Hipofraccionamiento Extremo:

Próstata – Pulmón - Oligometástasis

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CENTRO MEDICO DEAN FUNES
TECNOLOGIA DEL NUEVO MILENIO
ASOCIADO A 21st CENTURY ONCOLOGY

Objetivos

- Mostrar un resumen de indicaciones y complicaciones reportadas en trabajos de investigación con SBRT

- Presentar estrategias para mitigar el riesgo, ya que las restricciones de dosis están disponibles en la web

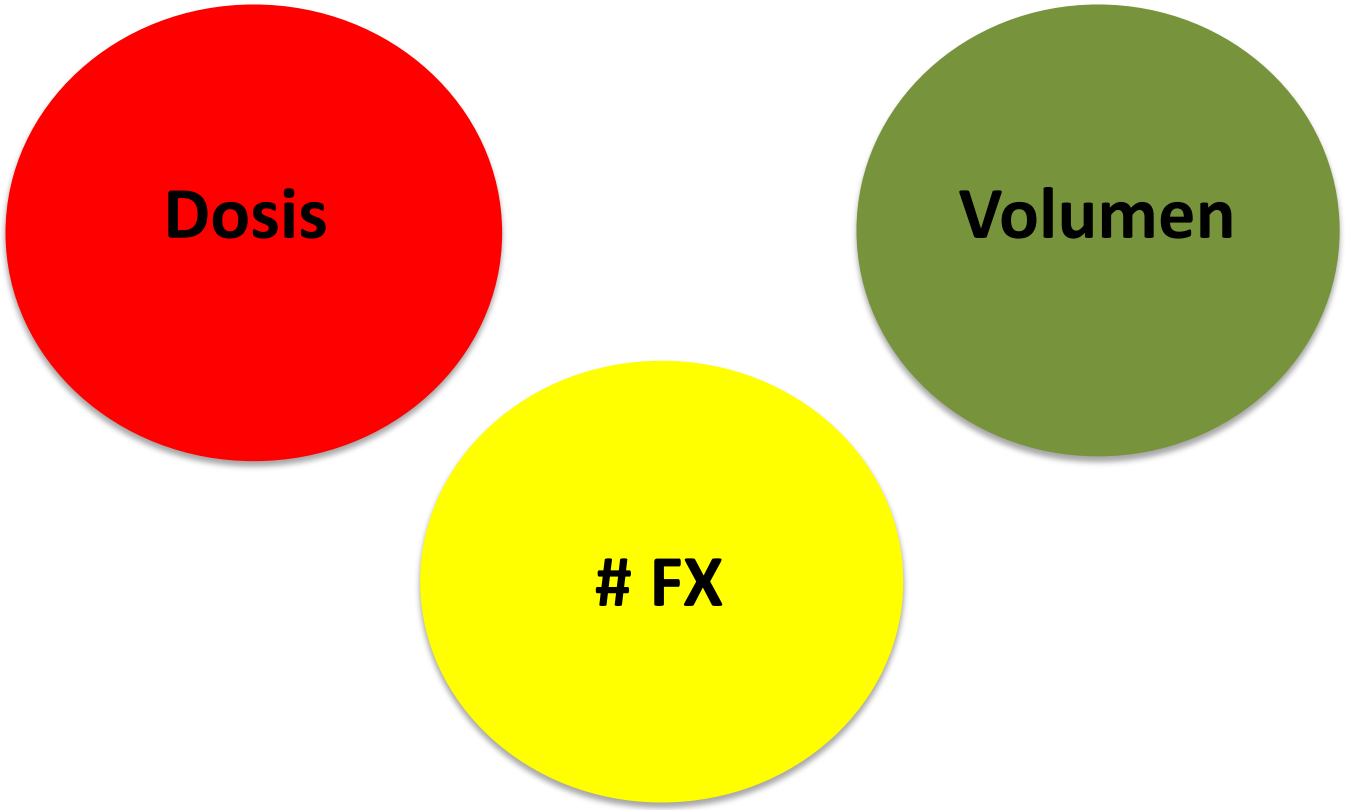
Escenario General

- **Órganos o estructuras seriales**
  - PTV muy próximo a OAR o superpuesto
  - Re-irradiación

- **Órganos o estructuras paralelas**
  - Volumen inadecuado para mantener la función del órgano
  - Órgano enfermo/ tejido restante inadecuado para mantener su función: Hígado y Pulmón

Radioprotección: Evitar Toxicidad

- Toxicidad no está relacionada a una técnica per se, pero si a:



Márgenes en general

- GTV=CTV
- Márgenes adicionales dependen de las sistemas de inmovilización, manejo de movimiento de órganos y equipo IGRT
- ITV para movimiento
- PTV para variabilidad de set-up, mínimo 3-5 mm
- BED > 100

Evaluación del plan
Gradientes de dosis

- Puede llegar a ser un desafío
- Isodosis prescripción: 95% cobertura PTV
- Conformidad: Radio entre la isodosis del volumen de prescripción (PIV) y el volumen del PTV
- Ideal < 1.2
- Áreas con >105% de la prescripción dentro del PTV

Estrategias Generales

- Delineación de TODOS los Órganos a Riesgo (OAR) relevantes
- PRV para algunos OAR: médula, duodeno
- Piel
- Múltiples blancos: órganos paralelos/seriales
- Fraccionamientos más prolongados
- Fraccionamiento diario/días alternos

Pulmón (primario/oligo MTTS)

ASTRO Guidelines

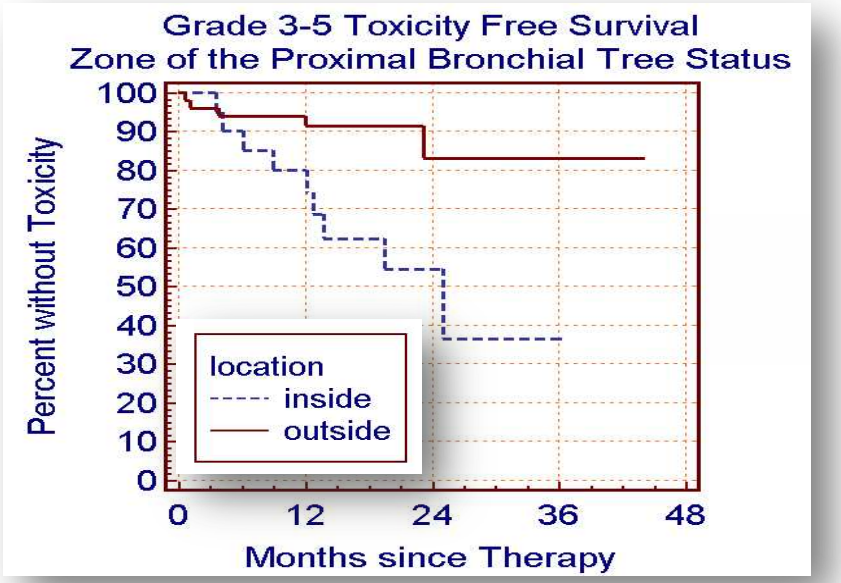
Special Article

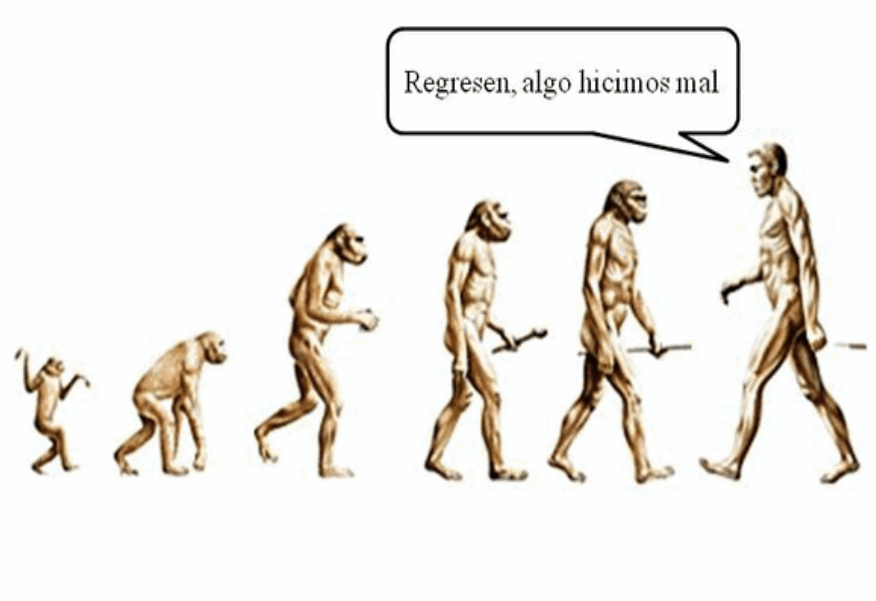
Stereotactic body radiation therapy for early-stage non-small cell lung cancer: Executive Summary of an ASTRO Evidence-Based Guideline

Gregory M.M. Videtic MD, CM, FRCPC, FACR [a,*], Jessica Donington MD [b], Meredith Giuliani MBBS [c], John Heinzerling MD [d], Tomer Z. Karas MD [e], Chris R. Kelsey MD [f], Brian E. Lally MD [g], Karen Latzka [h], Simon S. Lo MB, ChB, FACR [i], Drew Moghanaki MD, MPH [j], Benjamin Movsas MD [k], Andreas Rimner MD [l], Michael Roach MD [m], George Rodrigues MD, PhD, FRCPC [n], Shervin M. Shirvani MD, MPH [o], Charles B. Simone II MD [p], Robert Timmerman MD [q], Megan E. Daly MD [r]

Universidad Indiana: Fase II

- 60-66 Gy en 3 Fracciones. 70 pts. (<7 cm)
- Toxicidad Grado 3-5
- Tumores centrales (27% vs 10%)
- 6 muertes toxicas (4 centrales)

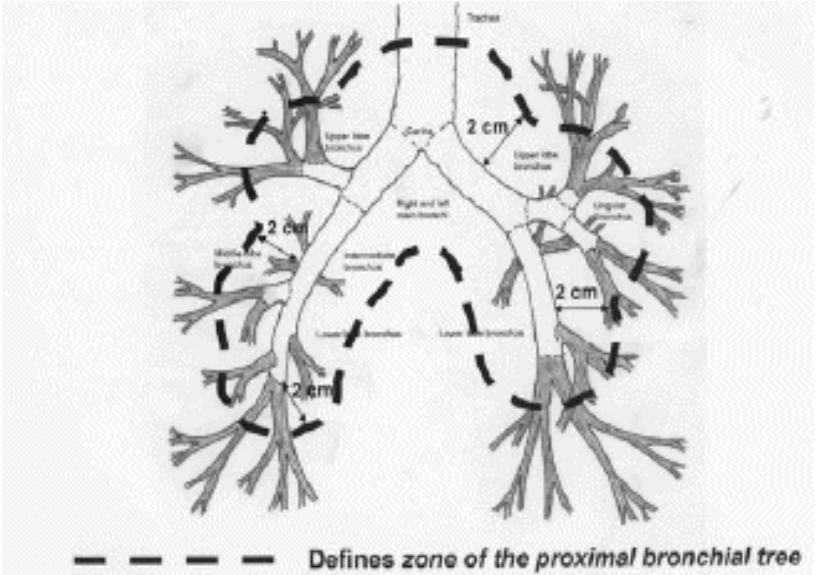




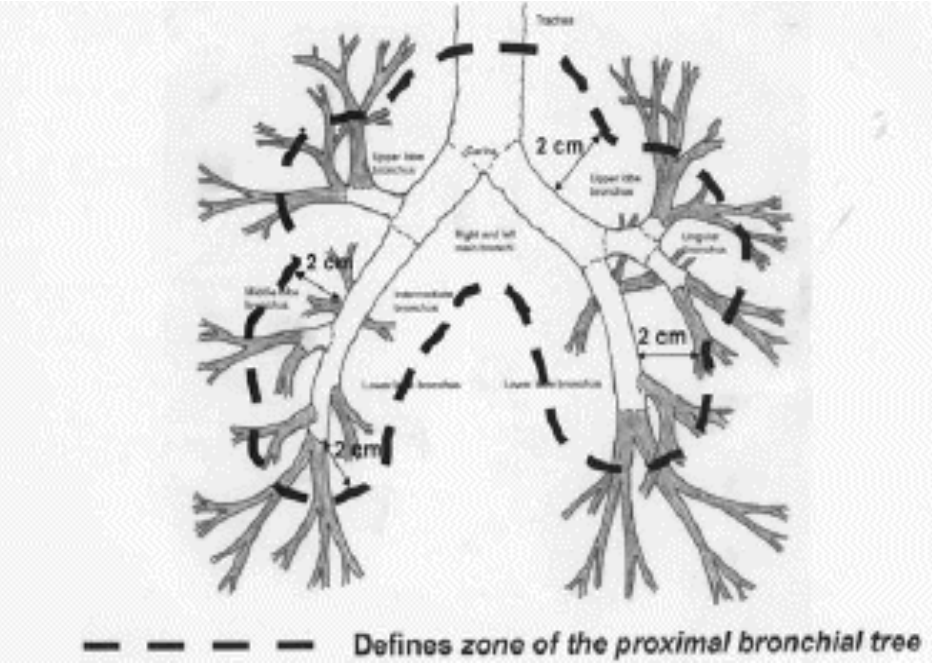
Tórax

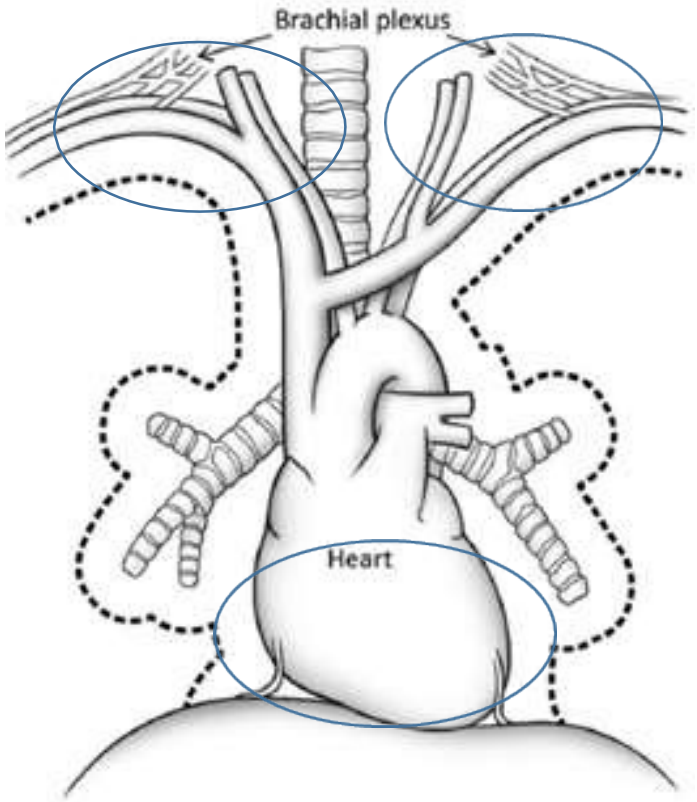
- Predictores de toxicidades Grado 3-5:
- Localización hilar/pericentral (riesgo ↑ 11 veces)
- Volumen tumoral >10 ml (riesgo ↑ 8 veces)

Definición RTOG Tumores Centrales



Tumores Centrales

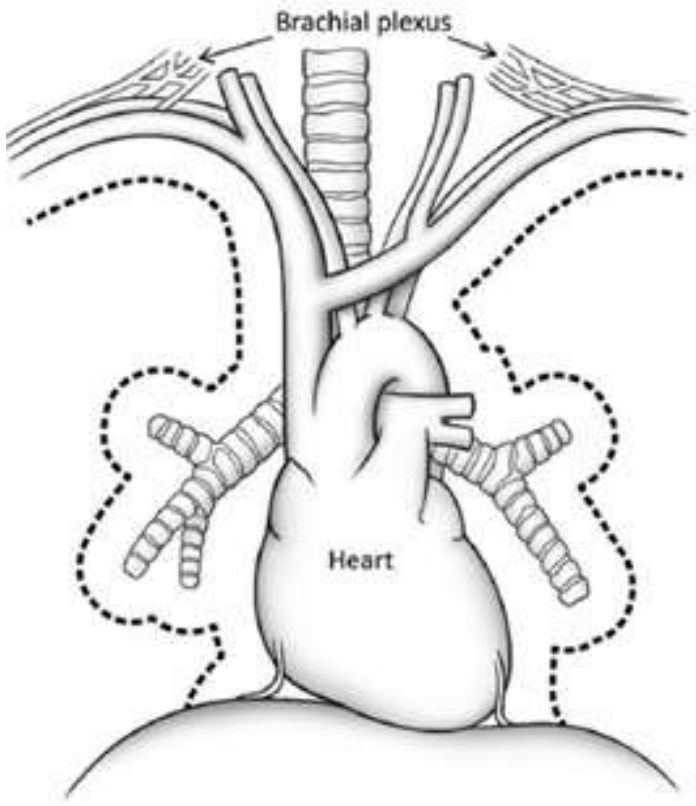




Proximal Bronchial Tree (PBT) =Distal 2cm trachea to the beginning of segmental bronchi (Timmerman)

RTOG 0813:
Tumour within or touching the zone of PBT or PTV touching med pleura/ pericardium

Tumores Ultra-Centrales



Central

GTV abuts PBT

Mihai ASTRO 2018

ITV abuts the proximal bronchial tree

Sunybrook

PTV contacts/ overlaps PBT, Oesophagus, trachea, pulmonary vein/artery

Princess Margaret

Tumores Centrales

- Delinear vías aéreas mayores y grandes vasos

- Utilizar fraccionamientos más prolongados:
- 50-60 Gy en 5 Fxs (más común 50 Gy en 5 Fxs)
- 48-50 Gy en 4 Fxs
- 60 Gy en 8 Fxs
- 60 Gy en 12 fxs

Fraccionamientos: Diario vs Alternos

Quality of life

Lung stereotactic body radiation therapy (SBRT) delivered over 4 or 11 days: A comparison of acute toxicity and quality of life ☆,☆☆

Suneil Jain [a], Ian Poon [b], Hany Soliman [b], Brian Keller [b], Anthony Kim [b], Fiona Lochray [b], Latifa Yeung [c], Patrick Cheung [b,*]

[a] Centre for Cancer Research and Cell Biology, Queens University Belfast, United Kingdom; [b] Sunnybrook Odette Cancer Centre, Department of Radiation Oncology; [c] Rouge Valley Health System, Department of Pediatrics, Division of Gastroenterology, Hepatology, and Nutrition, Institute of Health Policy Management & Evaluation, University of Toronto, Canada

54 pacientes
48 – 52 Gy en 4 Fx

Radiotherapy and Oncology 108 (2013) 320–325

Fraccionamientos: Diario vs Alternos

Disnea > Grado 2 y síntomas respiratorios empeoraron con fraccionamiento diario

Table 4
CTCAE v4 grade 2 or higher dyspnea and respiratory symptoms corrected for baseline symptoms.

