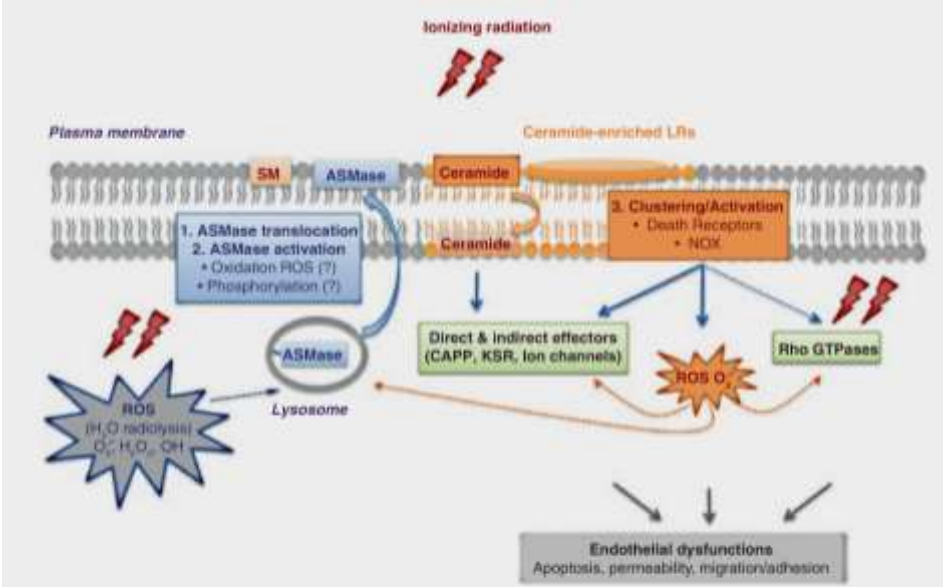


Fig. 3.1 Cell membrane signaling pathways in endothelial cells induced by stereotactic ablative radiotherapy. Abbreviations: *ASMase* acid sphingomyelinase, *CAPP* ceramide-activated protein phosphatase, *KSR* kinase suppressor of Ras, *LRs* lipid rafts, *NOX* nicotinamide adenine dinucleotide phosphate oxidase, *ROS* reactive oxygen species, *SM* sphingomyelin [48]. (From Corre et al. [48]. Open Access Creative Commons Attribution License)

Stereotactic Radiosurgery and Stereotactic Body Radiation Therapy A Comprehensive Guide
Editors: Trifiletti, D.M., Chao, S.T., Sahgal, A., Sheehan, J.P. (Eds.)

Ventajas de la SBRT

- Ambulatoria
- Tiempo total: 1-2 semanas (Corta duración)
- No anestesia
- No dolor durante el procedimiento
- Cómoda para el paciente (Puede variar según la capacidad pulmonar y la técnica de radiocirugía utilizada)
- No requiere de tiempo de recuperación
- Permite continuar actividades de la vida diaria

SBRT para cáncer de pulmón

- Alternativa con evidencia de estudios retrospectivos con análisis puntaje por propensión y de ensayos clínicos para pacientes con estadio I no operables (AUNQUE LA EVIDENCIA TIENE TASAS SIMILARES DESPUES DE LA LOBECTOMIA)
- Opción de tratamiento para pacientes con tumores oligometástasicos

Table 1: Series reporting results for SBRT for operable patients

Author	N	Dose	Median F/U (mos)	OS
Uematsu, 2001[51]	29	Most commonly 50-60 Gy in 5-10 fx	36	86% (3-year)
Onishi, 2011[54]	87	45-72.5 Gy in 3-10 fx	55	72% (IA), 63.2% (IB) (5-year)
Lagerwaard, 2012[177]	177	60 Gy in 3-8 fx	31.5	84.7% (3-year)
Timmerman, 2013[53]	26	54 Gy in 3 fx	25.4	84.4% (2-year)
Chang, 2015[55]	31	50-60 Gy in 3-5 fx	40.2	95% (3-year)
Nagata, 2015[56]	64	48 Gy in 4 fx	67	76.5% (3-year)
Shibamoto, 2015[57]	60	44-52 Gy in 4 fx	52.5	74% (5-year)
Komiyama, 2015[58]	661	32-79 Gy in 4-15 fx	35	79% (3-year)

AE, adverse event; F/U, follow-up; N/R, not reported; OS, overall survival; SBRT, stereotactic body radiation therapy

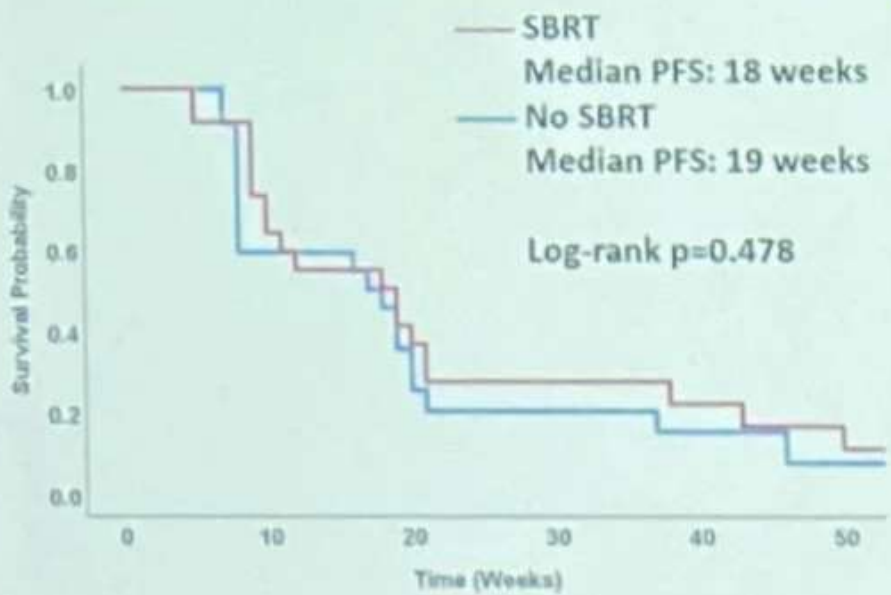
Videtic GMM, Donington J, Giuliani M, Heinzerling J, Karas TZ, Kelsey CR, Lally BE, Latzka K, Lo SS, Moghanaki D, Movsas B, Rimner A, Roach M, Rodrigues G, Shirvani SM, Simone CB 2nd, Timmerman R, Daly ME. Stereotactic body radiation therapy for early-stage non-small cell lung cancer: Executive Summary of an ASTRO Evidence-Based Guideline. Pract Radiat Oncol. 2017 Sep-Oct;7(5):295-301. doi: 10.1016/j.prro.2017.04.014. Epub 2017 Jun 5. PMID: 28596092.

