SBRT for GU cancers

Vedang Murthy
Professor
Tata Memorial Centre
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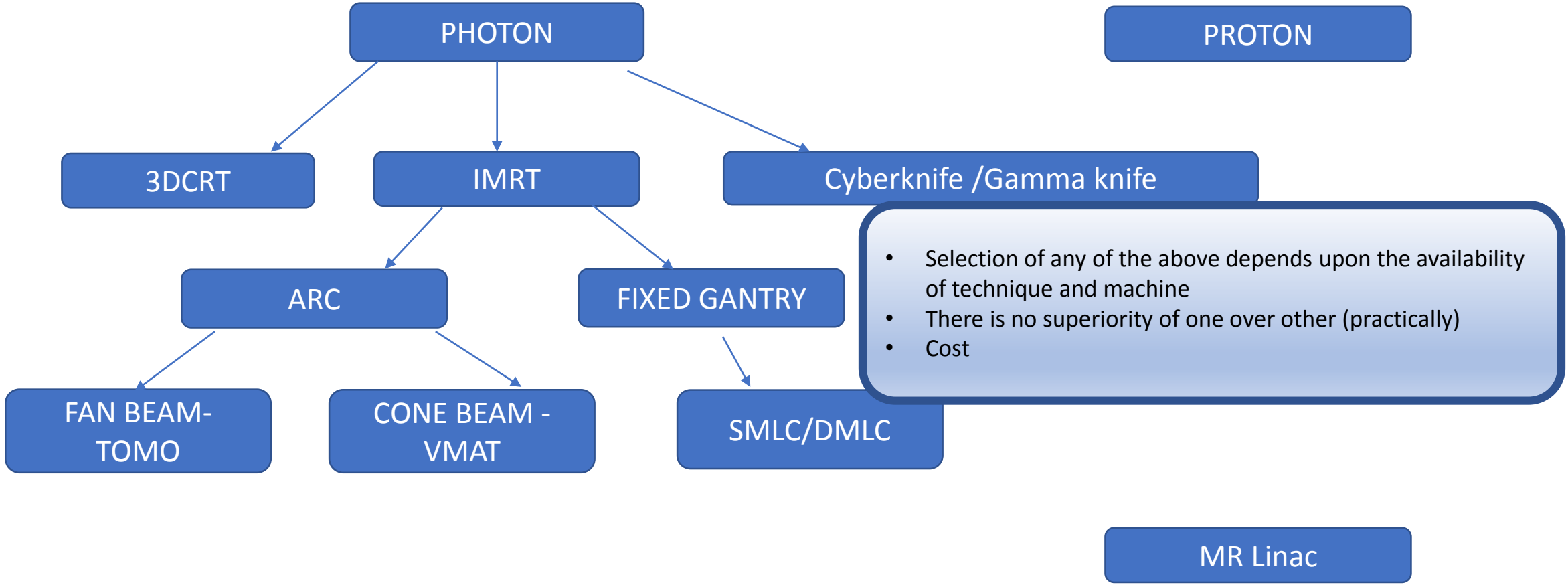
DIFFERENT TECHNIQUES OF DOING SBRT PROSTATE



Prostate Radiotherapy in India: Evolution, Practice and Challenges in the 21st Century