Symptom	Grade 2 or higher (percent)								*p*-Values
	4 day				11 day				
	Post-treatment	One month	Four month	Any time post-treatment	Post-treatment	One month	Four month	Any time post-treatment	
Dyspnea	14.8	14.8	14.8	25.9	3.7	7.4	3.7	11.1	0.15
Respiratory toxicity	14.8	14.8	18.5	29.6	7.4	7.4	7.4	14.8	0.16

Winner

Pneumonitis actínica

	Grade 2–4 pneumonitis (%)	*p* value
MLD		
≤4 Gy	4.3	0.02
>4 Gy	17.6	
V5		
≤20 %		0.67
>20 %	8.9	
V10		
≤12 %	5.7	0.1
>12 %	15	
V20		
≤4 % (Median)	4.3	0.03
>4 %	16.4	
≤10 % (RTOG)	9.6	0.42
>10 %	15.8	
PTV		
≤48 mL		0.18
>48 mL	13	
Tumor location		
Upper lobe	9	0.59
Lower/middle lobe	12	
COPD		
No	5.7	0.36
Yes	12	

Dosis Pulmonar Promedio (MLD)

Volumen de Pulmón que recibe > 20 Gy (V20)

Lo et al. Normal Tissue Constraints. In: Stereotactic Body Radiation Therapy (Editors: Lo, Teh, Lu, Schefter). Springer 2012

Toxicidad Pulmonar Radio-inducida

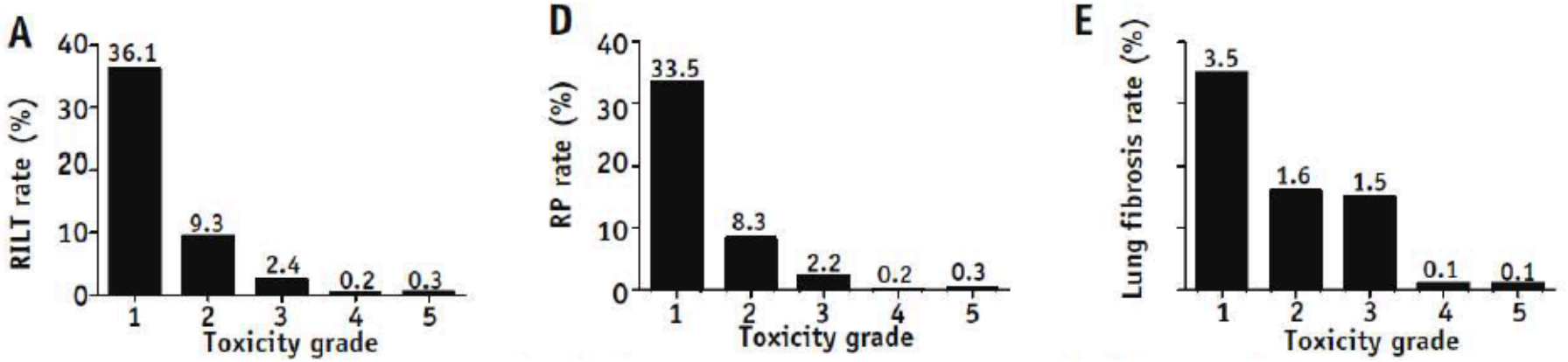
Clinical Investigation

Simple Factors Associated With Radiation-Induced Lung Toxicity After Stereotactic Body Radiation Therapy of the Thorax: A Pooled Analysis of 88 Studies

Jing Zhao, MD, PhD,[*,†] Ellen D. Yorke, PhD,[‡] Ling Li, MD, PhD,[*,§] Brian D. Kavanagh, MD,[||] X. Allen Li, PhD,[¶] Shiva Das, PhD,[#] Moyed Miften, PhD,[||] Andreas Rimner, MD,[**] Jeffrey Campbell, PhD,[*] Jinyu Xue, PhD,[††] Andrew Jackson, PhD,[‡] Jimm Grimm, PhD,[‡‡] Michael T. Milano, MD, PhD,[§§] and Feng-Ming (Spring) Kong, MD, PhD[*,§§§]

88 estudios – 7752 pacientes

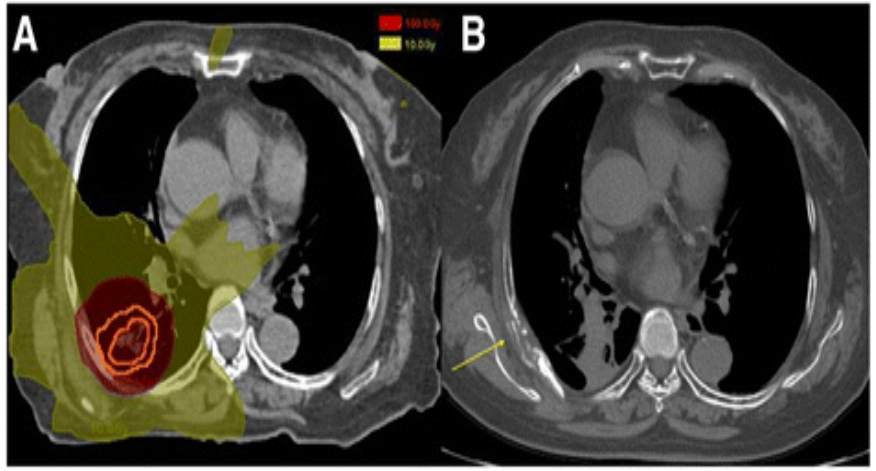
Factores de riesgo:
- Edad mayor
- Tumores grandes
- Dosis (V20 y MLD)



Zhao et al., Red J 95, 1357-66, 2016

Pared Costal

- Dolor costal (5-10%)
- Miositis
- Fibrosis
- Fractura costal (< 5%)



- Puede ser transitoria o crónica

- Intervalo de presentación 8-12 meses

Pared Costal

CHEST WALL VOLUME RECEIVING >30 GY PREDICTS RISK OF SEVERE PAIN AND/ OR RIB FRACTURE AFTER LUNG STEREOTACTIC BODY RADIOTHERAPY

NEAL E. DUNLAP, M.D.,* JING CAI, PH.D.,* GREGORY B. BIEDERMANN, M.D.,* WENSHA YANG, PH.D.,* STANLEY H. BENEDICT, PH.D.,* KE SHENG, PH.D.,* TRACEY E. SCHEFTER, M.D.,† BRIAN D. KAVANAGH, M.D.,† AND JAMES M. LARNER, M.D.*

Tratar de reducir el volumen que reciba >30 Gy a < 30 CC

Solo 10-15% de pacientes de MDACC y MSKCC pudieron logarlo
Variables:

- **Proximidad a la pared costal**
- **Depende del seguimiento**
- **Como se contornea la pared**
- **Otros factores: obesidad -diabetes**

Dunlap et al., Red J 76, 796-801, 2010

OBESITY INCREASES THE RISK OF CHEST WALL PAIN FROM THORACIC STEREOTACTIC BODY RADIATION THERAPY

JAMES WELSH, M.D.,* JIMMY THOMAS, M.D.,* DEEP SHAH, B.S.,* PAMELA K. ALLEN, PH.D.,* XIONG WEI, PH.D.,* KEVIN MITCHELL, B.S.,* SONG GAO, PH.D.,† PETER BALTER, PH.D.,† RITSUKO KOMAKI, M.D.,* AND JOE Y. CHANG, M.D., PH.D.*

Departments of *Radiation Oncology and †Radiation Physics, The University of Texas M. D. Anderson Cancer Center, Houston, TX

$$IMC = \frac{PESO}{ALTURA^2}$$

BMI	G2+ CWpain	%	Sign
< 29	13/196	6.7%	P=0.01
≥ 29	9/66	13.6%	

Int. J. Radiation Oncology Biol. Phys., Vol. 81, No. 1, pp. 91–96, 2011

SBRT central: Meta-analsis 2019

	N	p value	
3-Year OS Rate			
All	389	50.5 (39.4-61.5)	
BED_{10Gy} <100	108	51.4 (12.7-88.5)	
BED_{10Gy} ≥100	259	53.0 (44.1-61.8)	.949
1-Year LC Rate			
All	385	91.3 (83.2-95.7)	
BED_{10Gy} <100	98	75.9 (66.5-83.4)	
BED_{10Gy} ≥100	287	93.6 (89.7-96.0)	<.001
2-Year LC Rate			
All	382	82.2 (71.7-89.4)	
BED_{10Gy} <100	98	62.8 (52.8-71.8)	
BED_{10Gy} ≥100	284	86.7 (82.2-90.3)	<.001
3-Year LC Rate			
All	295	72.2 (55.0-84.7)	
BED_{10Gy} <100	116	66.3 (34.7-87.9)	
BED_{10Gy} ≥100	179	77.6 (65.2-86.5)	.441
Complication Grade ≥3			
All	442	9.1 (5.4-15.0)	
BED_{10Gy} <100	116	2.8 (0.4-16.4)	
BED_{10Gy} ≥100	300	10.8 (6.2-18.1)	.162

Yu et al. Clinical Lung Cancer 2019.

Outcomes of Stereotactic Ablative Radiotherapy for Centrally Located Early-Stage Lung Cancer

Cornelis J. A. Haasbeek, MD, PhD, Frank J. Lagerwaard, MD, PhD, Ben J. Slotman, MD, PhD, and Suresh Senan, MRCP, FRCR, PhD

63 pacientes

Tumores en no fly zone

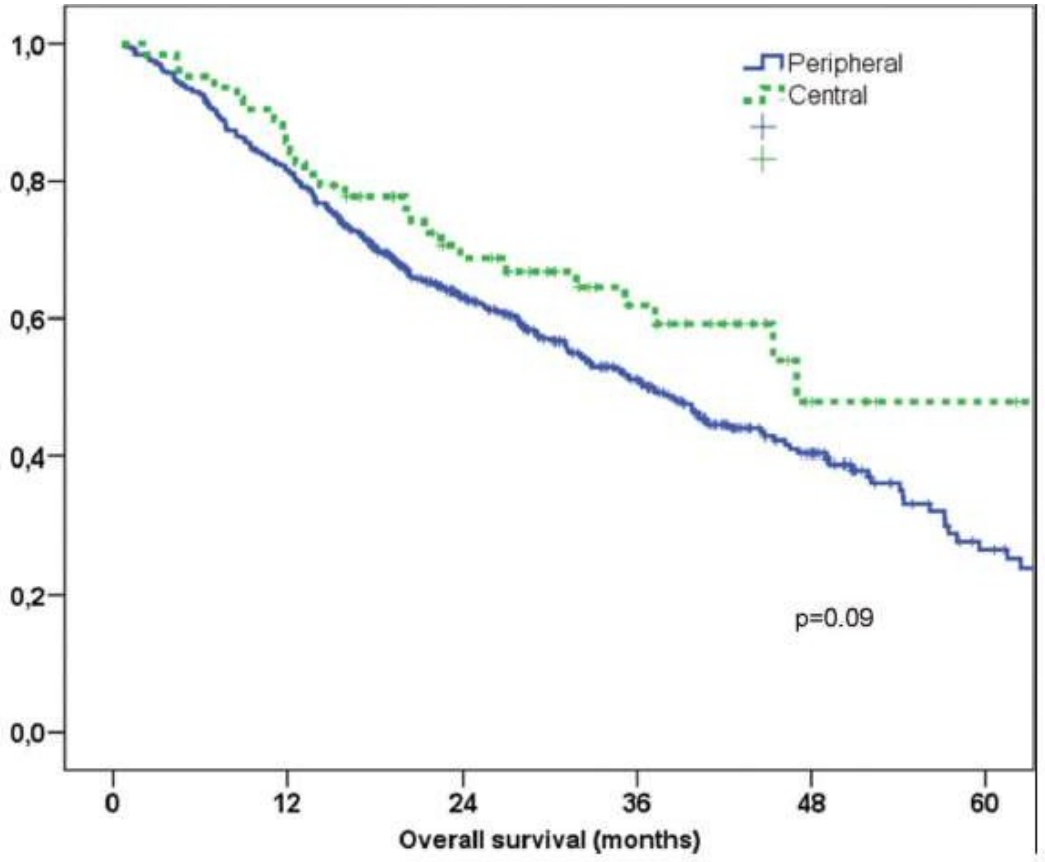
o ≤1 cm desde corazón o mediastino

PTV = ITV +3mm

60Gy/8 (7.5Gy/fracción) Rx 80% isodose

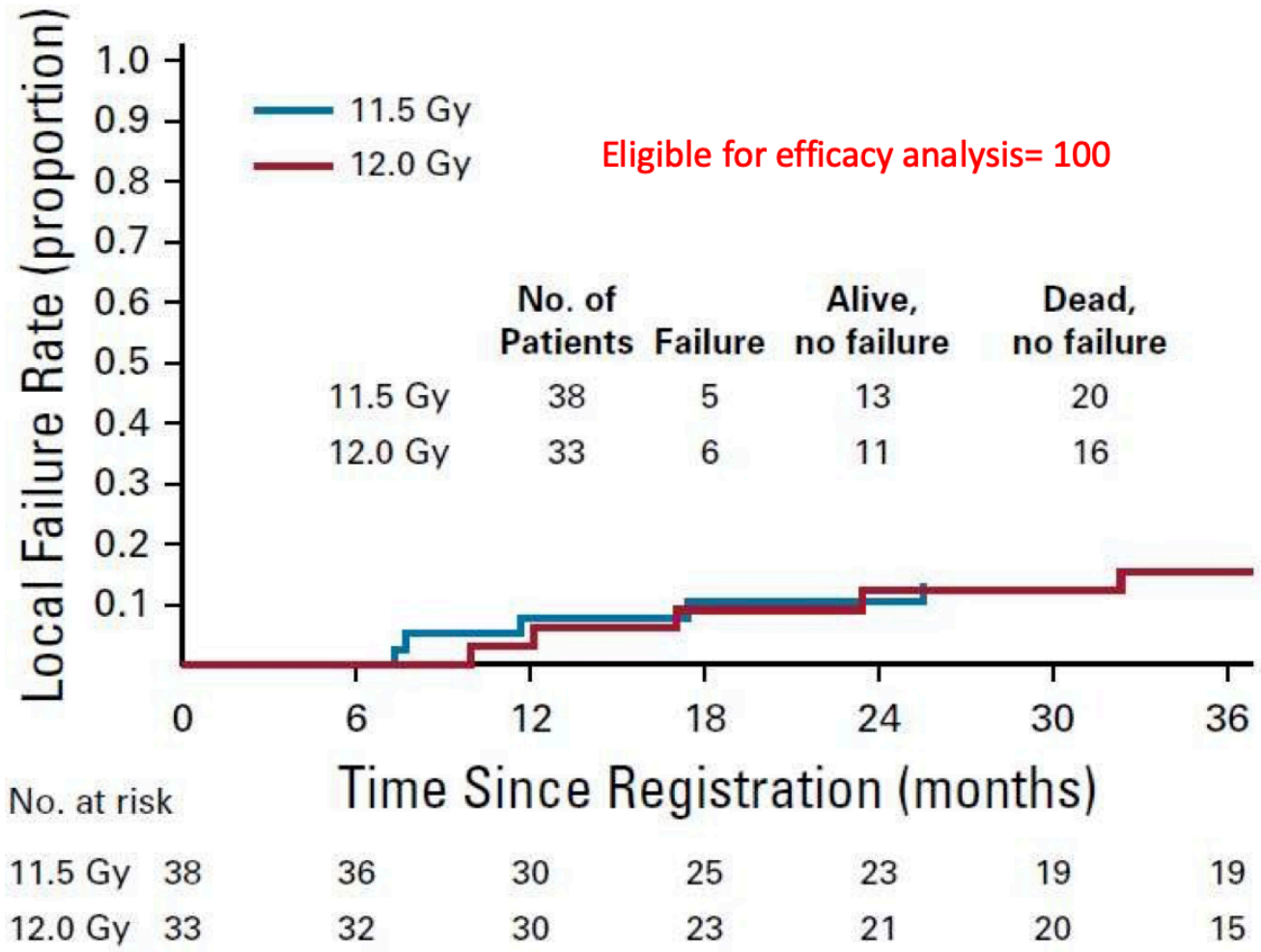
Toxicidad: 8% grado 3 No grado 4/5

Control local: 92.6% 3 años



VU University Amsterdam. J Thorac Oncol. 2011;6: 2036–2043

RTOG 0813: Escala de dosis NSCLC



Andrea Bezjak, JCO 1316, vol 37, issue 15

INTERNATIONAL JOURNAL OF RADIATION BIOLOGY
2019, VOL. 95, NO. 3, 329–337
https://doi.org/10.1080/09553002.2019.1552375

Taylor & Francis
Taylor & Francis Group

ORIGINAL ARTICLE

Is stereotactic body radiotherapy for ultra-central lung tumor a feasible option? A systemic review and meta-analysis

Chai Hong Rim[a], Young Kim[b], Chul Yong Kim[c], Won Sup Yoon[a], and Dae Sik Yang[d]

Table 3. Pooled rates of primary endpoints among patients with UC tumors.

Outcome	Study (*n*)	Patients (*n*)	*p*, heterogeneity	I^2 (%)	Egger's test, *p*	Events (%) (95% CI)
Two-year LC	4	126	.751	0	.483	96.7 (91.0–98.9)
Two-year OS	4	160	<.001	87.8	.781	57.7 (32.0–79.8)
Complications ≥ grade 3	7	205	<.001	75.7	.184	23.2 (11.8–40.5)

CI: confidence interval; LC: local control; OS: overall survival.