Results – PFS by Primary Disease Sites

Lung

Number at risk						
SBRT	31	24	22	19	14	8
No SBRT	28	12	4	3	3	3

Breast



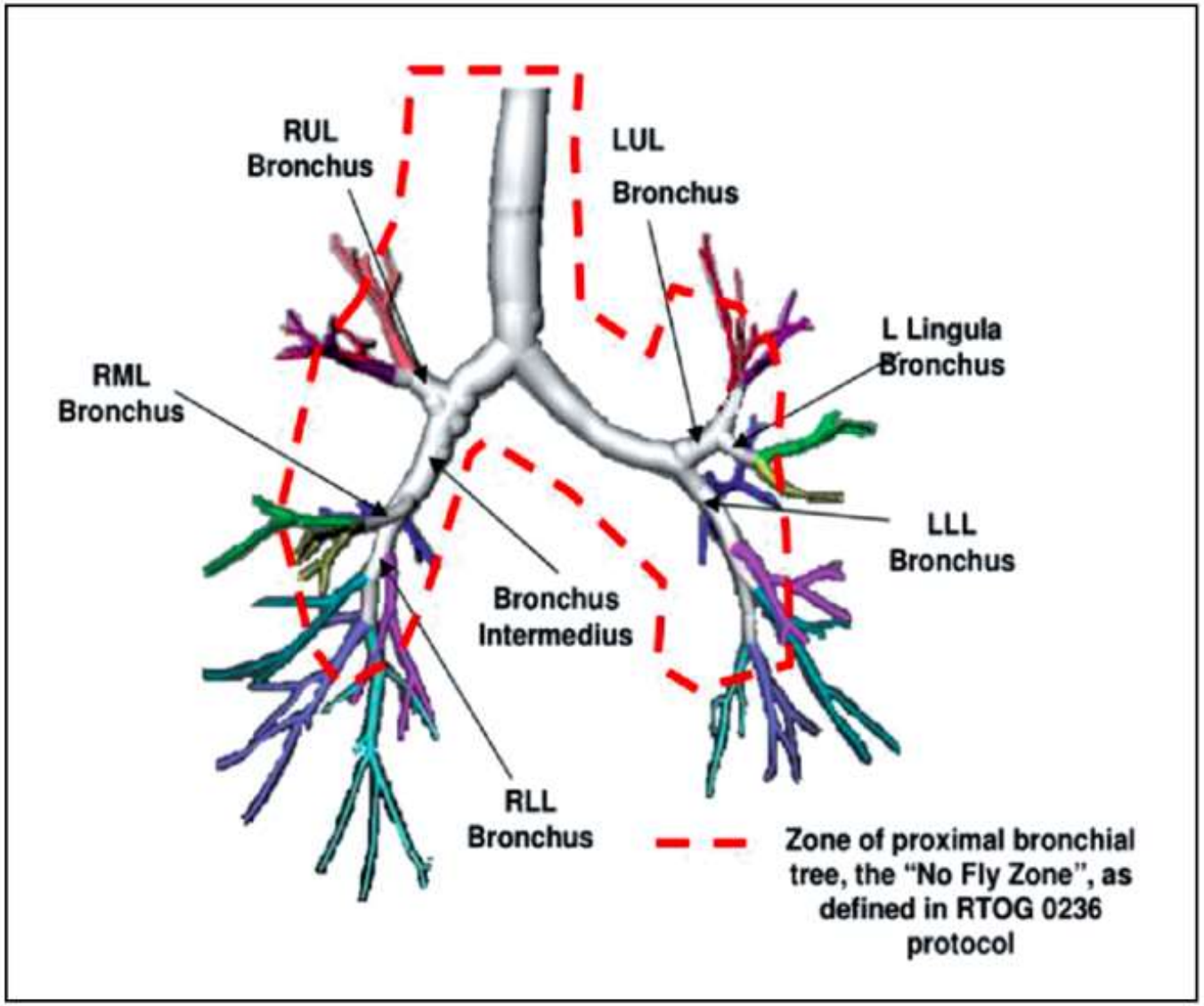
Number at risk						
SBRT	24	15	8	6	4	2
No SBRT	23	13	6	4	3	1

Tsai et al, *ASTRO* 2021

Localización

Definición de lesión Central

- La famosa "The no fly-zone"
- Radio de 2 cm de la traquea y el arbol bronquia desde la definicion del RTOG 0236



SANTINI B, ALEJANDRO, VALDEZ C, CRISTIÁN, SEPÚLVEDA A, VERÓNICA, BAEZA L, RICARDO, & BUSTOS C, SERGIO. (2016). Radioterapia esterotáxica: ¿Un segundo gold estándar en el tratamiento del cáncer de pulmón en etapa precoz?. *Revista chilena de enfermedades respiratorias*, *32*(2), 87-99.

Ultracentral

- **SUNSET Trial**
- Tumores ≤ 6 cm
- PTV se sobrepone con la traquea o el bronquio principal esofago, vena pulmonar, arteria pulmonar

Table 1 Selected Studies Reporting on SBRT for Ultracentral Tumors

Study	Definition of Ultracentral	Dose/Fractionation	Toxicity	Remarks
Tekatli, 2016 (n = 47)[9]	PTV overlapping trachea or main bronchi	5 Gy × 12, 4 fractions per week over 3 weeks	• Grade 3 or higher toxicity: 38% • Likely related fatal lung hemorrhage: 13%	Stage I-IIIA, including recurrent disease
Tekatli, 2015 (n = 78)[10]	PTV ≤ 2 cm from proximal bronchial tree	7.5 Gy ×8	• Grade 3: 6.4% • Grade 4: 0 • Treatment-related death: 7.5%	Patients excluded from 2016 publication
Chaudhuri, 2015 (n = 68)[11]	GTV directly abutting central airway	10 Gy × 5 (3) 12.5 Gy × 4 (4)	• Grade 2 or higher toxicity: 22% (including central cohort) • Ultracentral toxicity—no significant difference compared to central	Mixed cohort (comparison between ultracentral central, and peripheral)
Timmerman, 2006 (n = 70)[4]	RTOG 0236	20-22 Gy × 3	• Grade 3-5 toxicity: 20% • 1 patient died of massive hemoptysis	Mixed (peripheral and central)
Song, 2009 (n = 32)[12]	Within 2 cm of central bronchial tree	10-20 Gy × 3-4 consecutive days, total of 40-60 Gy	• Grade 3 or higher pulmonary toxicity in 33% of patients with central tumors. Bronchial strictures also observed in 8 patients	Central versus peripheral
Chang, 2014 (n = 100)[13]	Within 2 cm of bronchial tree, major vessels, and pulmonary artery, esophagus, heart, trachea, pericardium, brachial plexus, vertebral body; at least 1 cm from spinal canal; and without direct involvement of bronchial tree or mediastinal structures	12.5 Gy × 4 7 Gy × 10	• Grade 2 or higher radiation pneumonitis: 13.4%, 5.5% • Grade 1 or higher chest wall pain: 32%, 28% • Brachial plexopathy: 3%, 0 • Grade 2 or higher esophagitis: 3%, 0	2 doses, 7 Gy × 10 used if constraints were not met
Haasbeek, 2011 (n = 37)[5]	RTOG 0236 or ≤ 1 cm from heart or mediastinum	7.5 Gy × 8	• 1 patient had bronchial stenosis, 2 had grade 3 dyspnea	—
Daly, 2017 (n = 46)[14]	UC = PTV overlapping PBT or esophagus, C = within 2 cm of PBT, PM = abutting mediastinum but not meeting criteria for C	Median 10 Gy × 5 (range 40-60 Gy/4-8)	• Grade 3 or higher toxicity: • UC = 22.2% • C = 4.3% • PM = 0	UC: 2 cases of grade 3 postobstructive pneumonia and 1 case of grade 1 respiratory failure

Abbreviations: C = central; PBT = proximal bronchial tree; PM = paramediastinal; RTOG = Radiation Therapy Oncology Group; UC = ultracentral.