V. Murthy [*], I. Mallick [†], M. Arunsingh [†], P. Gupta [*]

[*] Department of Radiation Oncology, Tata Memorial Hospital and Advanced Centre for Treatment Research and Education in Cancer (ACTREC), Homi Bhabha National Institute, Mumbai, India
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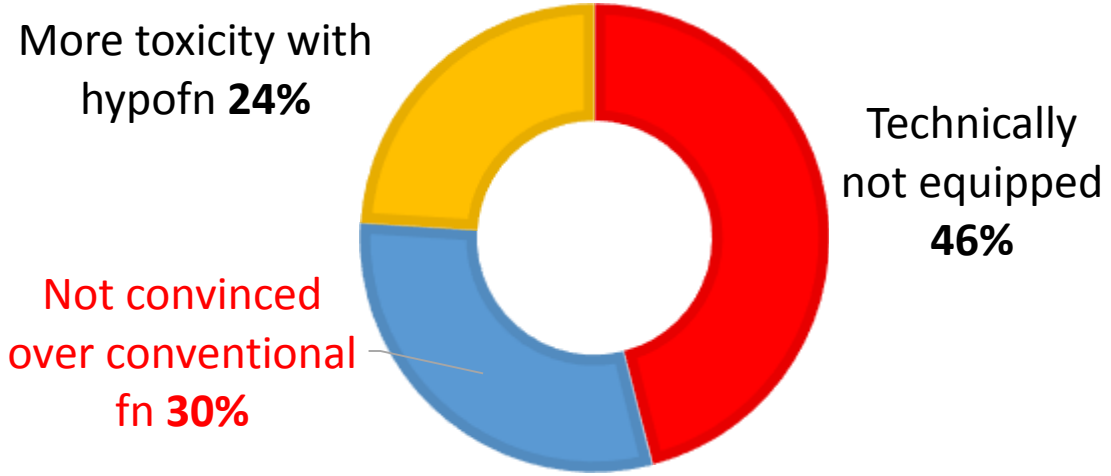
Received 17 April 2019; accepted 15 May 2019

Targeted survey of 100 Indian radiation oncologists practising prostate RT

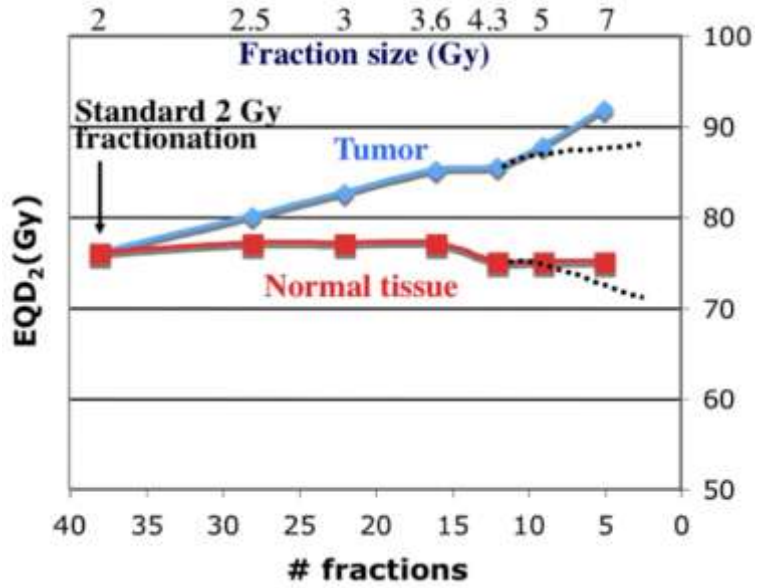
- 15% of respondents reported that SBRT was one of their clinically used schedules for radical treatment
- Five centers reported using SBRT for more than 50% of their patients

reasons



Biological Rationale

- **Prostate α/β : 1.5 to 1.8**



Parameters	Conventional fractionation	Moderate hypofractionation	Extreme fractionation/ SBRT
Equi-effective dose	**74Gy/37#**	**60Gy/20#**	**36.25Gy/5#**
Dose/#	2Gy	3 Gy	7.5Gy
Rectum BED (α/β :3)	**123 Gy**	**120 Gy**	**106 Gy**
Prostate BED			
α/β = 10	89 Gy	78 Gy	62 Gy
α/β = 2	148 Gy	150 Gy	168 Gy
α/β = 1.5	173 Gy	180 Gy	210 Gy