PTV vs cobertura OAR

Seleccionar restricciones
RTOG vs. EORTC

Restricciones OK

Tratamiento

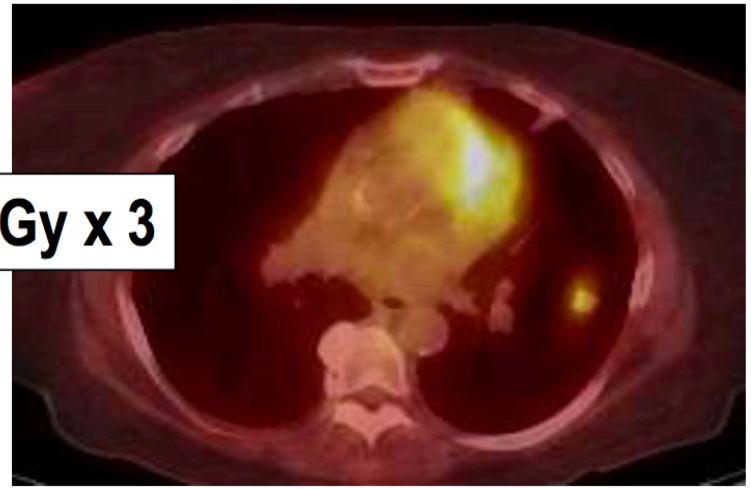
Restricciones no cumplidas

RT convencional

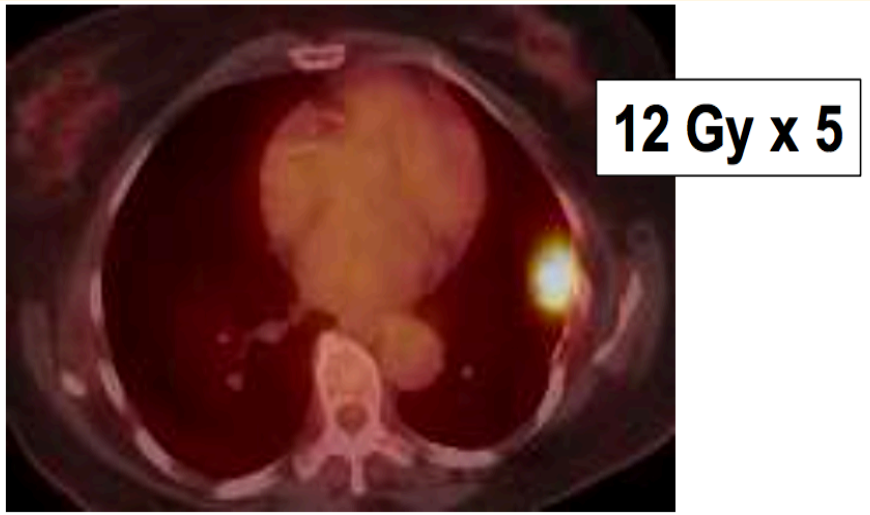
Compromiso de cobertura de PTV y/o bajar dosis para respetar OAR

Reducir dosis de PTV en porción crítica de PTV
Dose painting

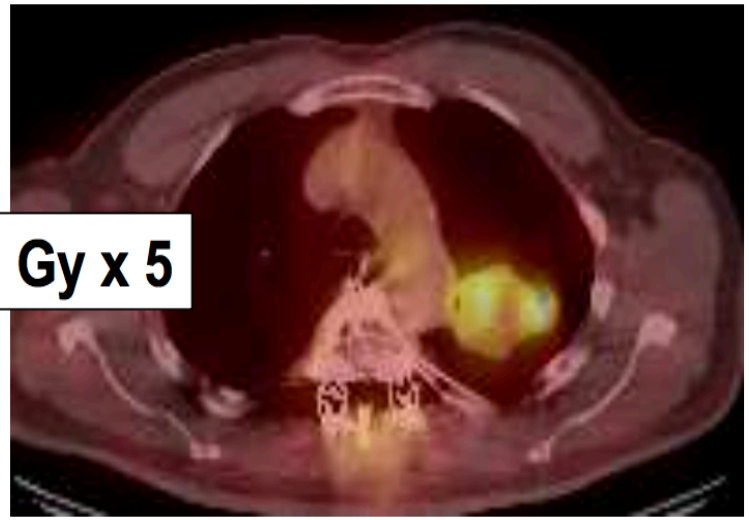
Fraccionamientos
Redicir hot spot
Minimizar ITV



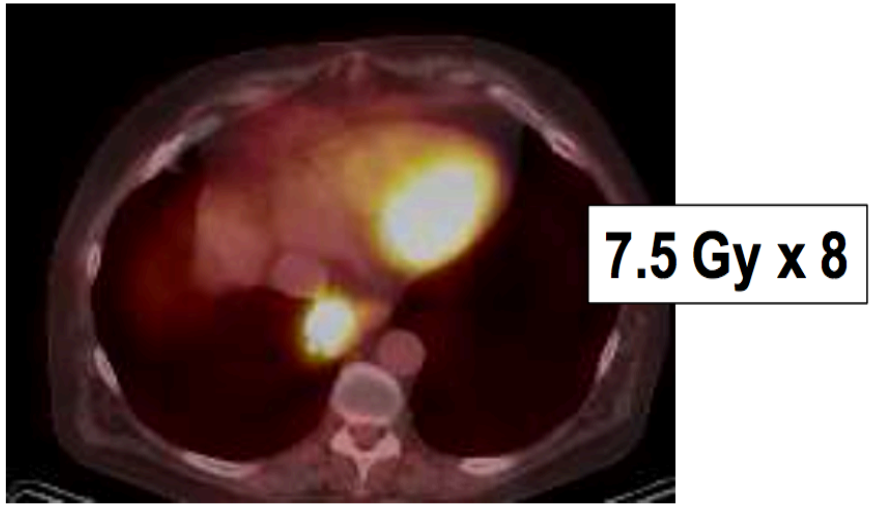
Peripheral



Very peripheral



Central



“Supercentral”

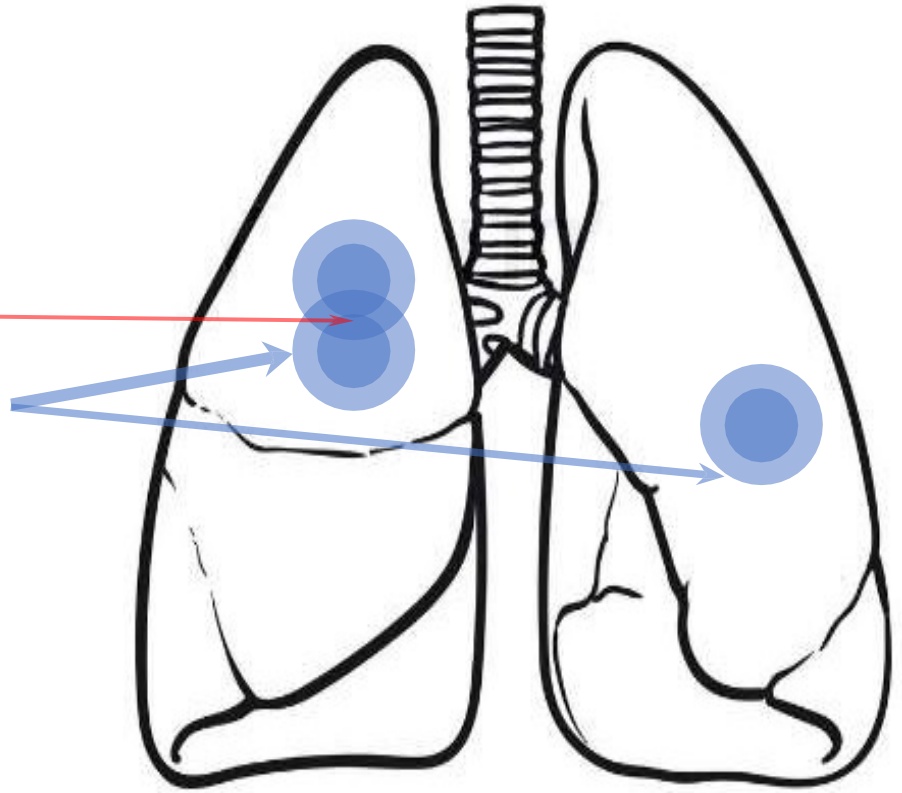
Tumores pulmonares múltiples: Escenarios

- 👉 **Primarios sincrónicos T1-T2 NSCLC**
- 👉 **Nódulos separados NSCLC**
  - **T3 (mismo lóbulo)**
  - **T4 (mismo pulmón, lóbulos diferentes)**
- 👉 **Oligometastasis**

Exposición tejidos sano

vs. blanco único…

- ↑ volumen de alta dosis
- ↑ volumen baja/moderada dosis



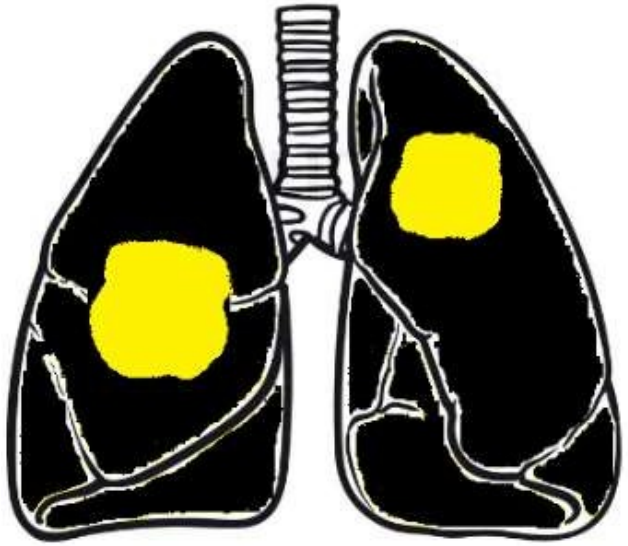
Volumen Absoluto de pulmón ahorrado

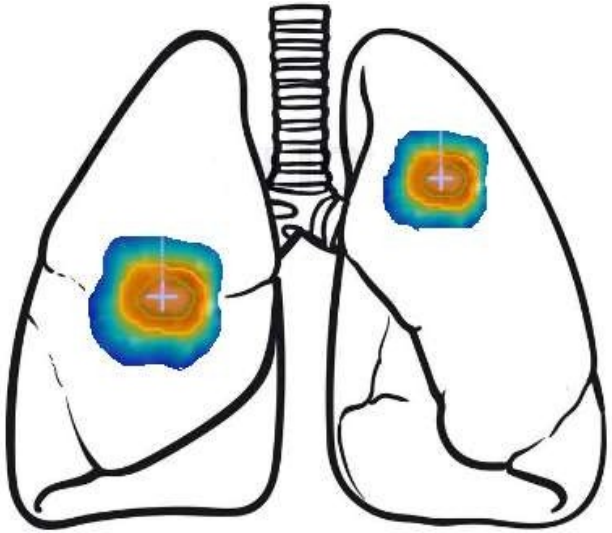
(Volumen crítico <12.5 Gy)

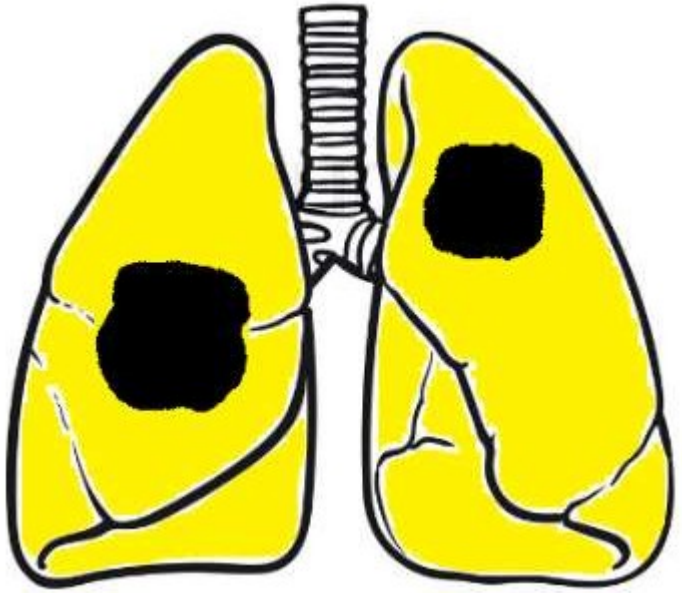
o

Volumen Relativo de pulmón irradiado

(lung V20)







Restricciones de dosis: NRG

- **NRG oligometastasis : BR001, BR002 and LU002**
- **SABR-COMET-3 &-10** (1-3 & 4-10 mets)

Toxicity	Critical Volume	1-fraction	3 fractions	5 fractions
Pneumonitis	>1000 cc	7.4 Gy	11.4 Gy	13.5 Gy
↓ lung function	>1500 cc	7.0 Gy	10.5 Gy	12.5 Gy
Toxicity	**Threshold**	**1-fraction**	**3 fractions**	**5 fractions**
Pneumonitis	<37%	V8	V11	V13.5

Restricciones de dosis: NRG

- **STEREO-SEIN** (1-5 oligometástasis cancer de mama)

Toxicity	Threshold	4-9 fractions
Pneumonitis	≤35%	V15
Pneumonitis	<10%	V20

Inst. Gustave Roussy

- **SAFRON II/TROG 13.01** (1-3 oligometástasis de pulmón)

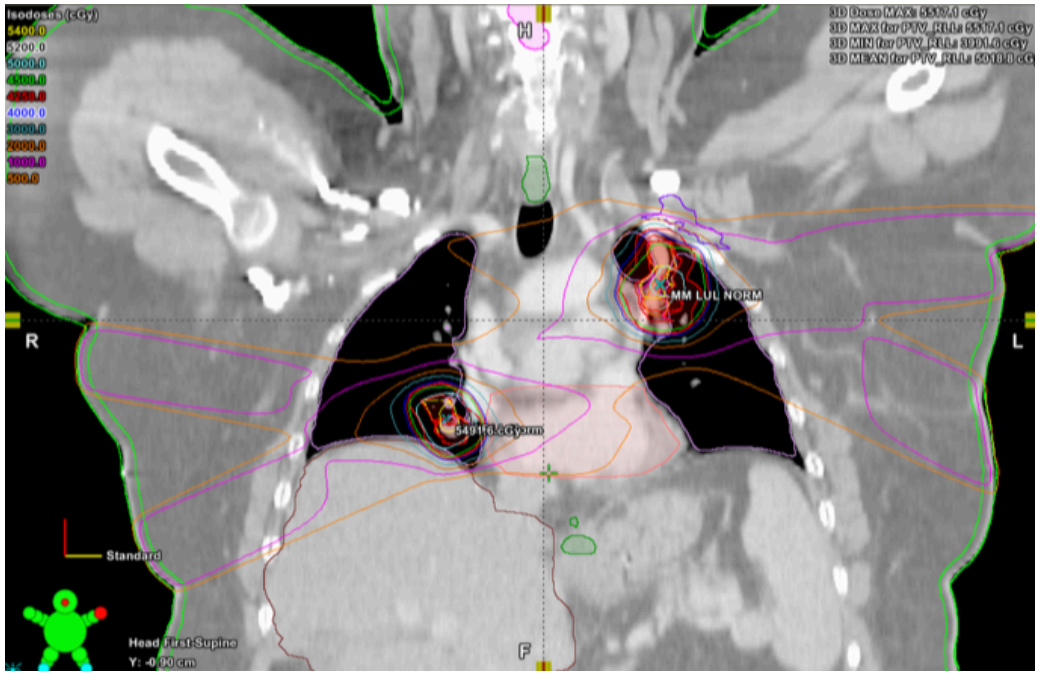
Toxicity	Threshold	1-fraction	4 fractions
Pneumonitis	<1000 cc	V5	V5
Toxicity	**Critical Volume**	**1-fraction**	**4 fractions**
Pneumonitis	>66% lung	7.4 Gy	12.4 Gy

Siva S et al. BMC Cancer. 2016;16:183

Soluciones prácticas + 2 lesiones

- **Isocentro único vs múltiple**
- **Haces modulados**
  - **Volume Modulated Arc Radiotherapy (VMAT)**
- **Generar plan suma** *(si hay isocentros separados)*
- **Fraccionamiento convencional/hipofraccionado moderado**
  - *Compromiso control local??*
- **Reducir márgenes PTV**
  - *Compromiso control local?*
- **Tratar las lesiones en dias alternos *(UK Consensus)***
  - *Reduce dosis diaria a todo el pulmón*

Múltiples sitios



Oligo-metástasis pulmonares:

SBRT
45 Gy/5Fx a lesión Derecha
40 Gy/5 Fx a lesión Izquierda

Siempre realizar un plan suma si se van a tratar múltiples lesiones

En caso de estructuras paralelas	Tener en cuenta VOLUMEN
En caso de estructuras seriales	Tener en cuenta DOSIS MAXIMA

Toxicidad Esofágica

Clinical Investigation

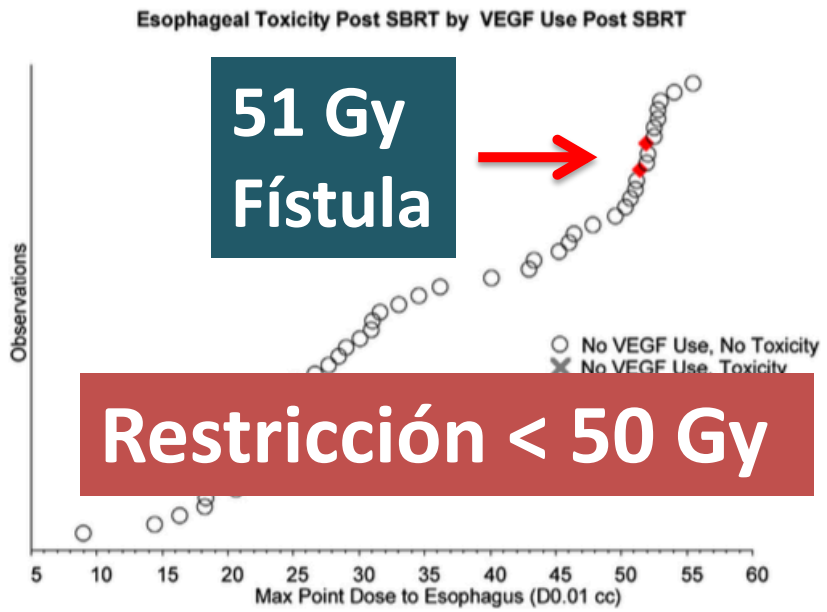
Esophageal Dose Tolerance to Hypofractionated Stereotactic Body Radiation Therapy: Risk Factors for Late Toxicity

Kevin L. Stephans, MD,* Toufik Djemil, PhD,* Claudiu Diaconu, MD,†
Chandana A. Reddy, MS,* Ping Xia, PhD,* Neil M. Woody, MD,*
John Greskovich, MD,* Vinit Makkar, MD,‡ and
Gregory M.M. Videtic, MD, CM, FRCPC*

Int J Radiation Oncol Biol Phys, Vol. 90, No. 1, pp. 197–202, 2014

Toxicidad Esofágica

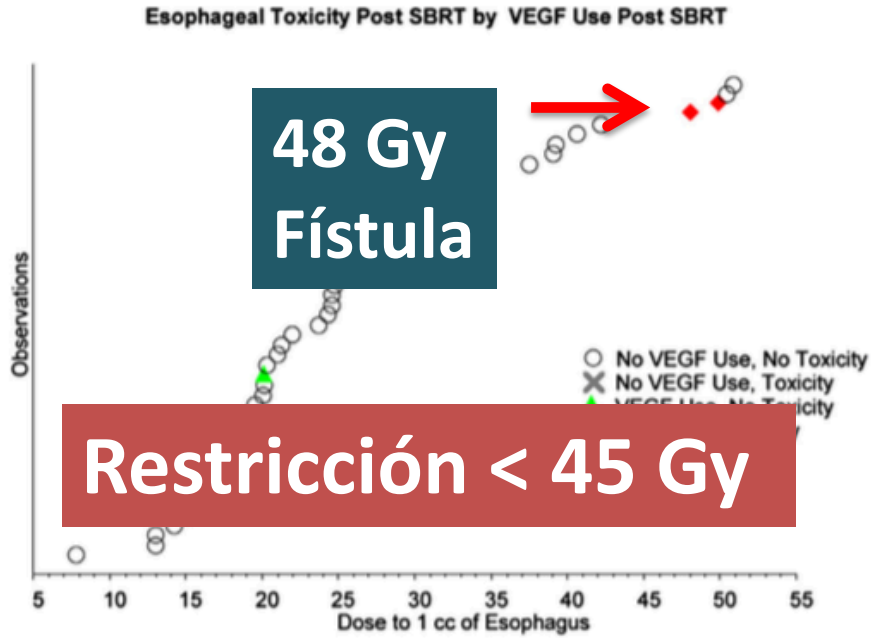
Max Point Dose



Restricción < 50 Gy

Fig. 1. Esophageal toxicity by maximum esophageal point dose and post–stereotactic body radiation therapy vascular endothelial growth factor use.

Dosis 1 CC



Restricción < 45 Gy

Fig. 2. Esophageal toxicity by dose to 1 cc of esophagus and post–stereotactic body radiation therapy vascular endothelial growth factor use.