Giuliani M, Mathew AS, Bahig H, Bratman SV, Filion E, Glick D, Louie AV, Raman S, Swaminath A, Warner A, Yau V, Palma D. SUNSET: Stereotactic Radiation for Ultracentral Non-Small-Cell Lung Cancer-A Safety and Efficacy Trial. Clin Lung Cancer. 2018 Jul;19(4):e529-e532. doi: 10.1016/j.cllc.2018.04.0

Dosis

Dosis requerida: BED_{10} > 100

Control local es del 85%

Onishi H, Araki T, Shirato H, et al. Stereotactic hypofractionated high-dose irradiation for stage I nonsmall cell lung carcinoma: clinical outcomes in 245 subjects in a Japanese multiinstitutional study. *Cancer* 2004;101:1623-31. 10.1002/cncr.20539

Park S, Urm S, Cho H. Analysis of biologically equivalent dose of stereotactic body radiotherapy for primary and metastatic lung tumors. Cancer Res Treat. 2014 Oct;46(4):403-10. doi: 10.4143/crt.2013.168. Epub 2014 Jul 17. PMID: 25036574; PMCID: PMC4206062.

Onishi H, Shirato H, Nagata Y, Hiraoka M, Fujino M, Gomi K, Karasawa K, Hayakawa K, Niibe Y, Takai Y, Kimura T, Takeda A, Ouchi A, Hareyama M, Kokubo M, Kozuka T, Arimoto T, Hara R, Itami J, Araki T. Stereotactic body radiotherapy (SBRT) for operable stage I non-small-cell lung cancer: can SBRT be comparable to surgery? Int J Radiat Oncol Biol Phys. 2011 Dec 1;81(5):1352-8. doi: 10.1016/j.ijrobp.2009.07.1751. Epub 2010 Jul 16. PMID: 20638194

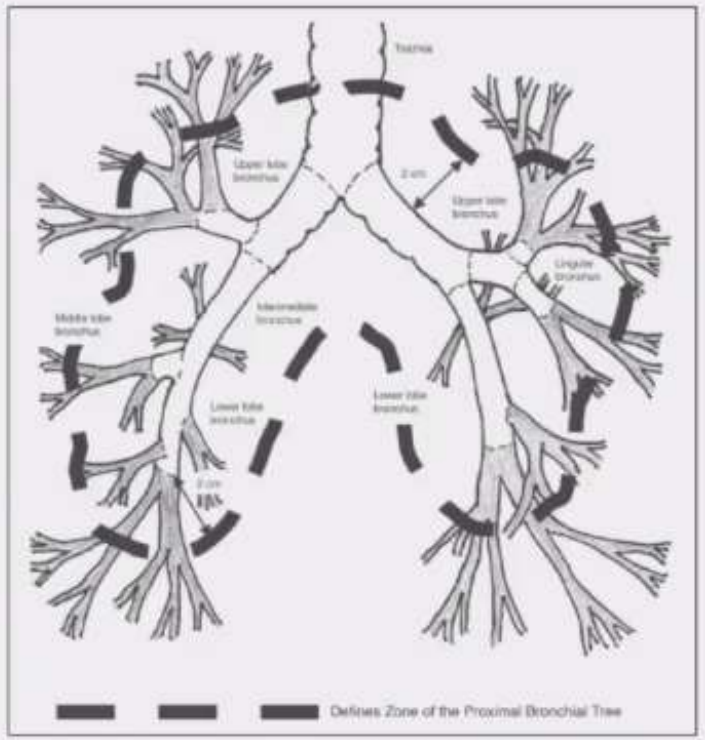
Leyenda de Icaro

Riesgo = Complicaciones fatales

Central tumors: Indiana series

- Higher risk of severe toxicity (pulmonary decline, pneumonia, effusions) for central tumors
- Defined as < 2 cm from tracheobronchial tree

Toxicity	Central (n=22)	Peripheral (n=48)
Grade 3-5	27%	10%
Grade 5	18%	4%



Fakiris et al. Int J Radiat Oncol Biol Phys 2009.
Timmerman et al. J Clin Oncol 2006.

Diapositiva presentada en ASTRO 2021 por Aileen Chen, MD

Complicaciones

- Hemorragia pulmonar
- Fistulas
- Neumonía
- Obstrucción bronquial
- Muerte

Tekatli et al.

- 12 x 5 Gy
- 47 Pacientes
- RIESGO DE HEMORRAGIA PULMONAR FATAL DEL 15%

Estudios

Estudio retrospectivos

- 70 Gy prescrito al GTV en 10 fracciones
- 43 pacientes
- Mediana de seguimiento de 27 meses
- Control local 93% a 3 años

PROMISING CLINICAL OUTCOME OF STEREOTACTIC BODY RADIATION THERAPY FOR PATIENTS WITH INOPERABLE STAGE I/II NON–SMALL-CELL LUNG CANCER

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Purpose: To evaluate the efficacy and toxicity of hypofractionated stereotactic body radiotherapy in patients with Stage I/II non–small-cell lung cancer.

Methods and Materials: Forty-three patients with inoperable Stage I/II non–small-cell lung cancer underwent treatment prospectively using the stereotactic gamma-ray whole-body therapeutic system (body gamma-knife radiosurgery) with 30 rotary conical-surface Co^{60} sources focused on the target volume. Low-speed computed tomography simulation was conducted, which was followed by three-dimensional conformal radiotherapy planning. A total dose of 50 Gy was delivered at 5 Gy/fraction to the 50% isodose line covering the planning target volume, whereas a total dose of 70 Gy was delivered at 7 Gy/fraction to the gross target volume. The median follow-up duration was 27 months.

Results: Three to 6 months after treatment, the complete response rate for body-gamma knife radiosurgery was 63%, and the overall response rate was 95%. The 1-year, 2-year, and 3-year local control rates were all 95% in all patients. The 1-year, 2-year, and 3-year overall survival rates were 100%, 91%, and 91%, respectively, in patients with Stage I disease and 73%, 64%, and 64%, respectively, in those with Stage II disease. Only 2.3% (1/43) of the patients had Grade 3 pneumonitis.