Prostate SBRT is here to stay

Trial Name	NRG-GU 005	HYPO RT-PC	PACE B	PACE C	PRIME
Study/Group	NRG Oncology	Scandinavia	Royal Marsden NHS	Royal Marsden NHS	**India**
Stage/ Eligibility	Low Risk (cT1a-T2b)	Intermediate risk	Low/Fav IR (cT1-T2c, GS ≤7)	Unfav IR/HR	**HR/VHR/N+**
Test arm	36.25Gy/5#	42.7Gy/7#	36.25Gy/5#	36.25Gy/5#	**36.25Gy/5#**
Std arm	70Gy/28#	78Gy/39#	78Gy/39# 62Gy/20#	60Gy/20#	**68Gy/25#**
Primary end point	DFS, 2-yr EPIC-26 toxicity	5-yr FFBF	5-yr BCF	5-yr bPFS	**5-yr BFFS**
Status	Completed	Published	2-yr toxicity results	Enrolling	**Enrolling, passed interim analysis**

In India (~LMIC):

- *Low awareness*
- *No screening*
- *If M0,*

~75% are HR-VHR

~ 20% are N+

How do I start?

- Choosing the right patient
  - Low/Intermediate risk: Where do I find those?
  - **High Risk: Yes, lots of them….but…**
    - Is it safe and effective?
    - Do I /can I treat the pelvis?
    - Many of my patients are N+….
    - What if they had a TURP?
    - Does it need “special” technique/equipment
  - Metastatic: Oh, plenty of those…
    - Low volume OligoM

Safe?


Stereotactic Body Radiotherapy for High-Risk Localized Carcinoma of the Prostate (SHARP) Consortium: Analysis of 344 Prospectively Treated Patients

Ritchell van Dams, MD, MHS • Naomi Y. Jiang, MD • Donald B. Fuller, MD • Andrew Loblaw, MD • Tommy Jiang, BA • Alan J. Katz, MD • Sean P. Collins, MD • Nima Aghdam, MD • Simeng Suy, PhD • Kevin L. Stephans, MD • Ye Yuan, MD, PhD • Nicholas G. Nickols, MD, PhD • Vedang Murthy, MD • Tejshri P. Telkhade, MD • Patrick A. Kupelian, MD • Michael L. Steinberg, MD • Tahmineh Romero, MS • Amar U. Kishan, MD • Show less

Published: January 22, 2021 • DOI: https://doi.org/10.1016/j.ijrobp.2021.01.016 • Check for updates

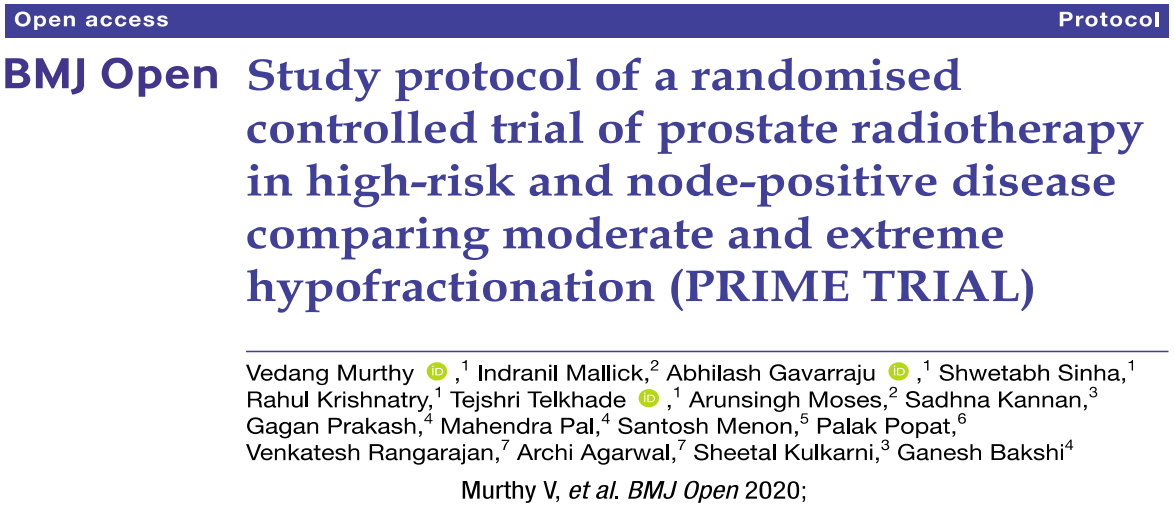
- Pooled data of 344 high risk patients
- Median follow-up 49.5 months
- 4-yr BFFS 82%, 4-yr DMFS 89%