~~VEGF~~

Int J Radiation Oncol Biol Phys, Vol. 90, No. 1, pp. 197–202, 2014

Toxicidad Esofágica: Dosis única

Clinical Investigation: Thoracic Cancer

Esophageal Toxicity From High-Dose, Single-Fraction Paraspinal Stereotactic Radiosurgery

Brett W. Cox, MD,* Andrew Jackson, PhD,† Margie Hunt, MS,† Mark Bilsky, MD,‡ and Yoshiya Yamada, MD*

Int J Radiation Oncol Biol Phys, Vol. 83, No. 5, pp. e661–e667, 2012

Toxicidad Esofágica: Dosis única

Restringir dosis 2.5 cm^3 < 14 Gy → Toxicidad Grado 3 <5%

Table 4 Dosimetric and volumetric predictors of grade ≥3 esophageal toxicity

Dosimetric variable	Median split	Toxicity incidence below median split		Toxicity incidence above median split		RR grade ≥3 toxicity	*P*
		n	%	*n*	%		
D2.5 cm^3	14.02 Gy	2/102	2	12/102	12	12/2 = 6	.01
V10 Gy	4.77 cm^3	4/102	4	10/102	10	10/4 = 2.5	.16
V12 Gy	3.78 cm^3	3/102	3	11/102	11	11/3 = 3.7	.05
V15 Gy	1.87 cm^3	1/102	1	13/102	13	13/1 = 13	.0013
V20 Gy	0.11 cm^3	2/102	2	12/102	12	12/2 = 6	.01
V22 Gy	0.0 cm^3	1/102	1	13/102	13	13/1 = 13	.0013

Abbreviation: RR = relative risk.

Int J Radiation Oncol Biol Phys, Vol. 83, No. 5, pp. e661–e667, 2012

Oligometástasis

Definición Oligometástasis

3 – 5
Metástasis
Detectadas por imágenes

3

5

- **Definición de oligo-metástasis no basada en evidencia**

Estimate of oligometastasis at presentation/year

Over **14,000** Oligometastatic Breast Cancer Patients

Over **50,000** Oligometastatic Lung Cancer Patients

Nearly **10,000** Oligometastatic Prostate Cancer Patients

Over **14,000** Oligometastatic Colorectal Cancer Patients

Ashworth A, et al. Lung Cancer 82(2):197-203 (2013).
Cancer Facts & Figures 2017. ©2017, American Cancer Society, Inc.
Engels B, et al. Radiat Oncol 2012;7:34.
Fong Y, et al. Ann Surg 1999;230(3):309-318.
Jain SK, et al. J Clin Oncol. 2012;30 Suppl; abstr e11512.
Khan AJ, et al. Radiother Oncol 81(2):163-7 (2006).
Khatri VP, et al. J Clin Oncol 2005;23(33):8490-8499.
Mehta N, et al. Int J Oncol 25(6):1677-83 (2004).
Miller KD, et al. CA Cancer J Clin. 66(4):271–289.
Muacevic et al. Urol Oncol 31(4):455-60;2013
Sridharan S, et al. Radiother Oncol 121:98-102, 2016
NCT02364557/NRG-BR003.
Parikh RB, et al. IJROBP 89(4):880-7 (2014).
Sakai K, et al. Thor Cancer 7(6):670-75 (2016).
Senkus E. Breast. 23(1) 2014.
Siegel RL, et al. CA Cancer J Clin 66(1):7-30.
Singh D, et al. IJROBP 58(1):3-10;2004
Takeda A, et al. World J Gastroenterol 2014;20(15):4220-4229.
Vichapat V, et al. Br J Cancer 2012. 10;107(2):221-223.
Walters S, et al. Thorax 68(6):551-64 (2013).
Waselenko JK and Dawson NA. Oncology 11(10):1551-60;1997

Eficacia Local SBRT

	Lesiones	Control Local@2 A
Mama	33	97%
NSCLC	148	83%
CRC	133	86%
RCC	56	91%
Sarcoma	20	70%
Esófago	15	93%
Melanoma	15	87%
Otros	105	89%
Total	**525**	**87%**

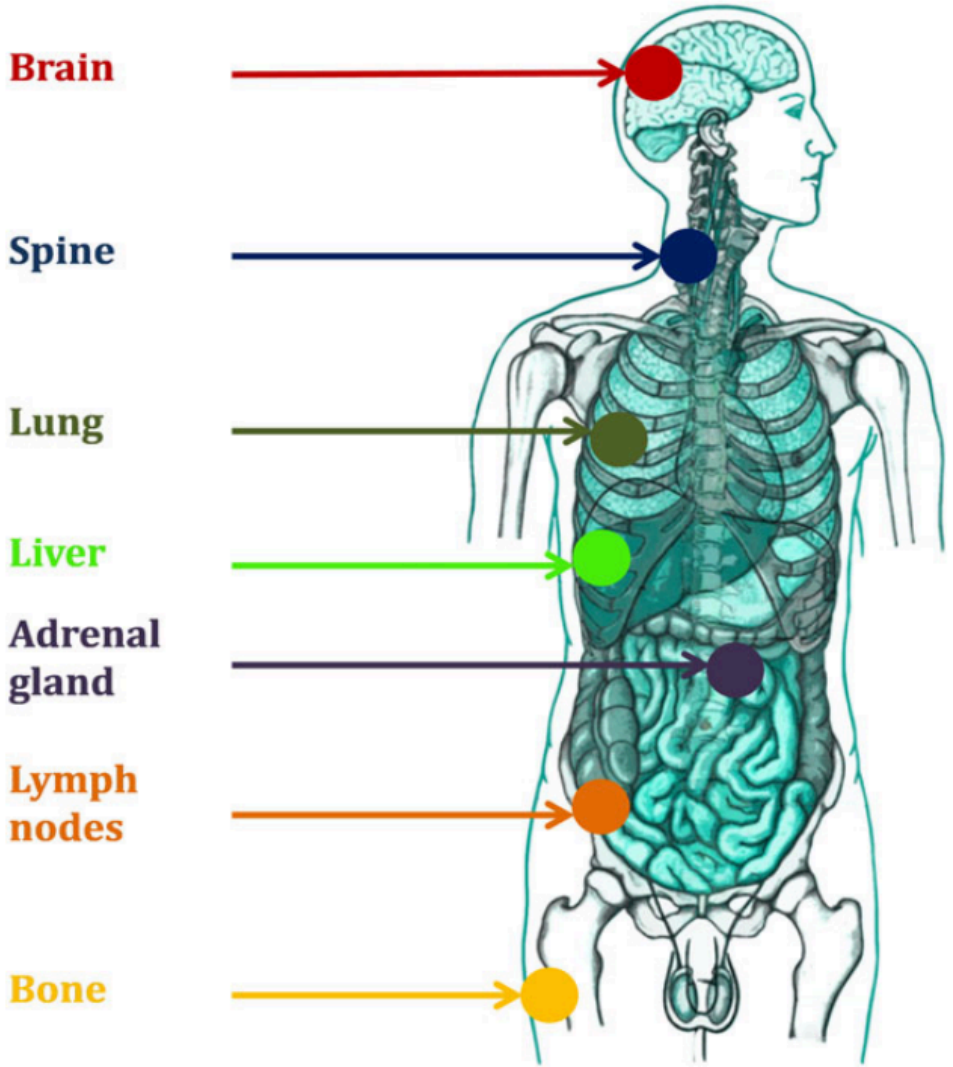
👉 ➢ **70 – 97% control local independiente de la histología**

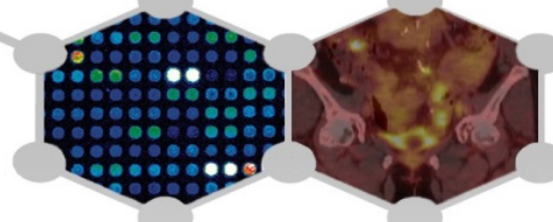
Guckenberger, Radiother Oncology 2015

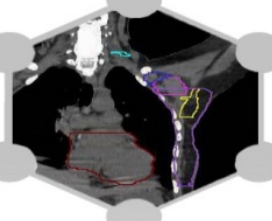
Objetivos tratamiento local

- Cura
- Retraso inicio terapia sistémica
- Paliación a largo plazo/Prevención de síntomas
- Inmuno-modulación
- Tratamiento extendido mas allá de oligoprogresión

Donde SBRT?







NRG ONCOLOGY

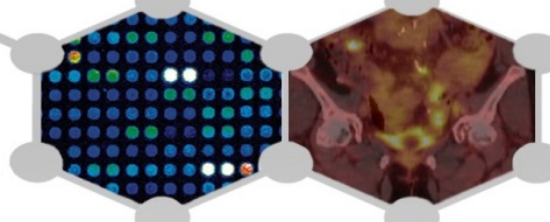
Advancing Research. Improving Lives.™

NRG-BR001: A Phase 1 Study of Stereotactic Body Radiotherapy (SBRT) for the Treatment of Multiple Metastases

Steven J Chmura, MD, PhD[1], Kathryn A Winter, MS[2], Joseph K Salama, MD[3], Clifford Robinson, MD[4], Thomas M. Pisansky, MD[5], Virginia Borges, MD[6], Hania Al-Hallaq, PhD[1], Martha Matuszak, PhD[7], Sean S Park, MD[5], Victor Gonzalez, MD[8], Yasmin Hasan, MD[1], Jose Bazan, MD[9], Philip Wong, MD[10], Harold A Yoon, MD[11], Janet K Horton, MD[3], Gregory N Gan, MD PhD[12], Michael T Milano, MD, PhD[13], Elin Ruth Sigurdson, MD[14], Jennifer Moughan, MS[2], Julia White, MD[9]

[1] University of Chicago Comprehensive Cancer Center; [2] NRG Oncology Statistics and Data Management Center/ACR; [3] Duke University Medical Center; [4] Washington University in St. Louis; [5] Mayo Clinic; [6] University of Colorado – Anschutz Medical Center; [7] University of Michigan; [8] University of Arizona Medical Center – University Campus; [9] Ohio State University Comprehensive Cancer Center; [10] Centre Hospitalier de l'Université de Montréal; [11] Heartland Cancer Research NCORP; [12] University of New Mexico Comprehensive Cancer Center; [13] University of Rochester; [14] Fox Chase Cancer Center

ASTRO Annual Meeting: 10/24/2018



SBRT Dosing

NRG ONCOLOGY

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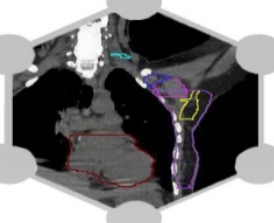
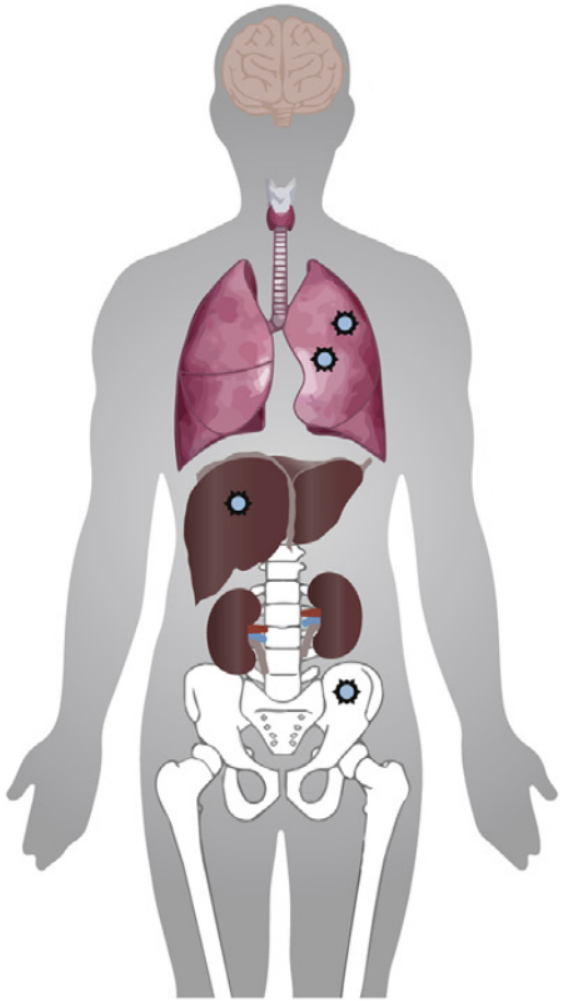


Metastatic Location	Initial Starting Dose	Dose De-escalation
Lung – Peripheral	45 Gy (3 fxs)	42 Gy (3 fxs)
Lung – Central	50 Gy (5 fxs)	47.5 Gy (5 fxs)
Mediastinal/Cervical Lymph Node	50 Gy (5 fxs)	47.5 Gy (5 fxs)
Liver	45 Gy (3 fxs)	42 Gy (3 fxs)
Spinal/Paraspinal	30 Gy (3 fxs)	27 Gy (3 fxs)
Osseous	30 Gy (3 fxs)	27 Gy (3 fxs)
Abdominal-pelvic	45 Gy (3 fxs)	42 Gy (3 fxs)



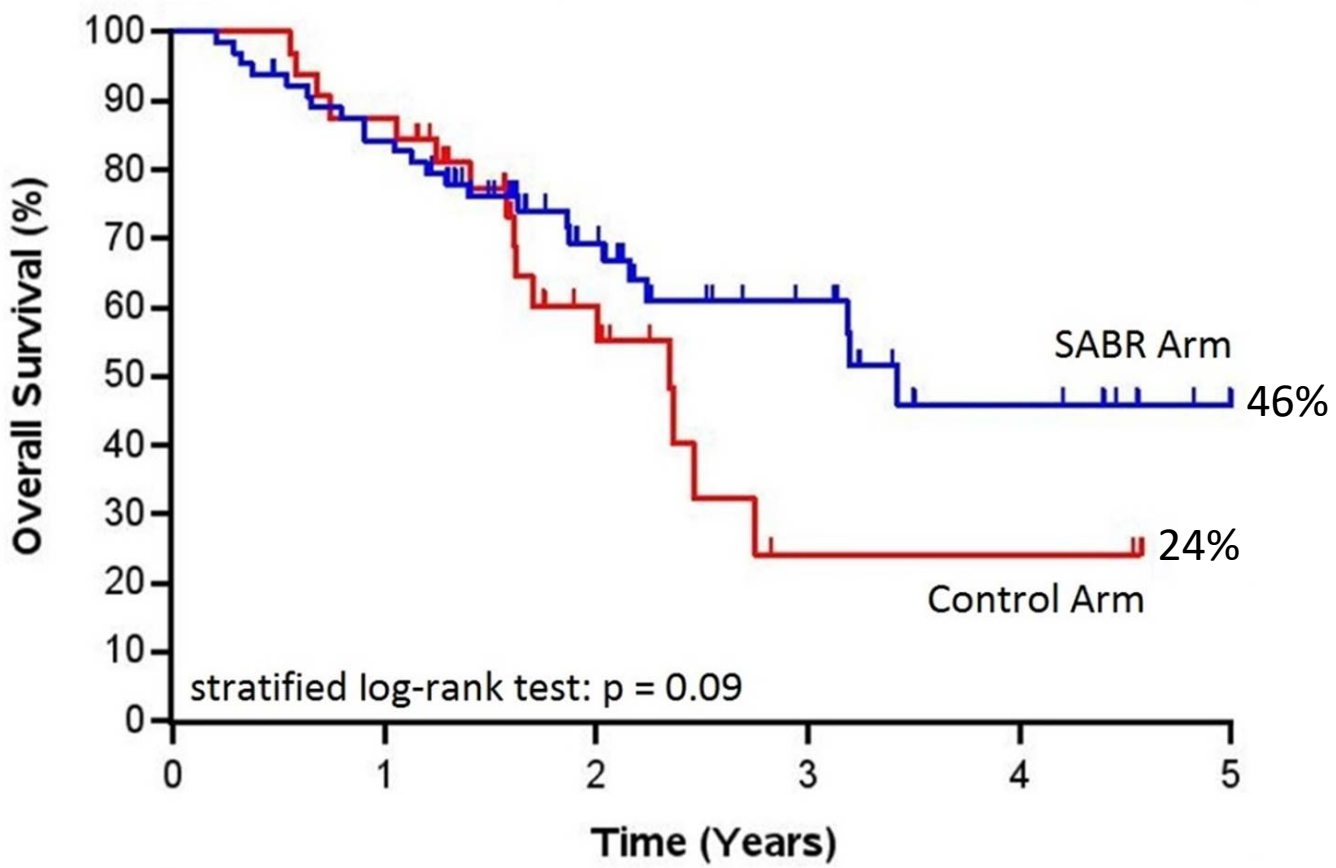
SABR-COMET: Stereotactic Radiation for the Comprehensive Treatment of Oligometastatic Cancers – Results of a Randomized Study

D. Palma, R. Olson, S. Harrow, S. Gaede, A. Louie, C. Haasbeek, L. Mulroy, M. Lock, G. Rodrigues, B. Yaremko, D. Schellenberg, B. Ahmad, G. Griffioen, S. Senthi, A. Swaminath, N. Kopek, M. Liu, K. Moore, S. Currie, G. Bauman, A. Warner, S. Senan

Western UNIVERSITY · CANADA

OICR Ontario Institute for Cancer Research

Sobrevida Total



Number at risk:

Control	33	28	12	2	2	
SABR	66	53	29	15	7	1

SV Media

Rama Control: 28 meses
(95% CI: 19-33 meses)

Rama SABR: 41 meses
(95% CI: 26 meses no alcanzada)

Oligometástasis Abdominales

- Toxicidad Hepática
- Toxicidad gástrico/duodenal

Toxicidad Hepática

- Índices de toxicidad son bajos en los trabajos prospectivos con metástasis hepáticas
- Mayor toxicidad en pacientes con hepatocarcinoma, especialmente pacientes Child-Pugh B con score >8
- Es prudente utilizar diferentes restricciones: metástasis # HCC

RILD
Enfermedad Hepática Radio-inducida

- Síndrome caracterizado por:
  - Ascitis anictérica
  - Elevación de FAL y Transaminasas
  - Entre 2 semanas y 4 meses post RT
  - Fallo hepático y muerte

Selección de Pacientes: Metástasis

Table 2 Selection criteria for SBRT

Selection criteria	Patients categories		
	Suitable	Cautionary	Unsuitable
Lesion number	<3	4	>4
Lesion diameter (cm)	1-3	>3 and ≤6	>6
Distance from OARs (mm)	>8	5-8	<5
Liver function	Child A	Child B	Child C
Free liver volume (cc)	>1,000	<1,000 and ≥700	<700

SBRT, stereotactic body radiation therapy; OARs, organs at risk.