Conclusion: Our highly focused stereotactic body radiotherapy method resulted in promising local control and survival with minimal toxicity.

Non–small-lung cancer, SBRT, Body gamma knife, Stage I, Stage II.

Estudio retrospectivos – MD Anderson

- Pacientes no elegibles para 50 en 4 fracciones
- 82 pacientes
- Control local del 96.2%

SBRT of lung cancer

Stereotactic ablative radiotherapy (SABR) using 70 Gy in 10 fractions for non-small cell lung cancer: Exploration of clinical indications

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ABSTRACT

Background and purpose: We report our outcomes for patients with NSCLC treated with SABR to 70 Gy in 10 fractions and propose indications for this regimen as well as new dose–volume constraints.

Materials and methods: Volumetric image-guided SABR was used to treat 82 patients with clinical challenging NSCLC, not suitable for 50 Gy in 4 fractions, to a final dose of 70 Gy in 10 fractions. Endpoints included overall survival (OS), toxicity, and disease control.

Results: At a median follow-up time of 21.1 months, 3-year OS and local control rates were 66.4% and 94.2%, respectively. The most common side effects were radiation pneumonitis (14.6% grade 2, 2.4% grade 3), followed by chest wall pain (4.9% grade 2, 1.2% grade 3). Multivariate analysis revealed chest wall $V50 > 80\,cm^3$ to be associated with chest wall pain. No patient developed brachial plexopathy. One patient with bronchial tree tumor invasion died of hemoptysis.

Conclusions: SABR with 70 Gy in 10 fractions appears to achieve excellent local control and acceptable toxicity for clinically challenging cases with improved tolerance of the chest wall and brachial plexus as compared with 50 Gy in 4 fractions. This regimen may not be suitable in patients with tumor invading critical central structures. More studies are needed to validate our conclusions.

 Radiotherapy and Oncology 112 (2014) 250–255

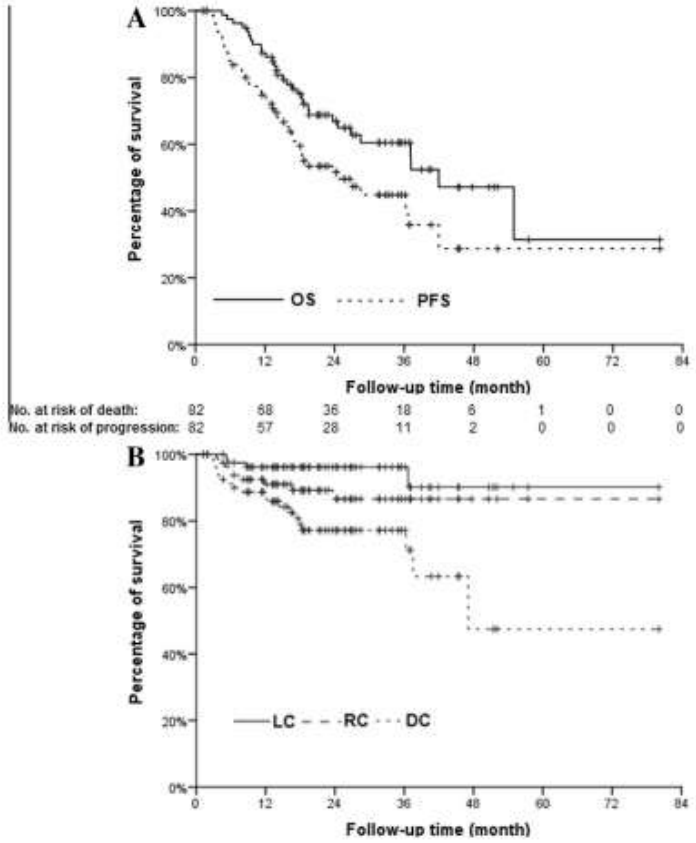


Fig. 1. Kaplan–Meier curves for (A) OS and PFS; (B) LC, RC and DC over time.

Estudio prospectivo- RTOG 0813

- 9 Niveles de dosis
- 8-12 Gy por fraccion cada 2-3 dias
- Aumentos de 0.5 Gy por fraccion
- Dosis inicial 50 Gy/5 fx;
- Dosis final 60 Gy/5 fx

120 pacientes
Mediana de seguimiento de 37.9 meses

Máxima dosis tolerada 12 Gy por fracción con una probabilidad de toxicidad limitante de dosis de 7.2 % 95% CI, 2.8% to 14.5%)
Control local 87.9% (IC 90% 78.8-97%)
Supervivencia global 72.7% (IC 95% 54.1%-84.8%)
Supervivencia libre de progression 54.5% (IC 95% 36.3%-69.6%)