- Late gr3 toxicity: GU 2.3%, GI 0.9%

PRIME Trial Overview

- **Design:** **Multicentric, Non Inferiority, Randomised (MFRT vs SBRT)**
- **Current Accrual:** **435/464 (Estimated end: Dec 2023)**

- **Primary Endpoint:** **5 year BFFS**
- **Secondary Endpoints:**
  - **Acute Toxicity**
  - **Late Toxicity**
  - **PCSF and OAS**
  - **Quality of Life**
  - **Out of Pocket Expenditure**
  - **Decision regret**



Trial Design

Murthy V, *et al. BMJ Open* 2020;

- GS 8-10
- cT3a-T4b
- index PSA >20

High risk or Very High Risk (NCCN) or N+ M0

Staging with

MRI pelvis and

PSMA PET-CT

SBRT eligible

RANDOMISE

Mod Hypo RT

68Gy in 25# (50Gy/25# to Pelvis)

62Gy in 20# (44Gy/20# to Pelvis)

Stratification

- N0 vs N+
- ADT medical vs surgical
- Centre

24 months of ADT

Boost to node in N+

SBRT

36.25Gy in 5# (25Gy/5# to Pelvis)

EOD or weekly

Acute (90-day) urinary toxicity

CTCAE toxicity	Total (n=296) (%)	MHRT (n=146) (%)	SBRT (n=150) (%)	p-value	
Urinary					
Grade 3	1.0	1.4	0.7	*0.5*	***N=3 (MHRT 2, SBRT 1)***
Grade 2	32.4	33.1	31.8	*0.5*	

Acute (90-day) gastrointestinal toxicity

CTCAE toxicity	Total (n=296) (%)	MHRT (n=146) (%)	SBRT (n=150) (%)	p-value	
Gastrointestinal					
Grade 3	0.7	0.7	0.7	*0.9*	**N=2 (MHRT 1,**
Grade 2	16.2	17.2	15.2	*0.9*	

*CTCAE grade 3 toxicity in parentheses, others grade 2

Treating the pelvis?

Journal of Clinical Oncology
An American Society of Clinical Oncology Journal

GS 8-10: Any PSA, T1-T3a N0
GS 7: PSA >15, T1-T3a N0
GS 6: PSA >30, T1-T3a N0
T3b-T4a N0: Any GS, Any PSA