J Gastrointest Oncol 2014;5(3):190-197

Toxicidad Hepática: Metástasis

Table 1. — Summary of Dose-Volume Constraints for Liver With Conversion to Biologic Equivalent Dose (BED) and Single-Fraction Equivalent Dose (SFED)

Study	Dose-Volume Constraint (as reported)	Dose-Volume Constraint (converted to V_{Gy})	BED (Gy_3)		SFED	
Herfarth et al[19]	12 Gy to 30% 7 Gy to 50%	V12 ≤ 30% V7 ≤ 50%	V60 ≤ 30% V29.3 ≤ 50%		V12 ≤ 30% V7 ≤ 50%	
			1 fx	**3 fx**	**1 fx**	**3 fx**
Wulf et al[21] Wulf et al[23]	D30 < 7 Gy D50 < 5 Gy	V7 ≤ 30% V5 ≤ 50%	V23.3 ≤ 30% V13.3 ≤ 50%	V12.4 ≤ 30% V7.8 ≤ 50%	V7 ≤ 30% V2.8 ≤ 30%	V5 ≤ 50% V0.8 ≤ 50%
Schefter et al[20] Kavanagh et al[8]	700 cm^3 < 15 Gy	$V_{≤15}$ ≥ 700 cm^3	$V_{≤40}$ ≥ 700 cm^3		$V_{≤10.8}$ ≥ 700 cm^3	
Hoyer et al[22]	10 Gy total < 30%	V10 < 30%	V21.1 < 30%		V5.8 < 30%	
			3 fx	**5 fx**	**3 fx**	**5 fx**
Méndez Romero et al[18]	D33 < 21 Gy D50 < 15 Gy	V21 ≤ 33% V15 ≤ 50%	V70 ≤ 33% V40 ≤ 50%	V50.4 ≤ 33% V30 ≤ 50%	V16.8 ≤ 33% V12.6 ≤ 33%	V10.8 ≤ 50% V6.6 ≤ 50%
Tse et al[24] *	mean dose < 22 Gy*	N/A mean dose	< 49.6 Gy_3		mean dose < 11.5	

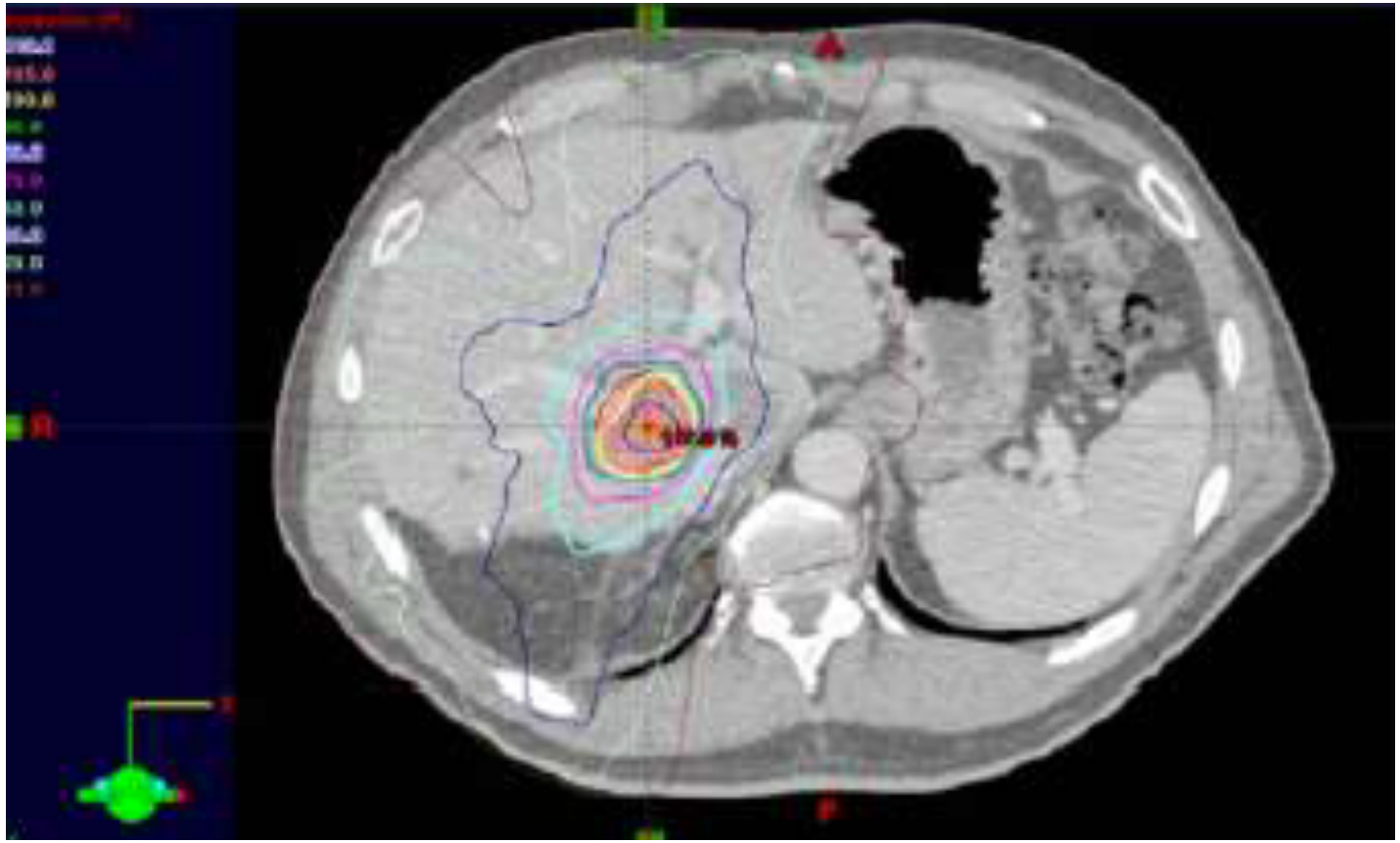
* This study determined liver dose constraint based on a previously reported normal tissue complication probability model described in the appendix. In this appendix it was noted that the constraint was "usually mean dose < 22 Gy."

Sawrie et al. Cancer Control 2010

Take Home Pearls

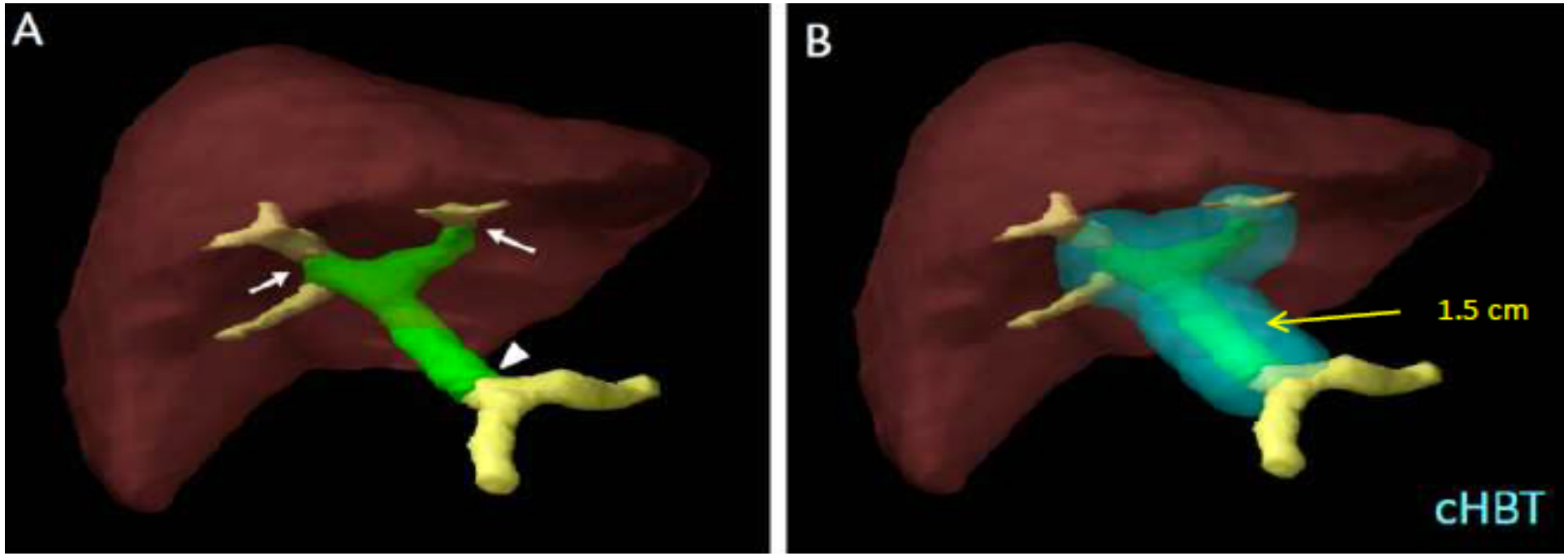
- Dosis iguales o mayores 45-50 Gy, 3-5 Fx
- 35 Gy FX única en localización periférica
- 2-3 fracciones por semana
- Utilizar restricciones conservadoras
- 15 Gy < 700 cc^3 hígado

Toxicidad Hepática Central



SBRT segmento VIII

Toxicidad Hepática Central



$VBED_{10}72 \geq 21\ cm^3$, $VBED_{10}66 \geq 24\ cm^3$, and
$DmeanBED_{10}$ cHBT ≥ 14 Gy → cHBT toxicity

5 fractions: $V40 < 21\ cm^3$/ $V37.7 < 24\ cm^3$

3 fractions: $V33.8 < 21\ cm^3$/ $V32 < 24\ cm^3$

Osmundson et al. IJROBP 2015

Intestino Delgado

Int J Colorectal Dis (2013) 28:1707–1713
DOI 10.1007/s00384-013-1717-6

ORIGINAL ARTICLE

Severe intestinal toxicity after stereotactic ablative radiotherapy for abdominopelvic malignancies

Sun Hyun Bae · Mi-Sook Kim · So Young Kim · Won Il Jang · Chul Koo Cho · Hyung Jun Yoo · Kum Bae Kim · Dong Han Lee · Chul Ju Han · Ki Young Yang · Sang Bum Kim

Intestino Delgado

- Objetivo: Daño Intestinal
- N=202
- SBRT abdomen/pelvis: 33-60 Gy en 3 Fxs
- QD vs QOD V_{25} < 20 ml - Max Point Dose < 30 Gy
- Toxicidad intestinal severa disminuyó en pacientes que recibieron SBRT en 4-8 días respecto a días consecutivos
- 0% vs 18%, p= 0.037 – Mayor predictor de daño

Int J Colorectal Dis (2013) 28:1707–1713

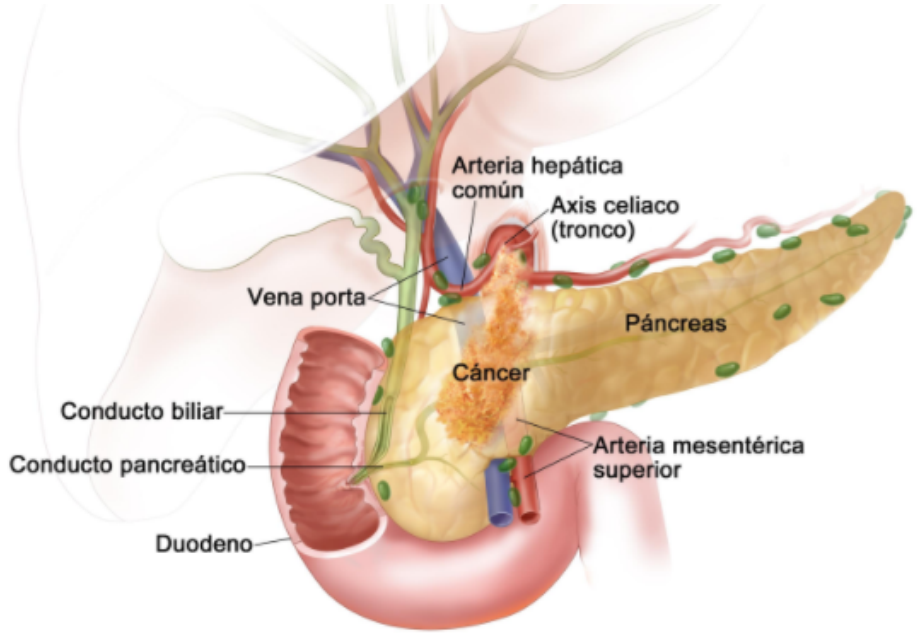
Intestino Delgado

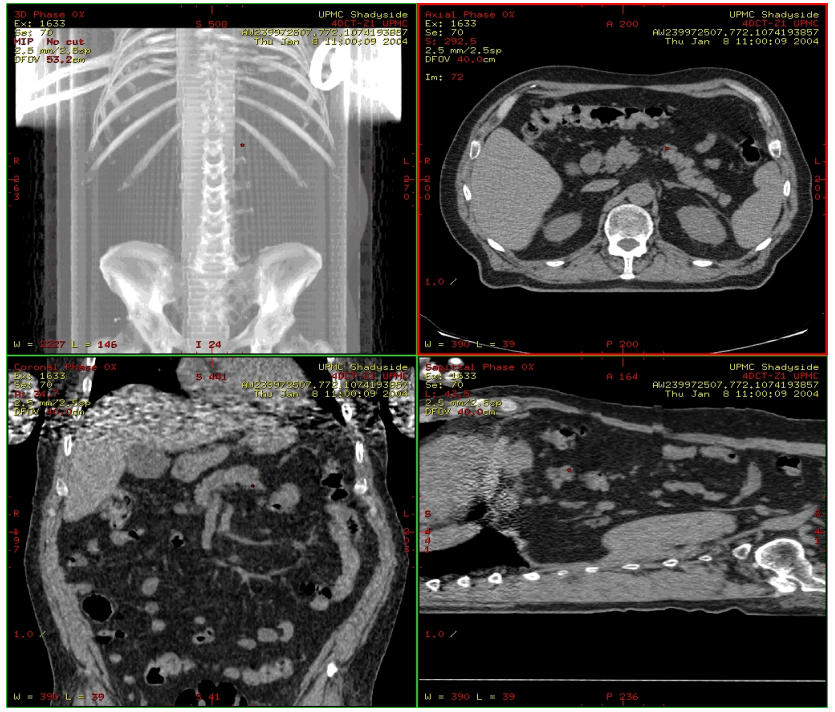
- Riesgo incrementado de toxicidad intestinal con el uso de inhibidores de crecimiento vascular (VEGF-I) post SBRT abdominal

- Incremento estadístico luego de 3 y hasta 6 meses post SBRT (38-33% vs 0%) HR: 16.7

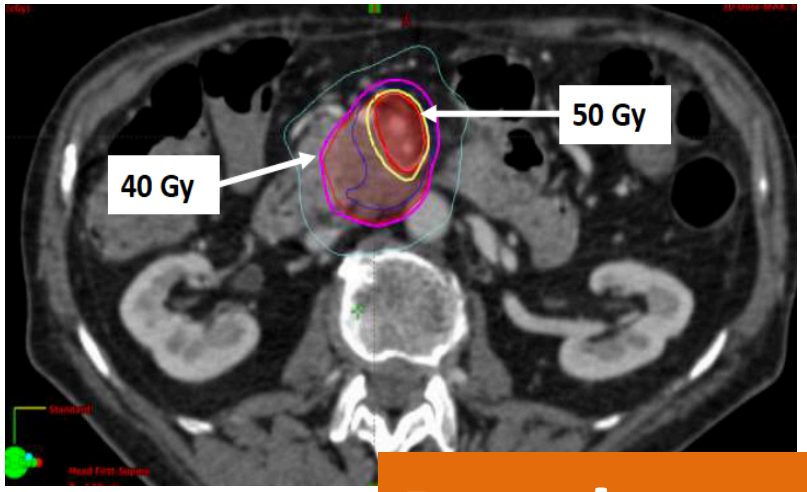
Barney et al. IJROBP 2013

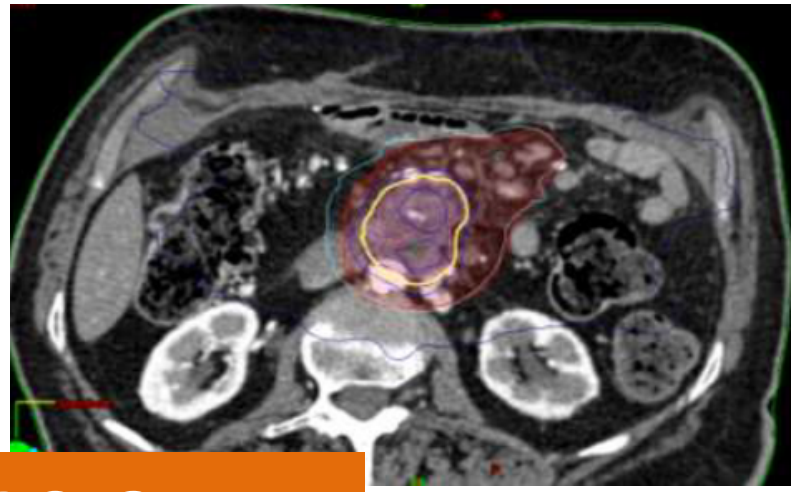
Toxicidad Gastro-duodenal



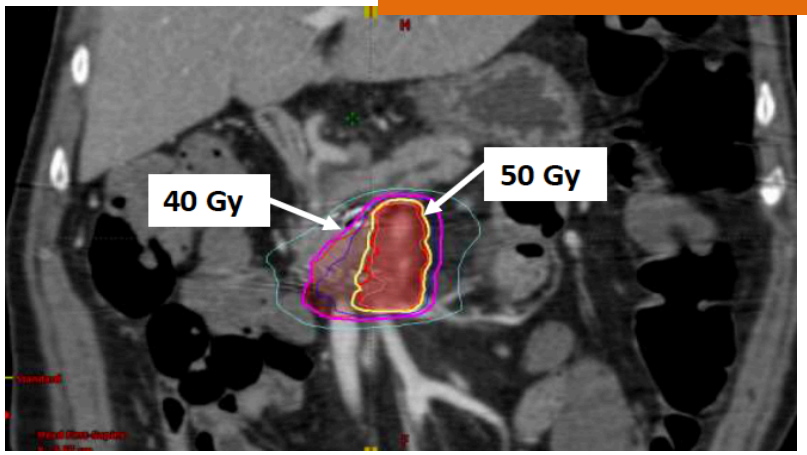


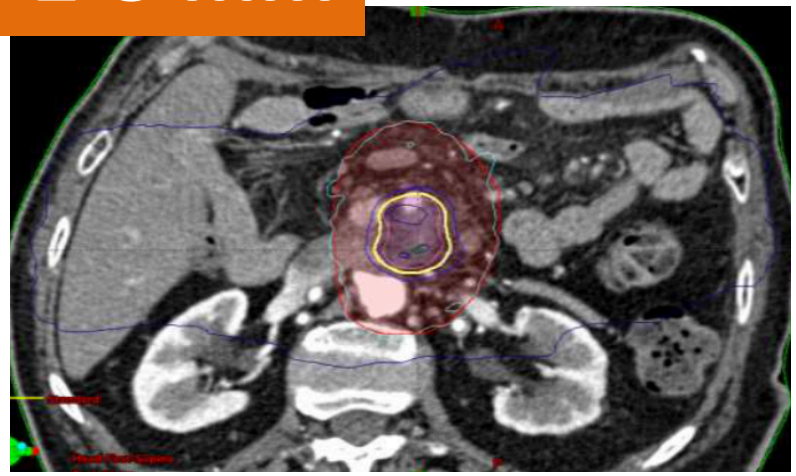
Estructuras adyacentes: Dose Painting





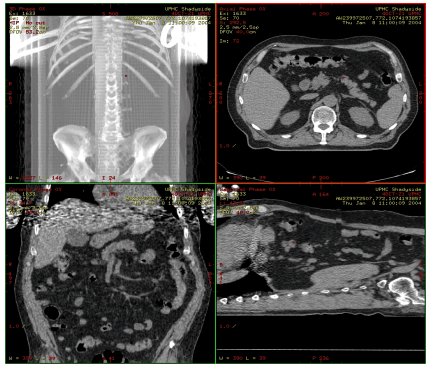
Duodeno: PRV 2-3 mm





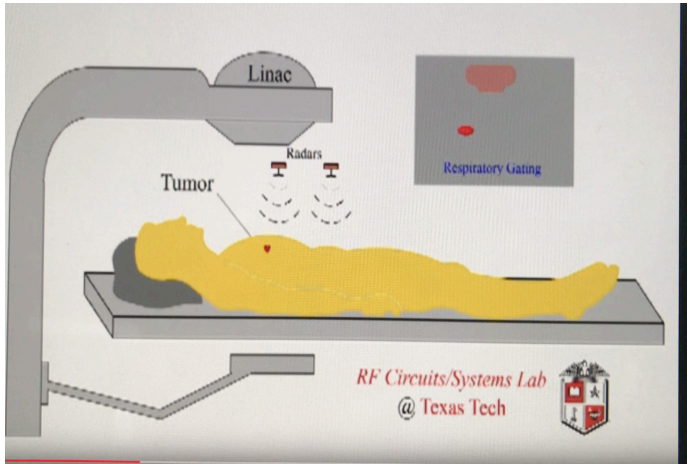
Resolviendo el desplazamiento

Tomografía 4D (4DCT)