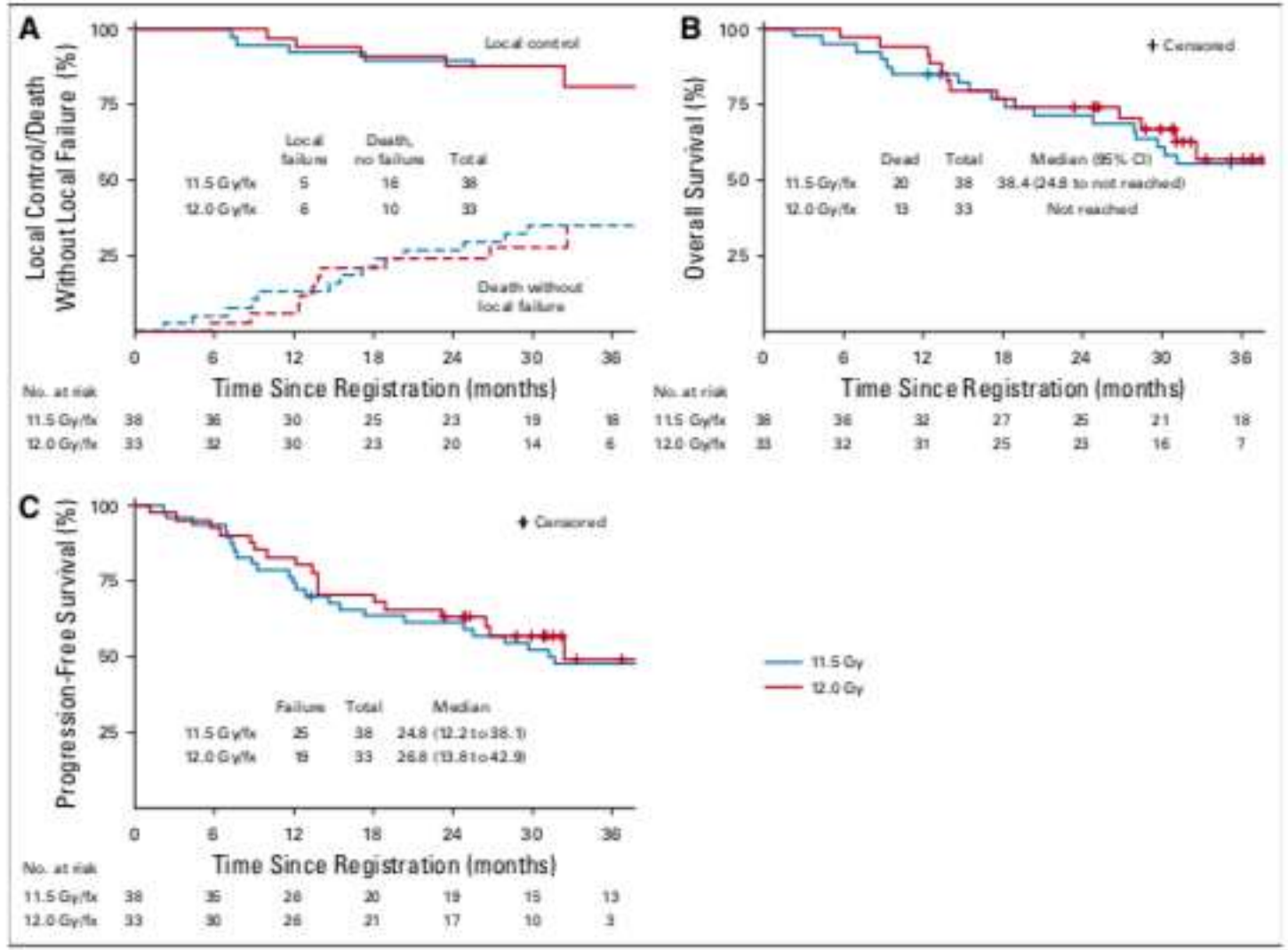
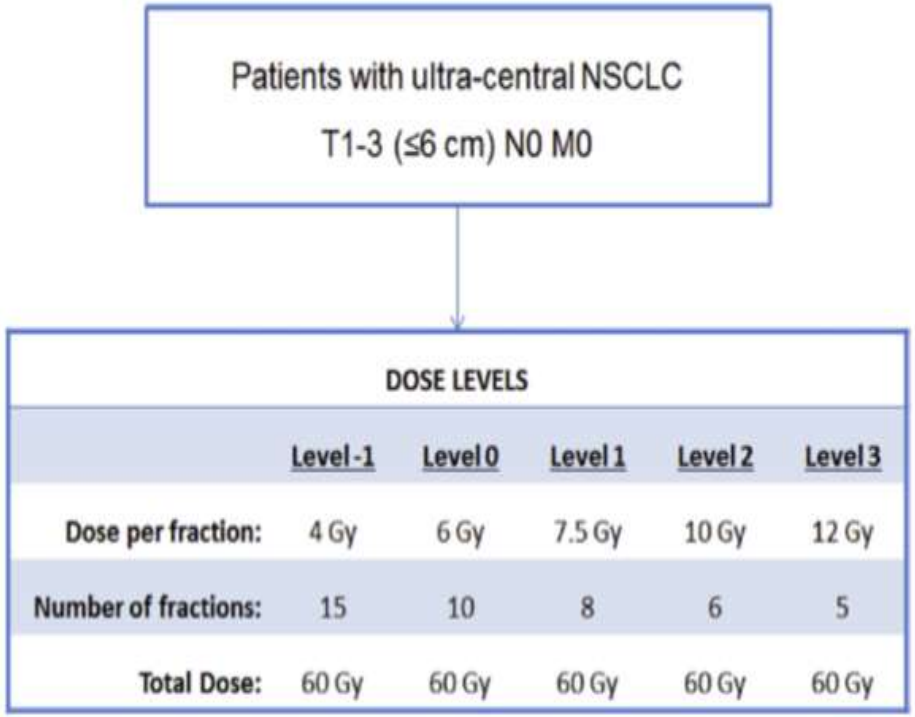


FIG 2. Outcomes for 11.5 and 12 Gy/fx cohorts. (A) Local control rates through 36 months. (B) Overall survival rates through 36 months. (C) Progression-free survival rates through 36 months. fx, fraction.

Sunset trial

- Pacientes con tumores T1-T3N0
- Tumores ≥ 6 cm
- PTV toca o se sobrepone con los árbol bronquial central, esófago, vena pulmonar o arteria pulmonar



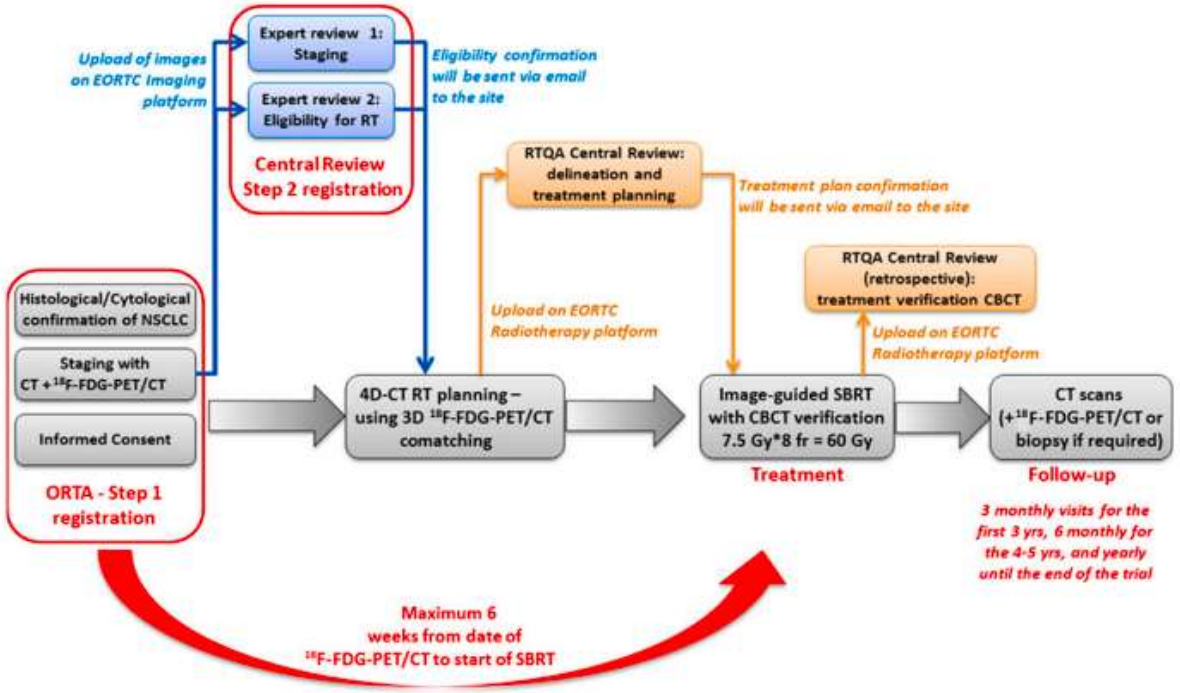
DOSE LEVELS					
	Level -1	Level 0	Level 1	Level 2	Level 3
Dose per fraction:	4 Gy	6 Gy	7.5 Gy	10 Gy	12 Gy
Number of fractions:	15	10	8	6	5
Total Dose:	60 Gy	60 Gy	60 Gy	60 Gy	60 Gy

Sunset trial

- 95% del PTV cubierto por 100% de isodosis de prescripción
- 99% del PTV recibe al menos el 90% de la dosis de prescripción
- Isodosis seleccionada para normalización debe ser $\geq$ 60% y $\leq$ 90% de la dosis
- Dosis máxima 120% dentro del ITV

LungTech Trial

- No completado



Adebahr S, Collette S, Shash E, Lambrecht M, Le Pechoux C, Faivre-Finn C, et al. LungTech, an EORTC Phase II trial of stereotactic body radiotherapy for centrally located lung tumours: a clinical perspective. Br J Radiol 2015;88:20150036.