High risk prostate cancer
Pelvic LN risk ≥20%

MRI pelvis and
PET-CT at baseline

RANDOMISE

Stratification
ADT: LHRHa vs Sx
GS: 8-10 vs 6-7
PSA ≥50 vs <50
TURP : Yes vs No

Prostate Only RT

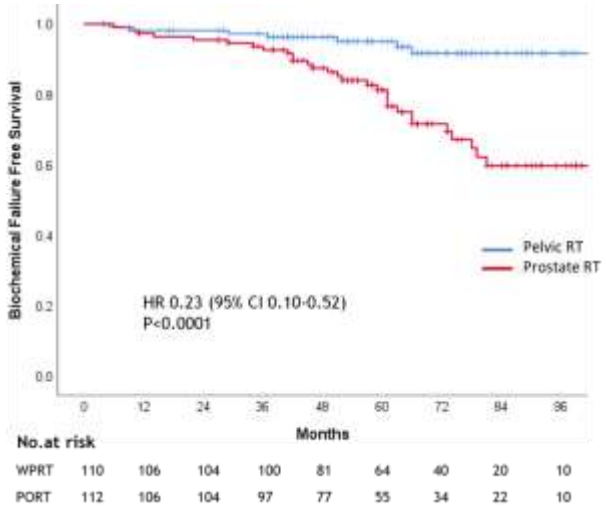
24 months of ADT

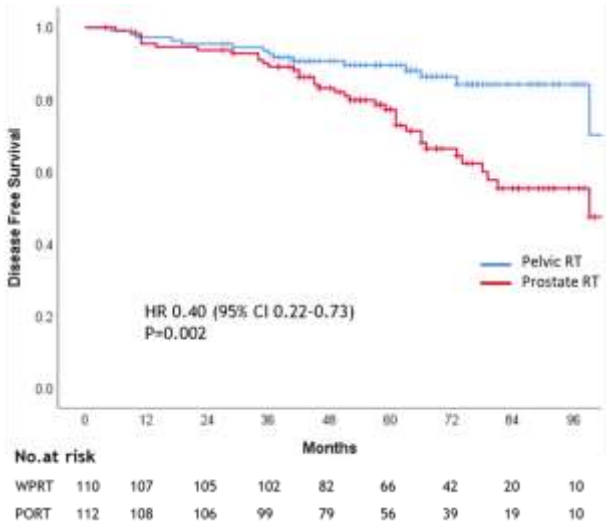
Whole Pelvic RT

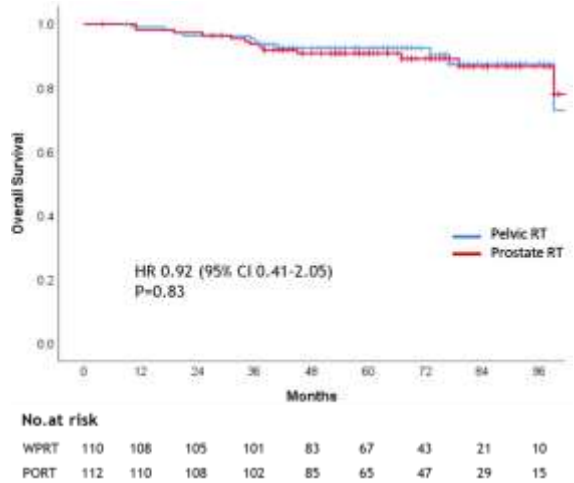
ORIGINAL REPORTS | Genitourinary Cancer

Prostate-Only Versus Whole-Pelvic Radiation Therapy in High-Risk and Very High-Risk Prostate Cancer (POP-RT): Outcomes From Phase III Randomized Controlled Trial

Vedang Murthy, MD[1]; Priyamvada Maitre, MD[1]; Sadhana Kannan, MSc[2]; Gitanjali Panigrahi, MSc[1]; Rahul Krishnatry, MD[1]; Ganesh Bakshi, MCh[3]; ...







What about SBRT?

- 2 trials:
  - pHART (n=30, no ENI)
  - SATURN (n=30, ENI+)
- 40 Gy/5# to prostate +/- 25 Gy/5# ENI