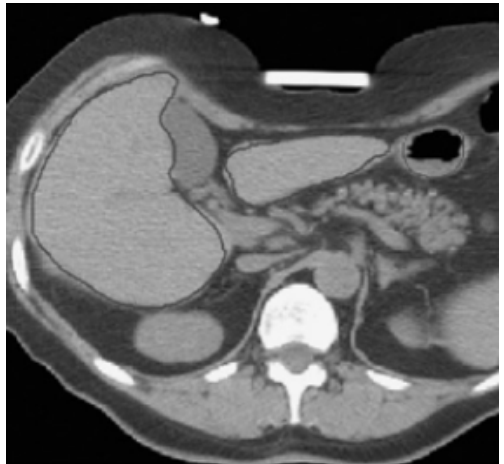


Movimiento > 5 – 10 mm

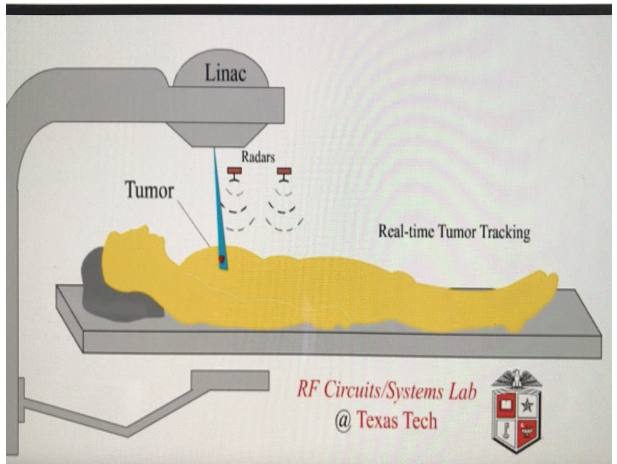
Gaiting Respiratorio



Compresión Abdominal



Tracking



Les prometo que ya termino!!!!!!!!

Columna

- Mielitis radiante
- Fractura/compresión vertebral
- Flare (aumento dolor)
- Plexopatías

Columna

Spine

SPINE Volume 41, Number 20S, pp S238–S245

METASTATIC SPINE TUMORS

Stereotactic Body Radiotherapy for Spinal Metastases

What are the Risks and How Do We Minimize Them?

Joe H. Chang, MD,* John H. Shin, MD,† Yoshiya J. Yamada, MD,‡ Addisu Mesfin, MD,§ Michael G. Fehlings, MD, PhD,¶ Laurence D. Rhines, MD,‖ and Arjun Sahgal, MD*

Recommendation 1

Clinicians might evaluate patients for stabilization prior to SBRT if the following risk factors are observed: baseline VCF, significant lytic tumor burden, spinal malalignment, SINS score indicating potentially or frankly unstable spine, mechanical pain, and/or planned SBRT with ≥20 Gy per fraction.

Columna

Spine

SPINE Volume 41, Number 20S, pp S238–S245

METASTATIC SPINE TUMORS

Stereotactic Body Radiotherapy for Spinal Metastases

What are the Risks and How Do We Minimize Them?

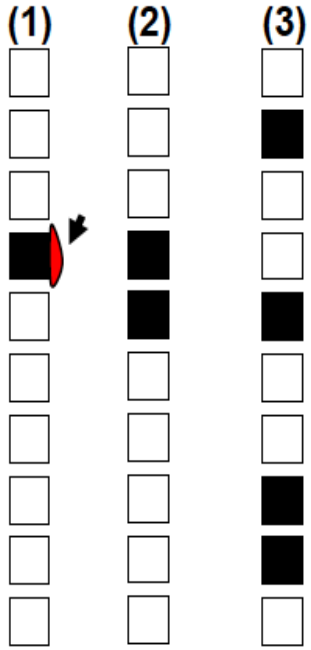
Joe H. Chang, MD,* John H. Shin, MD,† Yoshiya J. Yamada, MD,‡ Addisu Mesfin, MD,§ Michael G. Fehlings, MD, PhD,¶ Laurence D. Rhines, MD,|| and Arjun Sahgal, MD*

Recommendation 2

Clinicians might limit the Dmax to the thecal sac (as a surrogate structure for the spinal cord) for de novo SBRT to an EQD2 of ≤44.6 Gy.

- **Tratamiento primario de**
- **oligometastásis (RTOG 0631)**
  - **Menos del 50% de compromiso de vertebra**
  - **No fragmentos óseos en el canal**
  - **Columna estable**
- **Postoperatorio**
- **Recurrencia post RT**

Figure 1: Diagram of Eligible Metastatic Lesions



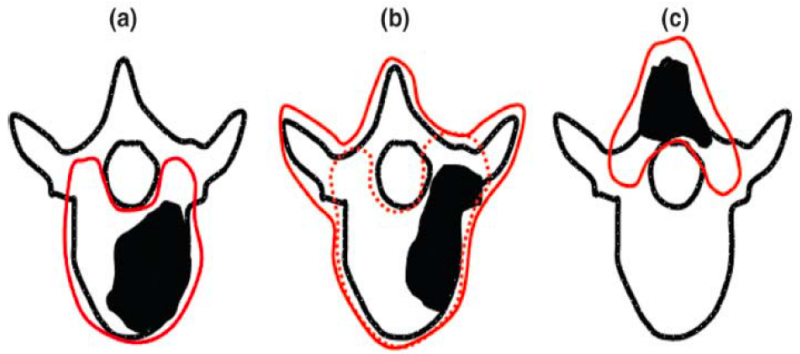


Figure 2: Diagram of Spine Metastasis and Target Volume

VOLUME 29 · NUMBER 22 · AUGUST 1 2011

JOURNAL OF CLINICAL ONCOLOGY

ORIGINAL REPORT

Spinal Instability Neoplastic Score: An Analysis of Reliability and Validity From the Spine Oncology Study Group

Daryl R. Fourney, Evan M. Frangou, Timothy C. Ryken, Christian P. DiPaola, Christopher I. Shaffrey, Sigurd H. Berven, Mark H. Bilsky, James S. Harrop, Michael G. Fehlings, Stefano Boriani, Dean Chou, Meic H. Schmidt, David W. Polly, Roberto Biagini, Shane Burch, Mark B. Dekutoski, Aruna Ganju, Peter C. Gerszten, Ziya L. Gokaslan, Michael W. Groff, Norbert J. Liebsch, Ehud Mendel, Scott H. Okuno, Shreyaskumar Patel, Laurence D. Rhines, Peter S. Rose, Daniel M. Sciubba, Narayan Sundaresan, Katsuro Tomita, Peter P. Varga, Luiz R. Vialle, Frank D. Vrionis, Yoshiya Yamada, and Charles G. Fisher

Spine Instability Neoplastic Score (SINS)

SINS Component	Description	Score
Location	Junctional (Occ-C2, C7-T2, T11-L1, L5-S) Mobile (C3-6, L2-4) Semirigid (T3-10) Rigid (S2-5)	3 2 1 0
Pain	Yes* Occasional non-mechanical pain No	3 1 0
Bone Lesion	Lytic Mixed Blastic	2 1 0
Alignment	Subluxation / translation De novo deformity Normal	4 2 0
Vertebral Body	>50% collapse <50% collapse No collapse with >50% VB involved None of above	3 2 1 0
Posterolateral Involvement	Bilateral Unilateral None	3 1

Tallied Score from 6 components

Stable	Potentially Unstable	Unstable
0-6	7-12	13-18

Fisher CG, et al. A novel classification system for spinal instability in neoplastic disease: an evidence-based approach and expert consensus from the Spine Oncology Study Group. Spine 35(22):E1221-9, 2010

Restricciones: Saco Tecal

Porqué el saco tecal? (márgen anatómico seguro)

- El saco tecal es equivalente a 1.5-2 mm de márgen del planning organ at risk (PRV) por fuera de médula

- El uso del saco tecal como OAR representa el peor escenario de dosis a la médula.
  - Compensa pequeñas incertaezas del software de fusión
  - Compensa movilidad medular
  - Compensa pequeños variaciones intrafracción

PRV médula

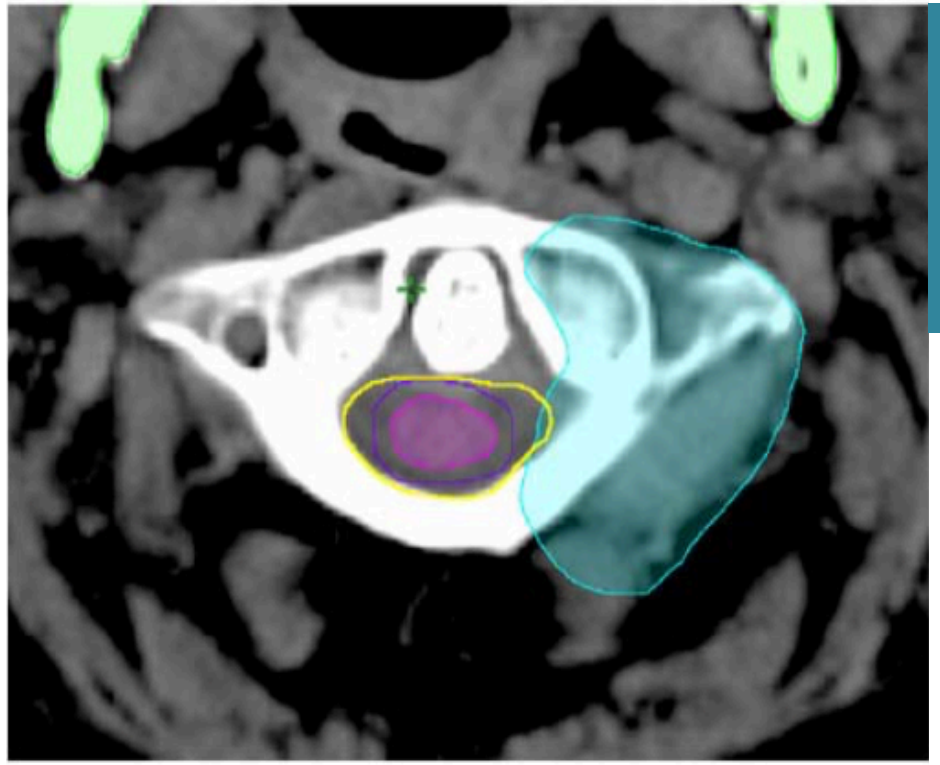
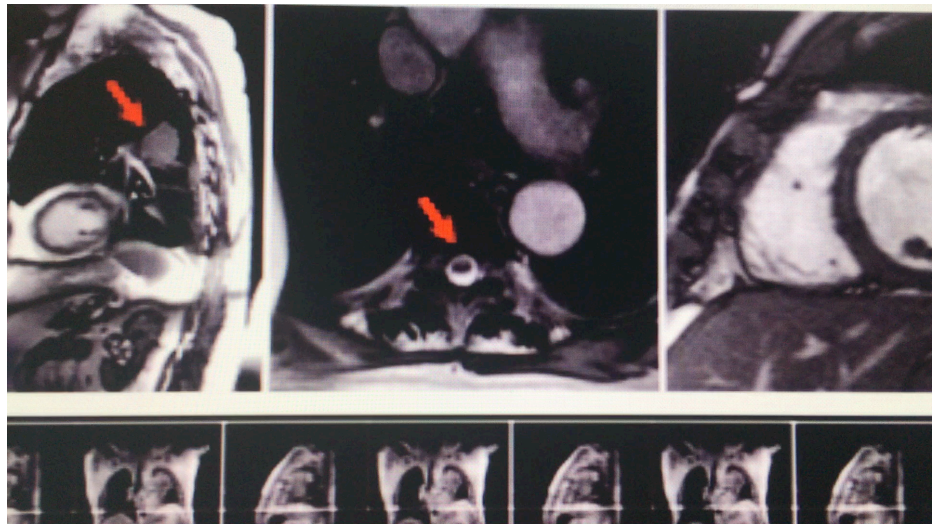


Fig. 1. Axial view of a C1 vertebra involved by metastatic non–small-cell lung carcinoma. The spinal cord is shaded in magenta, the planning organ-at-risk volume (spinal cord + 0.2 cm) is outlined in purple, and the thecal sac is outlined in yellow.

La práctica más común es
Agregar 1.5-2mm a la
Médula delineada en secuencia T2
De RMN o Mielograma de TAC



Lo et al. IJROBP 2010

Fractura/compresión vertebral

VOLUME 31 · NUMBER 27 · SEPTEMBER 20 2013

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ORIGINAL REPORT

Vertebral Compression Fracture After Spine Stereotactic Body Radiotherapy: A Multi-Institutional Analysis With a Focus on Radiation Dose and the Spinal Instability Neoplastic Score

Arjun Sahgal, Eshetu G. Atenafu, Sam Chao, Ameen Al-Omair, Nicholas Boehling, Ehsan H. Balagamwala, Marcelo Cunha, Isabelle Thibault, Lilyana Angelov, Paul Brown, John Suh, Laurence D. Rhines, Michael G. Fehlings, and Eric Chang

J Clin Oncol 31:3426-3431. © 2013

2-3 meses

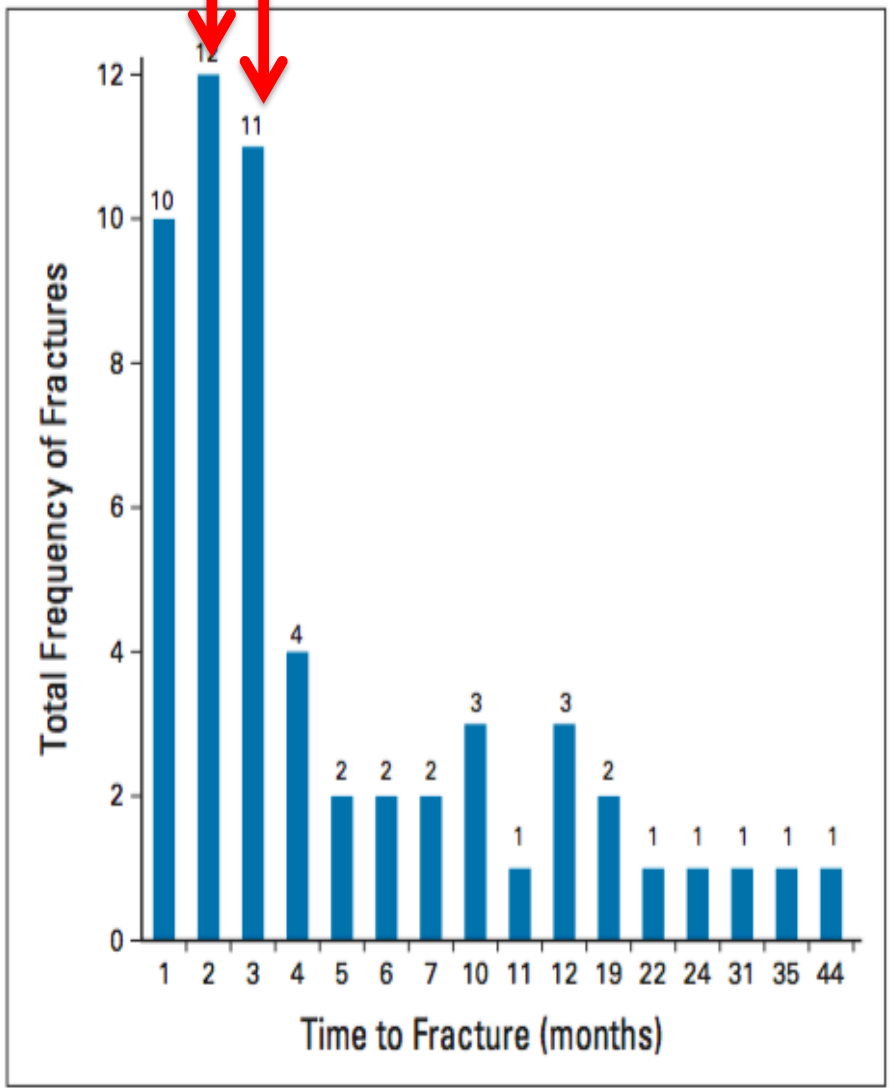

Fig 1. Distribution of the events of vertebral compression fracture over time in 1-month time intervals after spine stereotactic body radiotherapy.

Table 3. Significant Predictors of VCF on Univariate and Multivariate Analysis

Factor	Univariate *P*	Multivariable Fine and Grey Model *P*	HR	95% CI
Vertebral body collapse	< .001	Global, < .001		
≥ 50% VCF		.0189	6.92	1.38 to 34.77
< 50% VCF		< .001	8.98	4.48 to 18.00
No VCF but > 50% of vertebral body involved		< .001	4.46	2.08 to 9.57
Dose/fraction, Gy	< .001	Global, < .001		
≥ 24		< .001	5.25	2.29 to 12.01
20-23		< .001	4.91	1.96 to 12.28
Alignment	.0027	< .001	2.99	1.57 to 5.70
Bone lesion type	< .001	.0022	3.53	1.58 to 7.93
Paraspinal/epidural extension	.0036	NS		

NOTE. For vertebral body collapse, the reference is no VCF and less than 50% vertebral body involvement; for dose/fraction, the reference is ≤ 19 Gy/fraction; the reference for alignment was normal, and yphosis/scoliosis and subluxation/translation were grouped as only one patient had subluxation; and the reference for bone lesion was grouped according to mixed and osteoblastic tumor versus osteolytic, given that the majority of VCFs occurred in lytic tumors.

Abbreviations: HR, hazard ratio; NS, not significant; VCF, vertebral compression fracture.