¿Cómo hacer el tratamiento más seguro para nuestros pacientes?

Constraint – Restriccion de dosis de organos a riesgo RTOG 0813

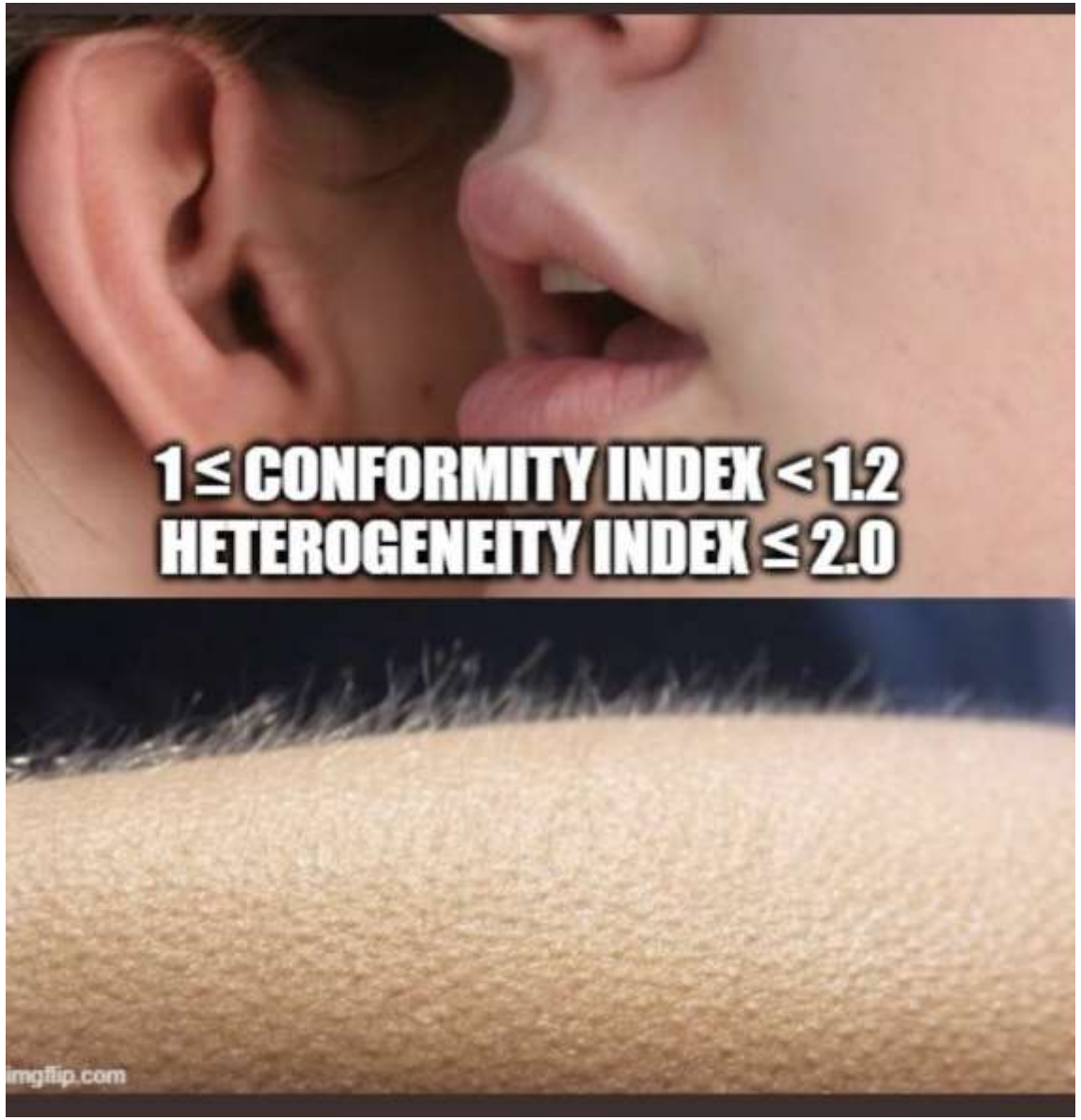
- **Heart:** <15cc receives ≥32 Gy (6.4 Gy/fx); maximum point dose ≤52.5 Gy
- **Trachea/ipsilateral bronchus** (non-adjacent wall): <4 cc receives ≥18 Gy (3.6 Gy/fx); maximum point dose ≤52.5 Gy
- **Great vessels** (non-adjacent wall): <10 cc receives >47 Gy (9.4 Gy per fraction); maximum point dose ≤52.5 Gy
- **Ipsilateral brachial plexus**: <3 cc receives ≥ 30 Gy (6 Gy/fx); maximum point dose ≤32 Gy (6.4 Gy per fraction)
- **Spinal Cord**:
  <0.25 cc receives≥ 22.5 Gy (4.5 Gy/fx)
- <0.5 cc receives≥ 13.5 Gy (2.7 Gy/fx)]
  Maximal point dose is 30 Gy (6 Gy per fraction)
- **Esophagus**: <5 cc receives ≥27.5 Gy (5.5 Gy per fraction); maximum point dose ≤52.5 Gy
- **Whole lung minus GTV**:
  <1500 cc receives ≥12.5 Gy (2.5 Gy per fraction) <1000 cc receives ≥13.5 Gy (2.7 Gy per fraction)
- **Skin**: <10 cc receives ≥30 Gy (6 Gy/fx). Maximal point dose is 32 Gy (6.4Gy per fraction)

TABLE 1. Normal Tissue Dose-Volume Constraints for Central Lesions Treated with SABR