- **5-yr BF 14.6% vs 0% (p=0.038)**

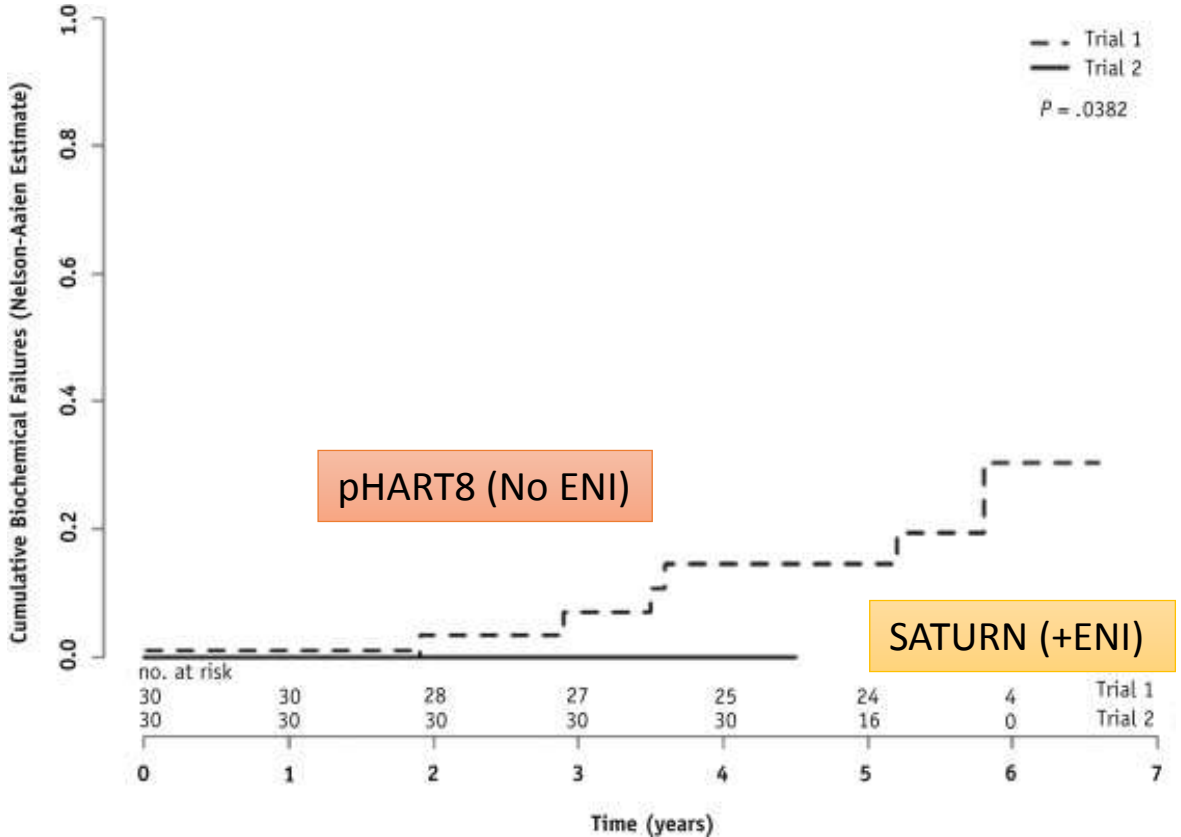
PACE NODES (UK) ONGOING

International Journal of Radiation Oncology*Biology*Physics
Volume 104, Issue 1, 1 May 2019, Pages 36-41

Clinical Investigation

SABR in High-Risk Prostate Cancer: Outcomes From 2 Prospective Clinical Trials With and Without Elective Nodal Irradiation

Yasir Alayed MD, MSc, FRCPC *, †, ‡, Patrick Cheung MD, FRCPC *, †, Danny Vesprini MSc, MD,



PO-SBRT vs WP-SBRT

Acute and Late Adverse Effects of Prostate-Only or Pelvic Stereotactic Radiation Therapy in Prostate Cancer: A Comparative Study

Vedang Murthy, MD,* Ketaki Adsul, MD,* Priyamvada Maitre, MD,* Aarushi Singla, MBBS,* Pallavi Singh, MSc,* Gitanjali Panigrahi, MSc,* Vysakh Raveendran, MSc,† and Reena Phurailatpam, MSc†

IJROBP May 2022

- N= 220 (PO or WP-SBRT)
- Definitive SBRT
- Prostate: 35-36.25Gy/5#
- Pelvis (Till CILN): 25Gy/5#
- Median f/u: 28 months

- CTCAE v5.0 Cumulative Toxicity

LATE-
Gr 3 GU- 2.5%, Gr 3 GI- 1%

TOXICITY (Overall Grade 2)	PO-SBRT (116)	WP-SBRT (102)	P-value
Acute GI (21.6%)	**14.7%**	**29.4%**	**0.008**
Late GI (15.8%)	13.4%	18.9%	0.1
Acute GU (30.7%)	25.9%	36.3%	0.1
Late GU (34.2%)	**25%**	**45.6%**	**0.003**