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Fractura/compresión vertebral

Precauciones

- Dosis > 20 Gy fracción
- Tumores líticos
- Fractura/compresión vertebral de base (>50%)
- Seguimiento frecuente: 2/3 dentro de 4 meses
- Utilidad Spinal Instability Neoplastic Score
  - Estable (0=6)
  - Potencialmente inestable (7-12)
  - Inestable > 12

Flare

Clinical Investigation: Central Nervous System Tumor

Pain Flare Is a Common Adverse Event in Steroid-Naïve Patients After Spine Stereotactic Body Radiation Therapy: A Prospective Clinical Trial

Andrew Chiang, MD,*,† Liang Zeng, MD(C),* Liying Zhang, PhD,*
Fiona Lochray, MRTT,* Renee Korol, PhD,* Andrew Loblaw, MD,*
Edward Chow, MBBS, PhD,* and Arjun Sahgal, MD*,†

Int J Radiation Oncol Biol Phys, Vol. 86, No. 4, pp. 638–642, 2013

Flare

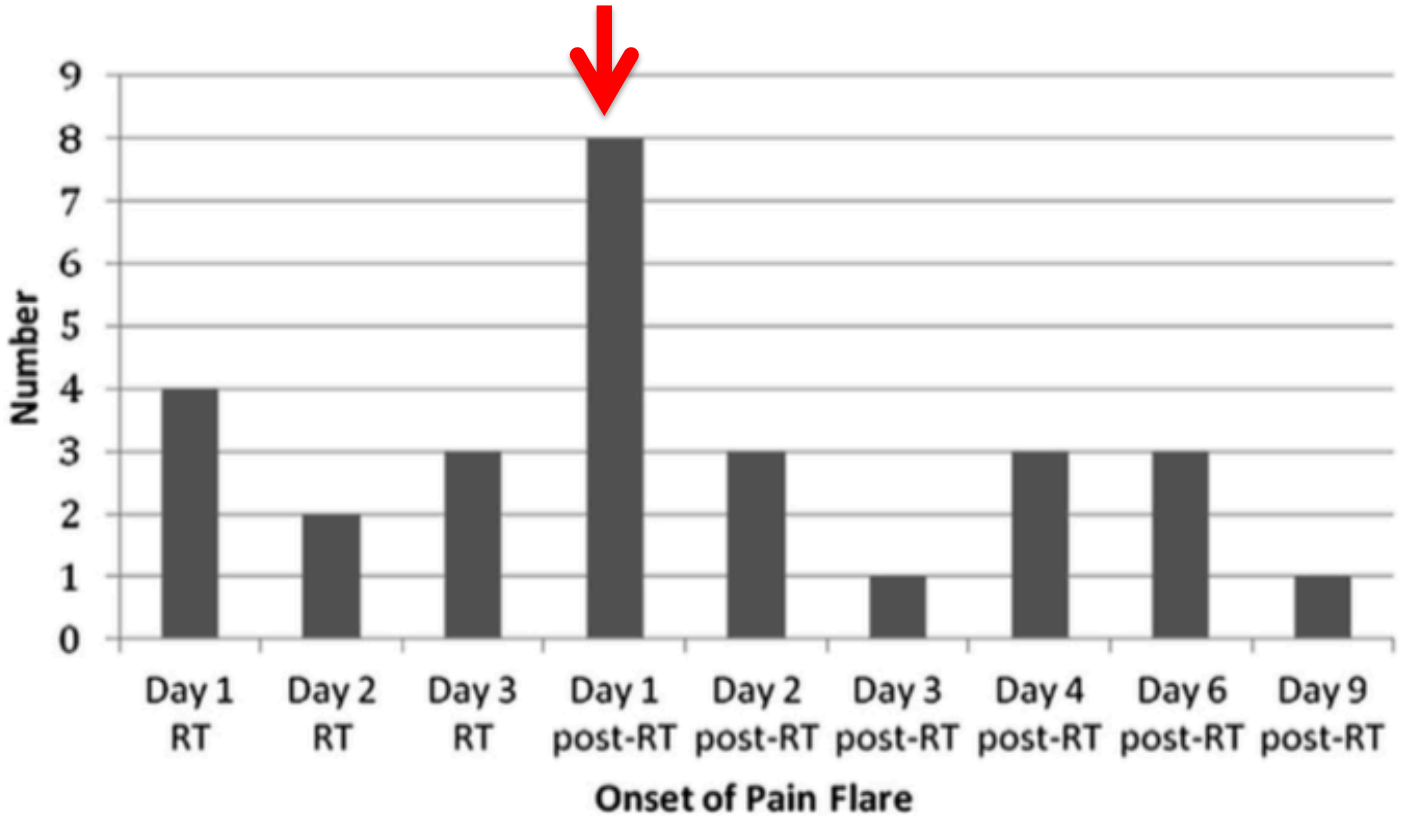

Fig. 1. Day of pain flare onset during and after spine stereotactic body radiation therapy (RT) (n = 28 pain flares).

68.3%

Int J Radiation Oncol Biol Phys, Vol. 86, No. 4, pp. 638–642, 2013

Table 2 Significant predictors of pain flare on multivariate logistic regression analysis

Predictive factor	*P*	Odds ratio (95% confidence interval)
Karnofsky performance status	.02	1.16 (1.03-1.31)
Spine location:	.033	
Lumbar vs thoracic	.02	28.79 (1.8-461.4)
Cervical vs thoracic	.049	11.30 (1.00-127.3)

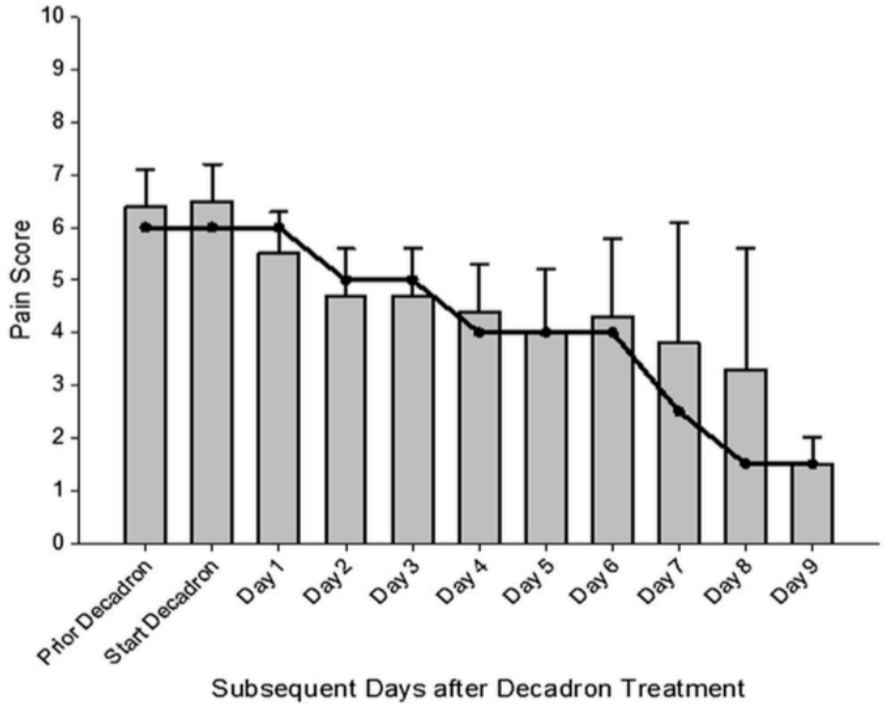

Fig. 2. Change in pain scores after initiation of dexamethasone (n = 11 patients). The bars highlight change in mean worst pain scores (standard error) over time, whereas the dotted line represents the change in median worst pain scores over time.

Los esteroides funcionan

Recomendación:
Profilaxis con esteroides
Con disminución precoz

Corroborado en trabajo
Plenaria ASTRO 2015

- Late-breaking Abstract Number 1

  Dexamethasone vs Placebo in the Prophylaxis of Radiation-induced Pain Flare Following Palliative Radiation Therapy for Bone Metastases: A Double-blind Randomized, Controlled, Superiority Trial

Plexopatias

Radiotherapy and Oncology 93 (2009) 408–413

Contents lists available at ScienceDirect

Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com

Lung cancer SBRT

Brachial plexopathy from stereotactic body radiotherapy in early-stage NSCLC: Dose-limiting toxicity in apical tumor sites

Jeffrey A. Forquer [a], Achilles J. Fakiris [a,*], Robert D. Timmerman [b], Simon S. Lo [c], Susan M. Perkins [d], Ronald C. McGarry [e], Peter A.S. Johnstone [a]

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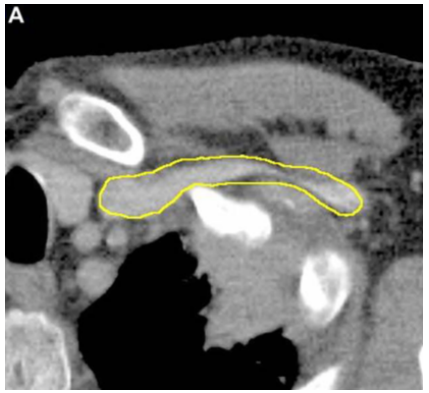


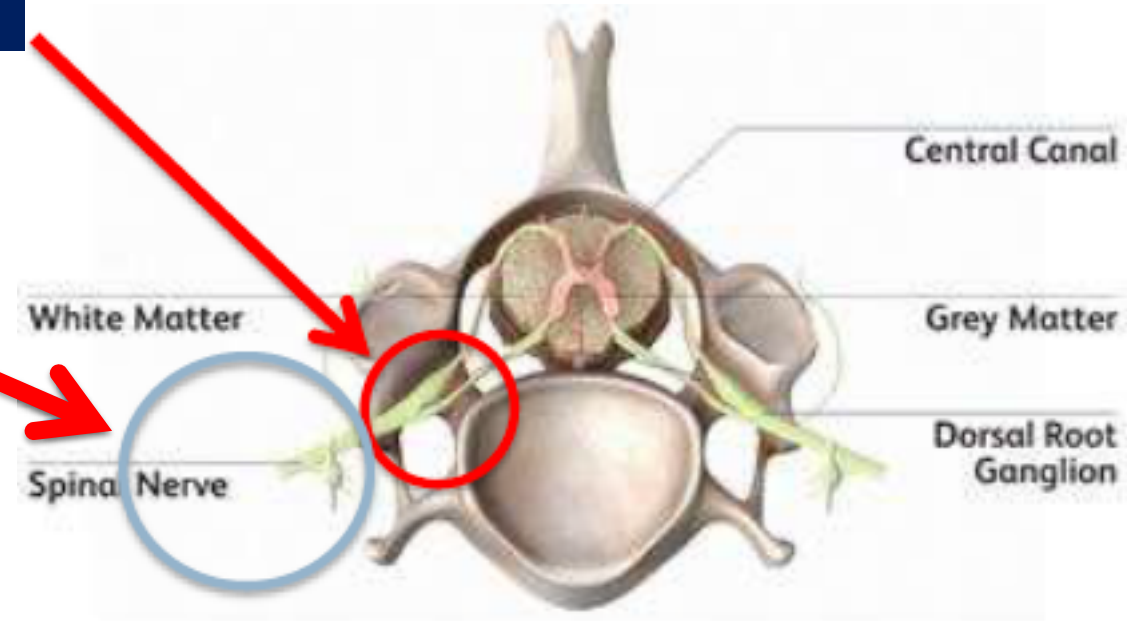
Table 3.3 Normal Tissue Constraints used by RTOG trials (www.rtog.org)*

Organ at Risk	1 Fraction	3 Fractions	4 Fractions	5 Fractions
Spinal cord	RTOG 0631 and 0915: 14 Gy (< 0.03 cc or maximum)/10 Gy (< 0.35 cc)/ 7 Gy (< 1.2 cc) (only for RTOG 0915)	RTOG 0236 and 0618: 18 Gy (maximum) RTOG 1021: 21.9 Gy (maximum)/ 18 Gy (< 0.35 cc)/12.3 Gy (< 1.2 cc)	RTOG 0915: 26 (maximum)/ 20.8 (< 0.35 cc)/13.6 (< 1.2 cc)	RTOG 0813: 30 Gy (maximum)/ 22.5 Gy (< 0.25 cc)/13.5 Gy (< 0.5 cc)
Brachial plexus	RTOG 0631 and 0915: 17.5 Gy (< 0.03 cc or maximum)/ 14 Gy (< 3 cc)	RTOG 0236 and 0618: 24 Gy (maximum) RTOG 1021: 24 Gy (maximum)/ 20.4 Gy (< 3 cc)	RTOG 0915: 27.2 Gy (maximum)/ 23.6 Gy (< 3 cc)	RTOG 0813: 32 Gy (maximum)/ 30 Gy (< 3 cc)
Cauda equina	RTOG 0631: 16 Gy (< 0.03 cc)/ 14 Gy (< 5 cc)	Not available	Not available	Not available
Sacral plexus	RTOG 0631: 18 Gy (< 0.03 cc)/ 14.4 Gy (< 5 cc)	Not available	Not available	Not available

Plexopatias MMII

Raíz Nerviosa: Radiculopatía

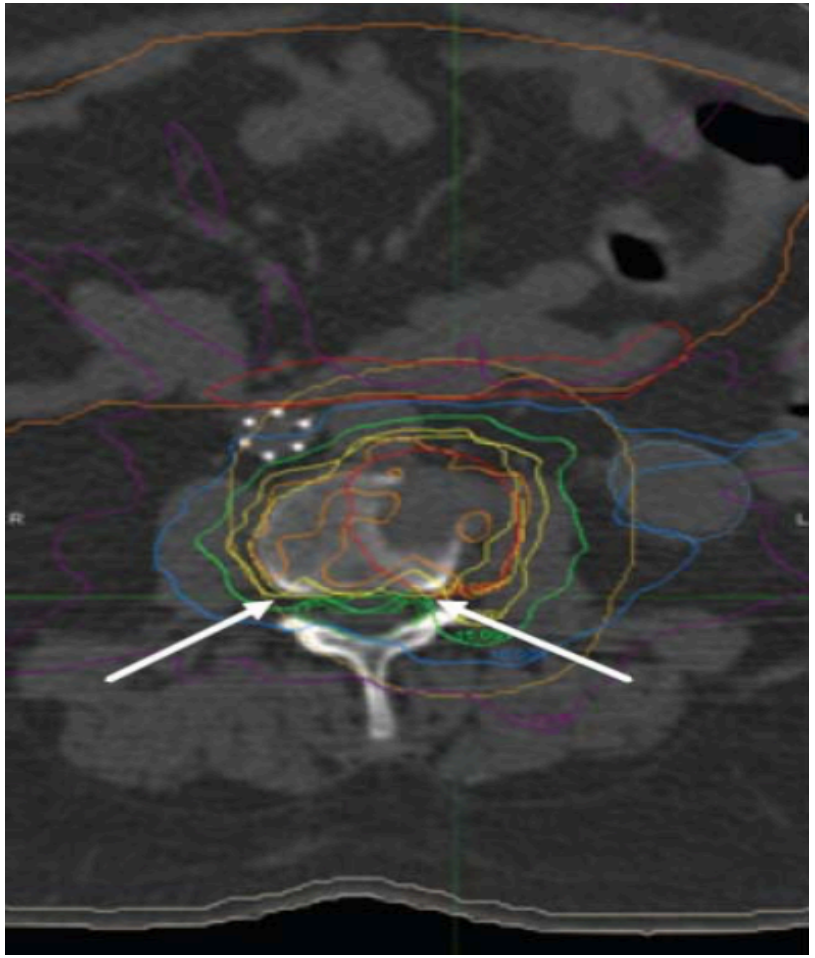
Más allá de raíz nerviosa: Plexopatía



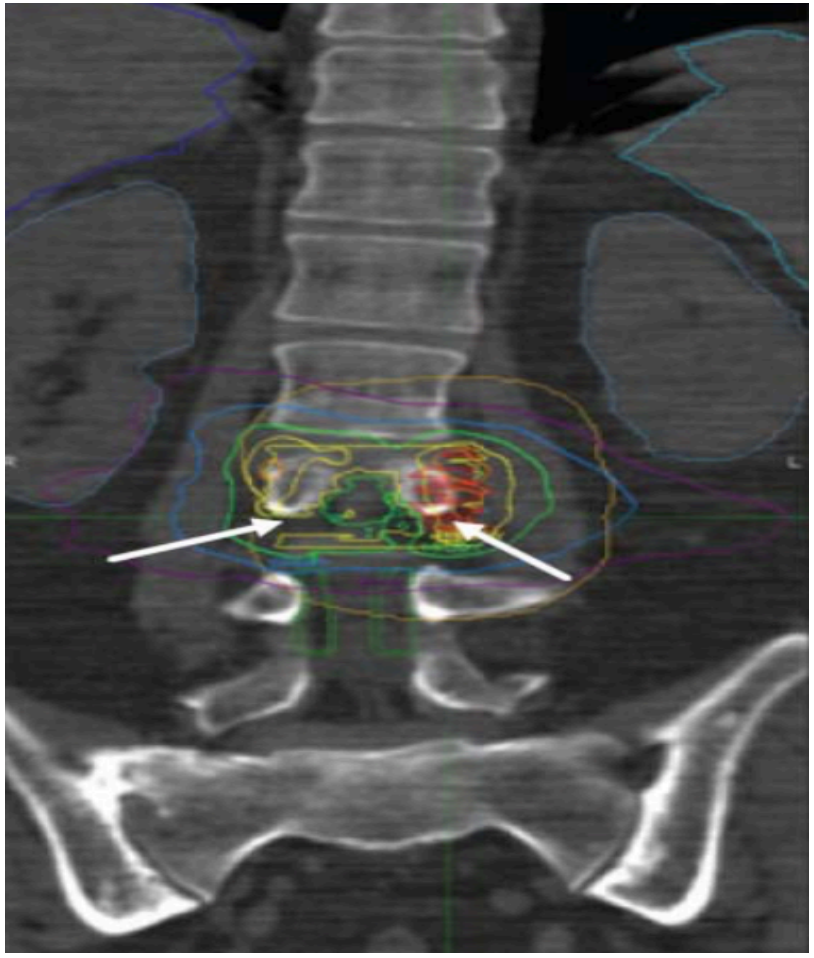
Riesgo < 5%

Yamada , ASTRO 2016

Plexopatias MMII

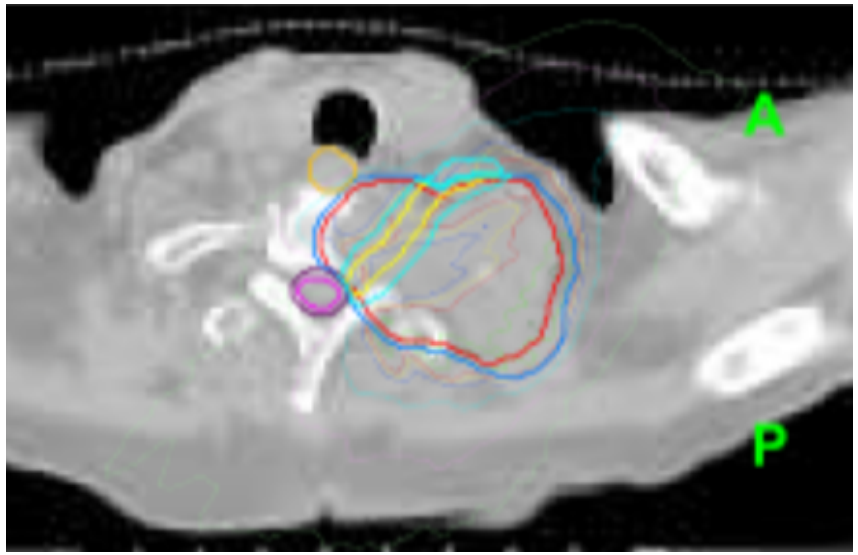


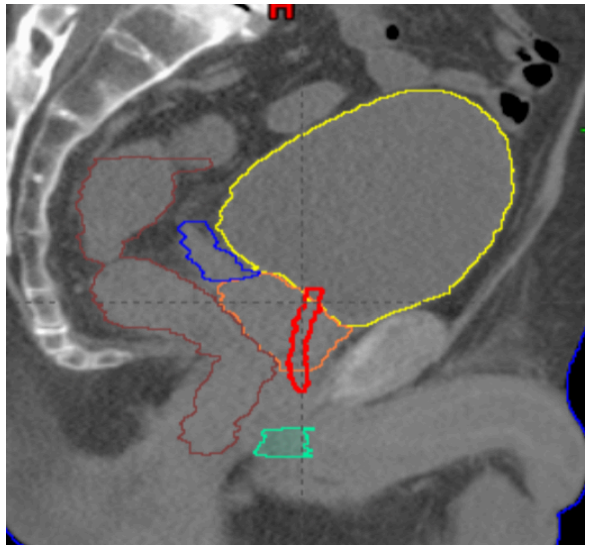
Delinear raíces nerviosas y plexos que inervan las extremidades



Regiones de altas dosis en raíces nerviosas causan radiculopatías

OAR dentro de PTV





Plexo Nervioso - Uretra

Delinear OAR en PTV

Evitar puntos calientes en OAR

SBRT Próstata

PRINCIPLES OF RADIATION THERAPY

Table 1: Regimens that have shown acceptable efficacy and toxicity. The optimal regimen for an individual patient warrants evaluation of comorbid conditions, voiding symptoms, and toxicity of therapy. Additional fractionation schemes may be used as long as sound oncologic principles and appropriate estimate of BED are considered.