	MD Anderson Experience				RTOG 0813		
	Regimen						
	50 Gy in Four Fractions		70 Gy in 10 Fractions		50–60 Gy in Five Fractions		
	Dose Constraints[Reference]						
Normal Tissue	Volume	Max Dose	Volume	Max Dose	Volume	Max Dose	Endpoint to be Avoided
Lung							
Total	MLD ≤ 6 Gy[20] $V_5 \leq 30\%$[20] $V_{10} \leq 17\%$[20] $V_{20} \leq 12\%$[20] $V_{30} \leq 7\%$[20]		MLD ≤ 9 Gy[20] $V_{40} \leq 7\%$[21]		$V_{12.5} < 1500\,cm^3$ $V_{13.5} < 1000\,cm^3$		Lung function/pneumonitis
Ipsilateral	iMLD ≤ 10 Gy[20] $iV_{10} \leq 35\%$[20] $iV_{20} \leq 25\%$[20] $iV_{30} \leq 15\%$[20]		NA		NA		
Trachea	$V_{35} \leq 1\,cm^3$[320]		$V_{40} \leq 1\,cm^3$[321]	$D_{max} < 60$ Gy [21]	$V_{18} < 4\,cm^3$	$D_{max} < 105\%$ of PTV	Pneumonitis/stenosis/fistula
Bronchial tree	$V_{35} \leq 1\,cm^3$[320]	$D_{max} \leq 38$ Gy[20]	$V_{50} < 1\,cm^3$[321]	$D_{max} < 60$ Gy[21]	$V_{18} < 4\,cm^3$	$D_{max} < 105\%$ of PTV	Pneumonitis/hemoptysis
Hilar major vessels	$V_{40} \leq 1\,cm^3$[320]	$D_{max} \leq 56$ Gy[20]	$V_{50} < 1\,cm^3$[321]	$D_{max} < 75$ Gy[21]			Pneumonitis/hemoptysis
Other chest great vessels	$V_{40} \leq 1\,cm^3$[320]	$D_{max} \leq 56$ Gy[20]	$V_{50} < 1\,cm^3$[321]	$D_{max} < 75$ Gy[21]	$V_{47} < 10\,cm^3$	$D_{max} < 105\%$ of PTV	Pneumonitis/hemoptysis
Esophagus	$V_{30} \leq 1\,cm^3$[320]	$D_{max} \leq 35$ Gy[20]	$V_{40} \leq 1\,cm^3$[321]	$D_{max} \leq 50$ Gy[21]	$V_{27.5} < 5\,cm^3$	$D_{max} < 105\%$ of PTV	Esophagitis/stenosis/fistula
Heart/pericardium	$V_{40} \leq 1\,cm^3$[320] $V_{20} \leq 5\,cm^3$[349]	$D_{max} \leq 45$ Gy[20]	$V_{45} < 1\,cm^3$[321]	Dmax ≤ 60 Gy[21]	$V_{32} < 15\,cm^3$	$D_{max} <105\%$ of PTV	Cardiac disorder/pericarditis
Brachial plexus	$V_{30} \leq 0.2\,cm^3$[320]	$D_{max} \leq 35$ Gy[20]	$V_{50} < 0.2\,cm^3$[321]	$D_{max} < 55$ Gy[21]	$V_{30} < 3\,cm^3$	$D_{max} < 32$ Gy	Brachial neuropathy
Spinal cord	$V_{20} \leq 1\,cm^3$[320]	$D_{max} \leq 25$ Gy[20]	$V_{10} \leq 1\,cm^3$[321]	$D_{max} < 40$ Gy[21]	$V_{22.5} < 0.25\,cm^3$ $V_{13.5} < 0.5\,cm^3$	$D_{max} < 30$ Gy	Myelitis
Chest wall/skin	$V_{30} \leq 30\,cm^3$ (cw)[50] $V_{30} \leq 50\,cm^3$ (skin)[50]		$V_{50} \leq 60\,cm^3$[321] $V_{40} \leq 120\,cm^3$[321] $V_{30} \leq 250\,cm^3$[321]	$D_{max} \leq 82$ Gy[21]	$V_{30} < 10\,cm^3$	$D_{max} < 32$ Gy	Chest wall pain/skin toxicity

MLD, mean lung dose; V_x, volume of tissue exposed to x Gy or more; D_{max}, maximum dose; PTV, planning target volume; NA, not available; SABR, stereotactic ablative radiotherapy

Índices de radiocirugía



No es seguro utilizar SBRT = Otros alternativas

- Esquemas hipofraccionados
- 60 Gy en 12-15 Fx
- 45 Gy en 15 fracciones al PTV – Refuerzo intgerado 60 Gy al PTV

Hypofractionated Volumetric-Modulated Arc Radiotherapy for Patients With Non-Small-Cell Lung Cancer Not Suitable for Surgery or Conventional Chemoradiotherapy or SBRT

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Background: Hypofractionated radiotherapy (HypoRT) has been used to pursue an alternative treatment regimen for patients with non-small-cell lung cancer (NSCLC) who are not eligible for stereotactic ablative radiotherapy (SABR), surgery or concurrent chemoradiotherapy (CCRT) and has shown good local control and safety. We analyzed the feasibility of using volumetric-modulated arc radiotherapy (VMAT) with the simultaneous integrated boost (SIB) technique to achieve high local control with few treatment-related toxicities.

Patients and Methods: A total of 55 patients with stage I-IV NSCLC who were not candidates for SABR, surgery or CCRT were included in the present study. All patients received a prescribed dose of 60 to 66 Gy in 15 fractions. Local progression-free survival (LPFS), PFS, overall survival (OS), and toxicities were retrospectively analyzed.

Results: Thirty-three patients (60.0%) had stage IV or recurrent disease in this study. The median follow-up time was 8 months (interquartile range: 5.0-16.3 months). The 1-year and 2-year OS rates were 84.3% and 69.9%, and the 1-year and 2-year LPFS rates were 91.0% and 63.0%. The median OS (mOS) and median LPFS (mLPFS) were not reached, and median PFS (mPFS) was 15 months. Twenty-eight (51.9%) patients had disease progression at the time of analysis. Of these, 7 (13.0%), 7 (13.0%) and 21 (38.9%) had local recurrence, locoregional failure and distant metastasis, respectively. All cases of local recurrence were found within the SIB region. Four patients had grade 2-3 pneumonitis, and 8 patients had grade 2-3 esophagitis. Patients with grade 2-3 esophagitis had significantly higher maximum dose and dose to 5 cm^3 volume to esophagus than those with grade 0-1 esophagitis. No grade 4 or higher toxicity was observed.