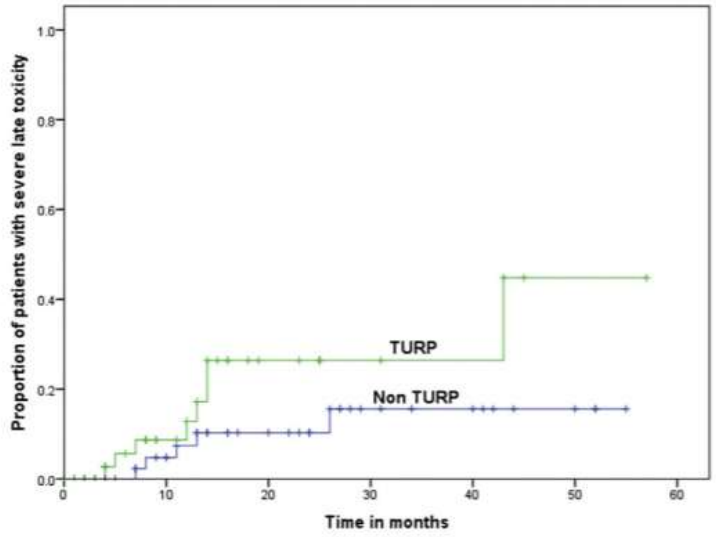
The TURP Problem: SBRT

› Pract Radiat Oncol. Sep-Oct 2019;9(5):347-353. doi: 10.1016/j.prro.2019.04.003. Epub 2019 Apr 9.

Safety of Prostate Stereotactic Body Radiation Therapy after Transurethral Resection of Prostate (TURP): A Propensity Score Matched Pair Analysis

Vedang Murthy [1], Shwetabh Sinha [2], Sadhana Kannan [3], Debanjali Datta [2], Rabi Das [2], Ganesh Bakshi [4], Gagan Prakash [4], Rahul Krishnatry [2]

- Up to **30%** of Indian patients planned for prostate RT have prior TURP
- Toxicity concerns with SBRT
- Methods:
  - Matched pair analysis
  - N=100 (50 TURP , 50 Non TURP)



- **CAUTION**:
  - SBRT Within 6 months from TURP
  - SBRT with Multiple TURPS
  - Evaluate pre-existing strictures rigorously