Regimen for Definitive Therapy	NCCN Risk Group (✓ indicates an appropriate regimen option if radiation therapy is given)					
	Very-Low[a]	Low[a]	Favorable or good prognostic[b] intermediate	Unfavorable, or poor prognostic[b], intermediate	High and Very-High[c]	Node Positive
Beam Therapies						
72 Gy to 80 Gy at 2 Gy per fraction	✓	✓	✓	✓ with 4 mo ADT	✓ with 1.5-3 y ADT	✓ with ADT
75.6 Gy to 81.0 Gy at 1.8 Gy per fraction	✓	✓	✓	✓ with 4 mo ADT	✓ with 1.5-3 y ADT	✓ with ADT
70.2 Gy at 2.7 Gy per fraction	✓	✓	✓	✓ with 4 mo ADT	✓ with 1.5-3 y ADT	✓ with ADT
70 Gy at 2.5 Gy per fraction	✓	✓	✓	✓ with 4 mo ADT	✓ with 1.5-3 y ADT	✓ with ADT
60 Gy at 3 Gy per fraction	✓	✓	✓	✓ with 4 mo ADT	✓ with 1.5-3 y ADT	✓ with ADT
51.6 Gy at 4.3 Gy per fraction	✓	✓	✓			
37 Gy at 7.4 Gy per fraction	✓	✓	✓			
40 Gy at 8 Gy per fraction	✓	✓	✓			
36.25 Gy at 7.25 Gy per fraction	✓	✓	✓			

Evidencia Nivel I

Intensity-modulated fractionated radiotherapy versus stereotactic body radiotherapy for prostate cancer (PACE-B): acute toxicity findings from an international, randomised, open-label, phase 3, non-inferiority trial

Douglas H Brand, Alison C Tree*, Peter Ostler, Hans van der Voet, Andrew Loblaw, William Chu, Daniel Ford, Shaun Tolan, Suneil Jain, Alexander Martin, John Staffurth, Philip Camilleri, Kiran Kancherla, John Frew, Andrew Chan, Ian S Dayes, Daniel Henderson, Stephanie Brown, Clare Cruickshank, Stephanie Burnett, Aileen Dufton, Clare Griffin, Victoria Hinder, Kirsty Morrison, Olivia Naismith, Emma Hall, Nicholas van As, on behalf of the PACE Trial Investigators*

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Toxicidades Rectales y GU

CLINICAL INVESTIGATION **Genitourinary Cancer**

LONG-TERM OUTCOMES FROM A PROSPECTIVE TRIAL OF STEREOTACTIC BODY RADIOTHERAPY FOR LOW-RISK PROSTATE CANCER

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Int. J. Radiation Oncology Biol. Phys., Vol. 82, No. 2, pp. 877–882, 2012

Toxicidad Rectal y GI

Table 2. Comparison of late urinary (GU) and late rectal (GI) RTOG toxicity between consecutive daily treatments (QD) vs. those delivered three times a week on alternating days (QOD)

GU toxicity	QD	QOD	*p* value*
RTOG Gr. 0	37% (6/16 pts)	80% (33/41 pts)	0.003
RTOG Gr. 1	50% (8/16 pts)	12% (5/41 pts)	0.004
RTOG Gr. 2	6% (1/16 pts)	5% (2/41 pts)	1
RTOG Gr. 3	6% (1/16 pts)	2% (1/41 pts)	0.48
RTOG Gr. 1–2	56% (9/16 pts)	17% (7/41 pts)	0.007
GI toxicity	**QD**	**QOD**	
RTOG Gr. 0	56% (9/16 pts)	95% (39/41 pts)	0.001
RTOG Gr. 1	37% (6/16 pts)	5% (2/41 pts)	0.0004
RTOG Gr. 2	6% (1/16 pts)	0% (0/41 pts)	0.28
RTOG Gr. 1–2	44% (7/16 pts)	5% (2/41 pts)	0.001

Fase II SBRT Próstata

Dosis:
36.25 en 5 Fx

N= 57

QD:
Más toxicidad GU y GI

Int. J. Radiation Oncology Biol. Phys., Vol. 82, No. 2, pp. 877–882, 2012

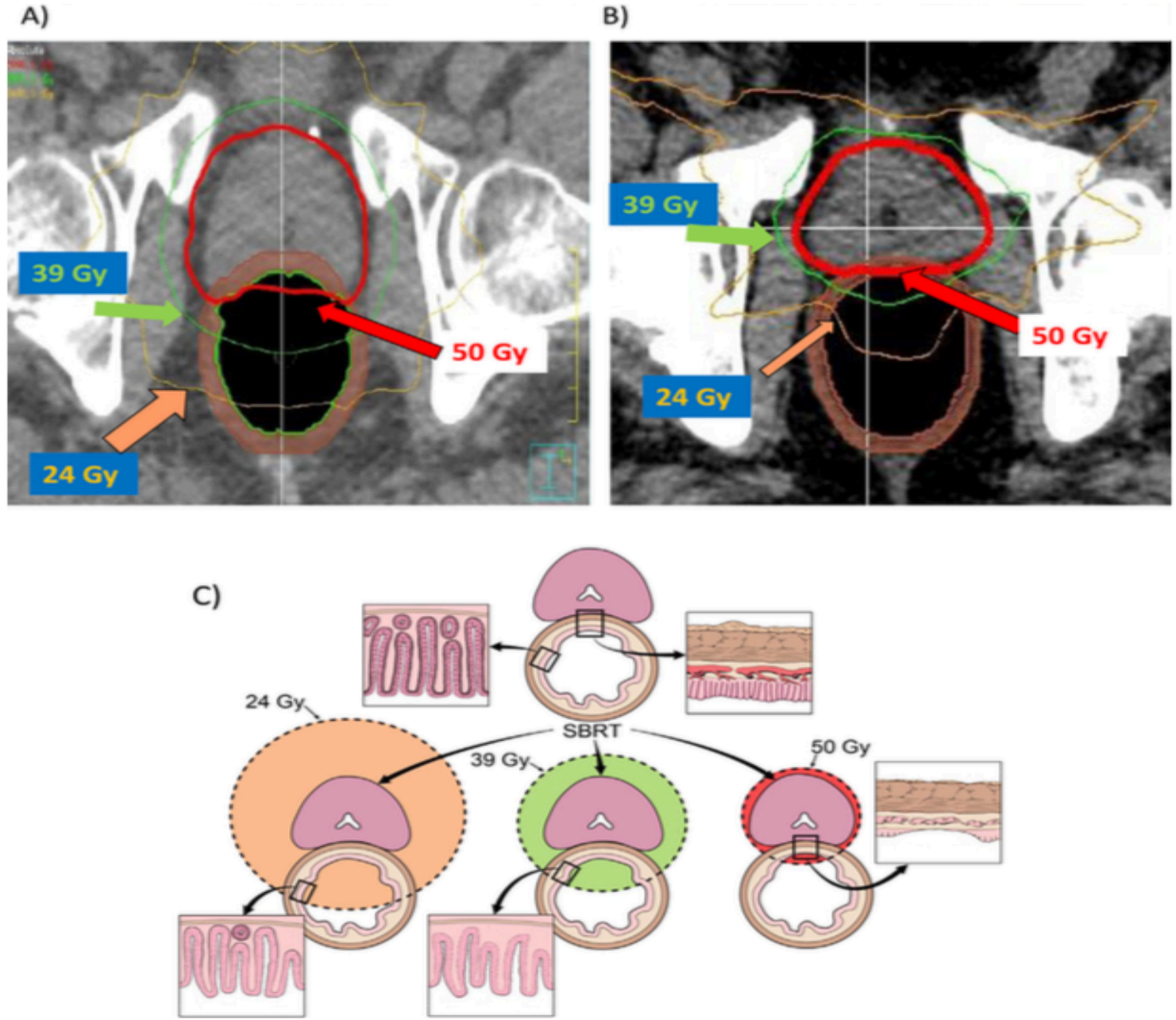
Toxicidad Rectal

Clinical Investigation: Genitourinary Cancer

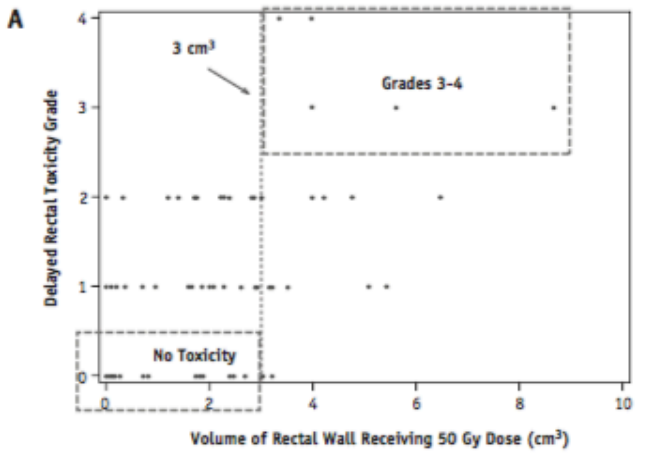
Predictors of Rectal Tolerance Observed in a Dose-Escalated Phase 1-2 Trial of Stereotactic Body Radiation Therapy for Prostate Cancer

D. W. Nathan Kim, MD, PhD,* L. Chinsoo Cho, MD,† Christopher Straka, BS,* Alana Christie, MS,‡ Yair Lotan, MD,§ David Pistenmaa, MD,* Brian D. Kavanagh, MD,‖ Akash Nanda, MD, PhD,¶ Patrick Kueplian, MD,# Jeffrey Brindle, MD,** Susan Cooley, RN,* Alida Perkins, ANP,* David Raben, MD,‖ Xian-Jin Xie, PhD,‡ and Robert D. Timmerman, MD*

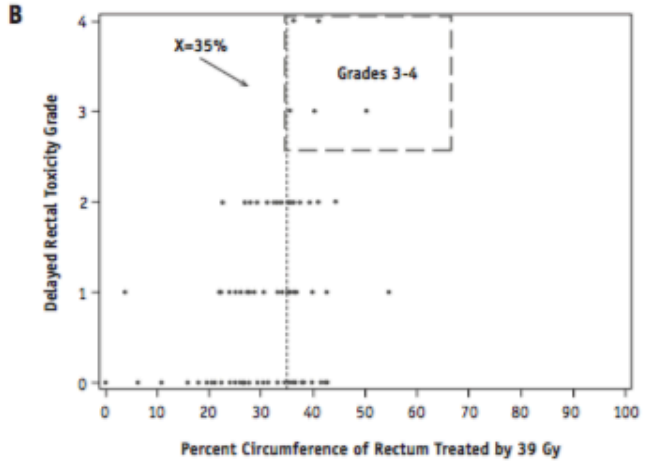
Int J Radiation Oncol Biol Phys, Vol. 89, No. 3, pp. 509–517, 2014



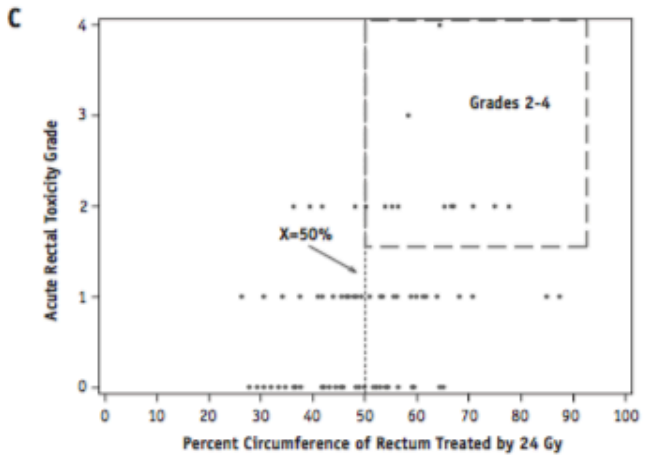
Int J Radiation Oncol Biol Phys, Vol. 89, No. 3, pp. 509–517, 2014



Volumen de pared rectal V50 < 3CC



% circunferencia 39 Gy < 35%



% circunferencia 24 Gy < 50%

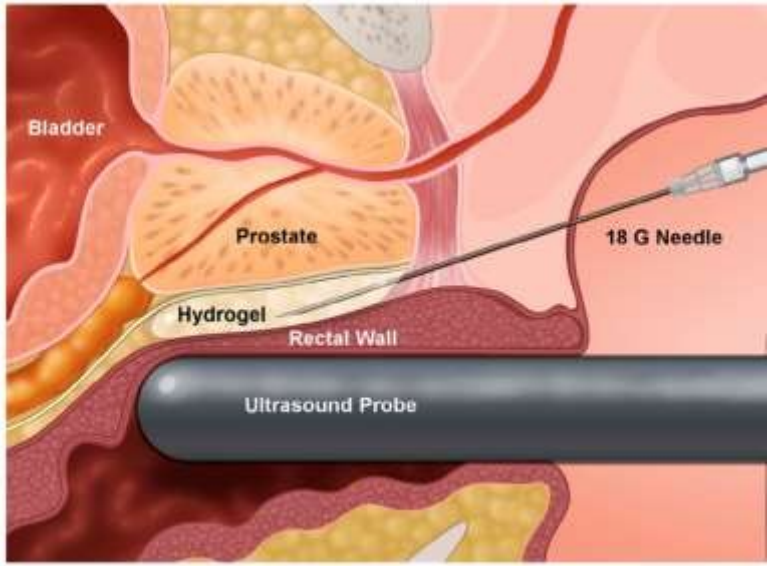
Int J Radiation Oncol Biol Phys, Vol. 89, No. 3, pp. 509–517, 2014

Próstata: Estrategias

- Respetar los umbrales de dosis de HDV, incluyendo dosis moderadas y bajas

- Evitar puntos calientes
- Evitar dosis altas (no respuesta > 40 Gy)
- Días alternos
- Enemas previos, balón rectal, biogel (spacer)
- Dibujar uretra y evitarla

Espaciador Rectal: < dosis



Hydrogel inyectable

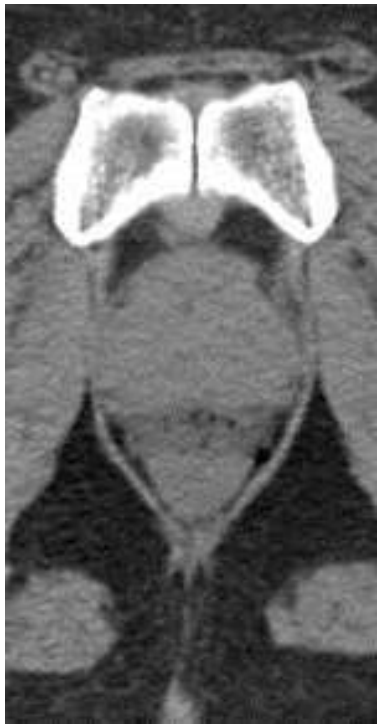


Imagen TAC

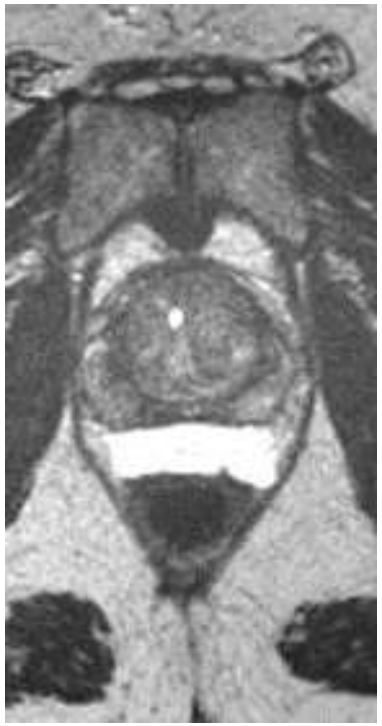
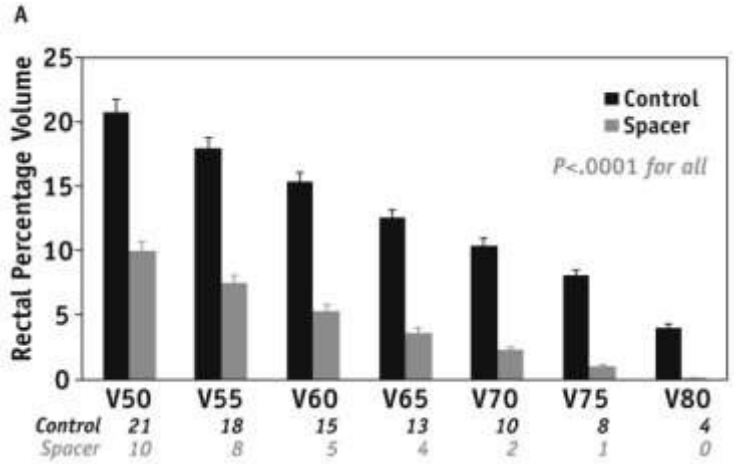


Imagen RMN



Reducción en dosis rectal con espaciador

Conclusiones

- El conocimiento sobre tolerancia de OAR a dosis ablativa es limitado, falta seguimiento
- Los límites de tolerancia de dosis son estimados usando modelos LQ y deben ser validados por datos clínicos
- Lo más seguro es usar dosis límites de tolerancia provenientes de estudios randomizados
- Factores de riesgo han sido identificados y deben usarse técnicas y maniobras para mitigar estas posibles complicaciones


THANK YOU
MERCI
DANKE
¡GRACIAS
TERIMA KASIH
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