Clinical Investigation

Precision Hypofractionated Radiation Therapy in Poor Performing Patients With Non-Small Cell Lung Cancer: Phase 1 Dose Escalation Trial

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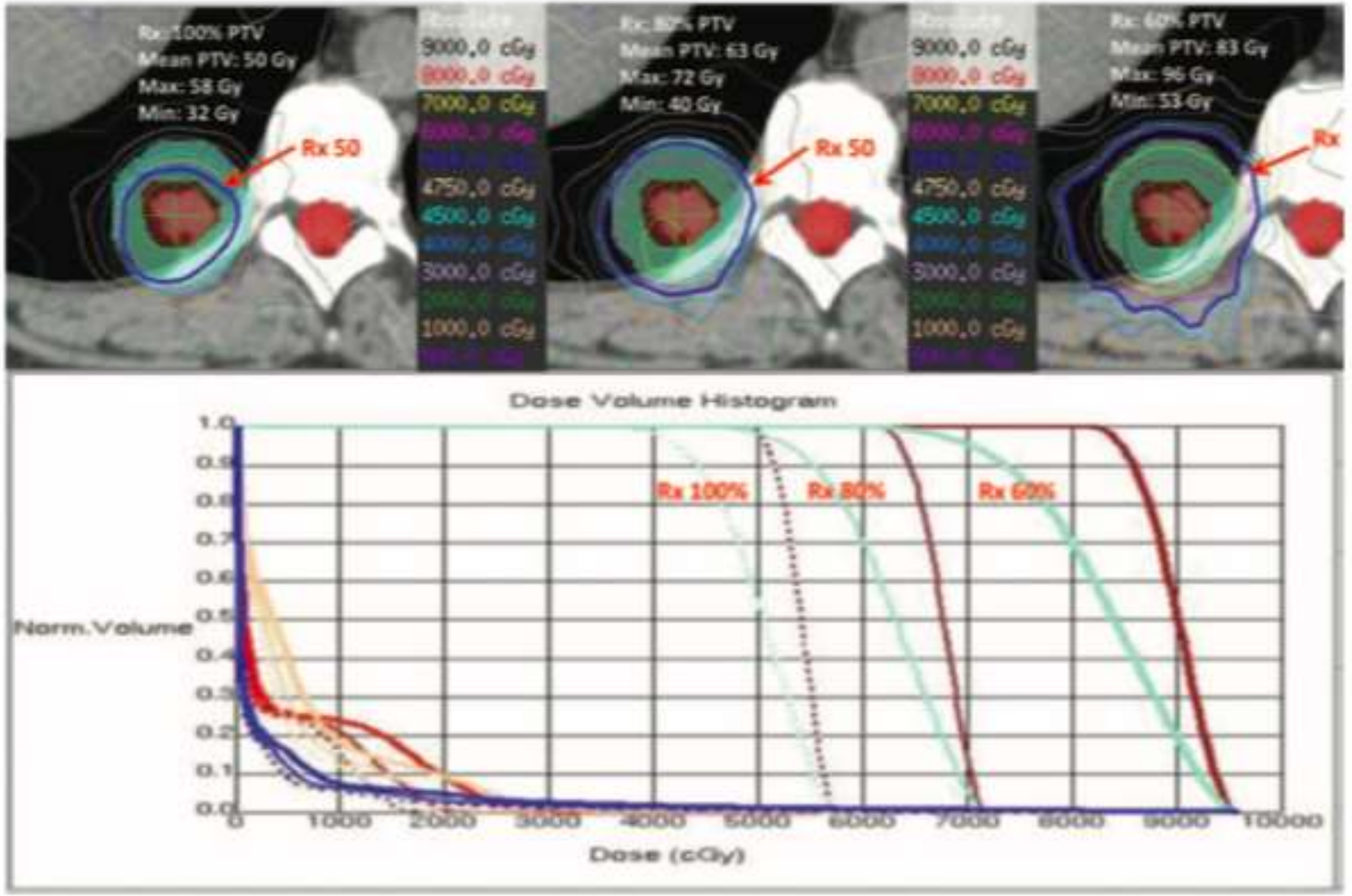
Recomendaciones

- Isodosis de prescripcion
- Posicionamiento diario
- Cobertura del blanco (Consideren cubrimiento del ITV y disminución de la dosis en PTV)
- **Técnica de control respiratorio**


Mean PTV: 50 Gy
Max: 58 Gy
Min: 32 Gy
Rx 50
9000.0 cGy
7000.0 cGy
4750.0 cGy
4500.0 cGy
3000.0 cGy
1000.0 cGy
Mean PTV: 63 Gy
Max: 72 Gy
Min: 40 Gy
Rx 50
Mean PTV: 83 Gy
Max: 96 Gy
Min: 53 Gy
Dose Volume Histogram
Rx 100%
Rx 80%
Rx 60%
Norm.Volume
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
Dose (cGy)

Asegurar el cubrimiento del ITV incluso a expensas de descubrir el PTV en el cubrimiento permite un control adecuado

FULL PAPER

The significance of PTV dose coverage on cancer control outcomes in early stage non-small cell lung cancer patients treated with highly ablative stereotactic body radiation therapy

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Objective: We evaluated whether patients with early-stage non-small-cell lung cancers (NSCLCs) treated with stereotactic body radiation therapy (SBRT) without full prescription dose coverage of the planning target volume (PTV) had inferior outcomes.
Methods: The SBRT regimen was 54 Gy in three fractions. Dosimetric constraints were as per the Radiation Therapy Oncology Group 0236 guidelines. All patients underwent four-dimensional CT (4D-CT) simulation. The internal target volume (ITV) was defined using 4D-CT, and the PTV was defined as a 6-mm longitudinal and a 3-mm axial expansion from the ITV. If normal tissue constraints were beyond tolerance, ITV-based dosing was employed where priority was made for full ITV coverage at the expense of PTV coverage. Patients with and without full PTV dose coverage were compared, and control rates were estimated using Kaplan–Meier analysis.
Results: 120 NSCLC cases were evaluated with 81% having adequate PTV dose coverage. ITV and PTV were significantly larger in the cohort with inadequate PTV dose coverage ($p = 0.0085$ and $p = 0.0038$, respectively), and the mean ITV and PTV doses were higher in patients with adequate PTV dose coverage ($p = 0.002$ and $p < 0.0001$, respectively). The 3-year local control rate was 100% for both cohorts. There was no difference in 3-year regional control ($p = 0.36$), disease-specific survival ($p = 0.79$) or overall survival ($p = 0.73$).
Conclusion: When delivering a highly ablative SBRT regimen for early-stage NSCLC, full-dose coverage of the ITV is sufficient for local control.
Advances in knowledge: Our data are among the first to evaluate the utility of PTV margins in a highly ablative SBRT regimen and suggest that when dosing constraints cannot be met, full tumouricidal dose coverage of the ITV is sufficient for local control.

IGUAL CONTROL LOCAL, SUPERVIVENCIA LIBRE DE ENFERMEDAD Y SUPERVIVENCIA GLOBAL

CONTROL RESPIRATORIO

- Protocolo adaptado a la tecnología
- No hay una solución perfecta
- Depende de cada servicio
- Limites de la seguridad del paciente

Conclusiones

- Debemos determinar la localización de la lesión y la posibilidad o no de realizar un tratamiento de SBRT
- Seguridad de los órganos a riesgo debe ser primero
- Debe existir una técnica y protocolo de control respiratorio
- La localización central o ultra-central por si solo no es una exclusión de la posibilidad de tratamiento
- Por el momento estamos esperando resultados del SUNSET trial y LungTech Trial

Muchas gracias

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