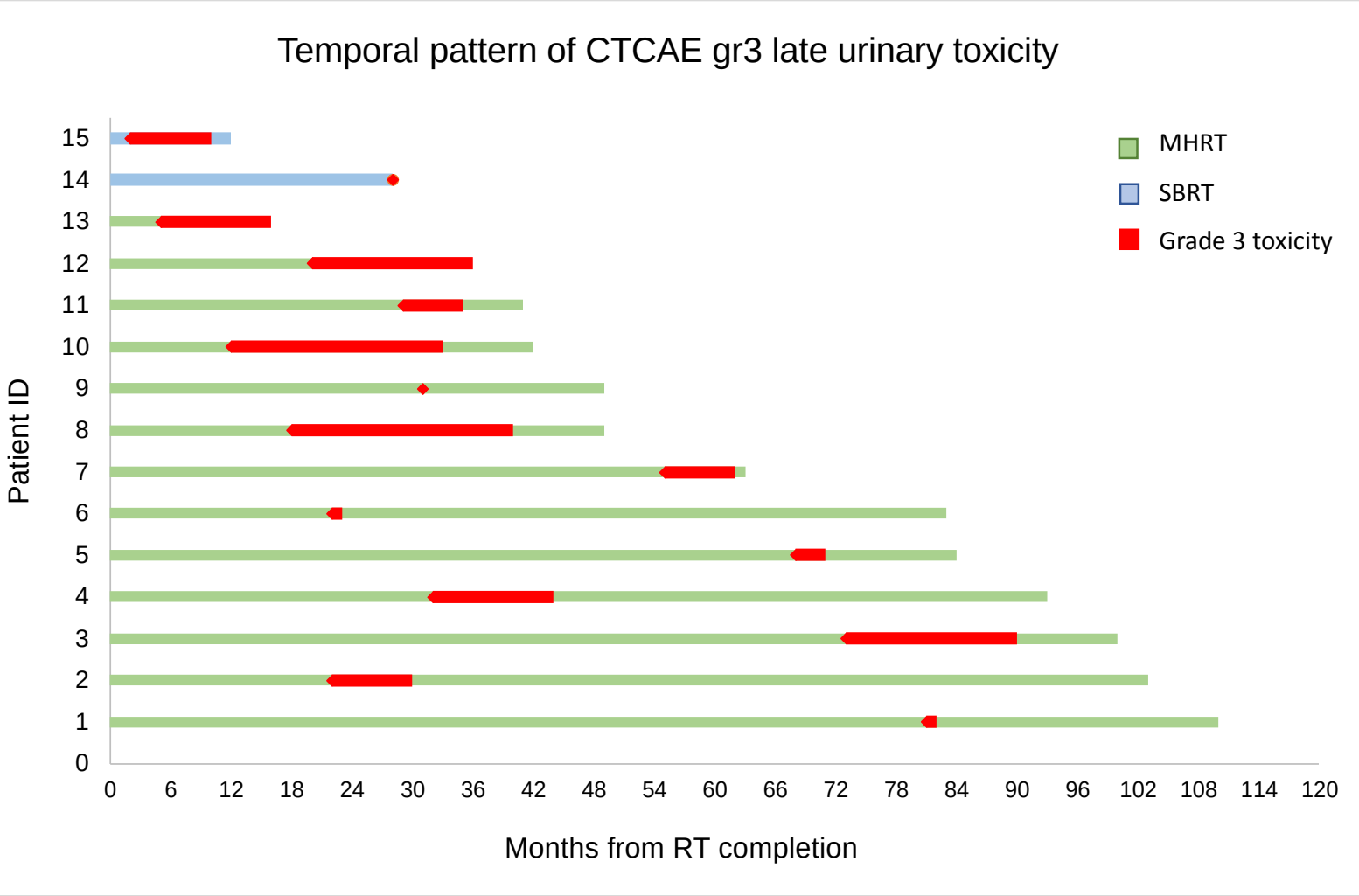
The TURP Problem: SBRT vs Mod Hypo RT

- N=204, **ALL TURP**
- Median follow-up 37m
- **MFRT (n=116)**
- **SBRT (n=88)**

		MFRT (n=116)	**SBRT (n=88)**	**Total (n=204)**
Median Prostate dose		68Gy/25#	36.25Gy/5#	
CTCAE late urinary toxicity	Grade 3	**11.3%**	**2.2%**	7.4%
	Grade 2	24.3%	27.0%	25.5%

- Gr2 similar (24.3% vs 27%, p=0.3).

Presented at ESTRO 2023



- Grade 3 toxicity persisted over median 8 months

In patients with prior TURP, moderate or extreme hypofractionated prostate RT did not result in excessive or long-lasting toxicity

Presented at ESTRO 2023

What about SBRT for N+?

Contents lists available at ScienceDirect

Clinical Oncology Nov 2020

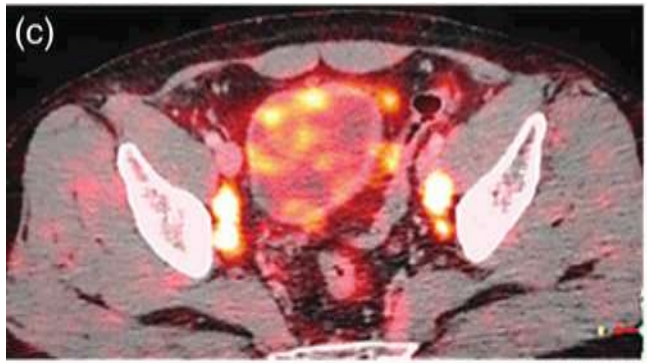
journal homepage: www.clinicaloncologyonline.net

Original Article

Safety and Efficacy of Ultra-hypofractionation in Node-positive Prostate Cancer

T. Telkhade [*], V. Murthy [*], T.S. Kanala [*], J.M. Mathew [*], R. Phurailatpam [†], S. Mokal [‡], D. Chourasiya [‡], G. Panigrahi [‡], R. Krishnatry [*]

[*] *Department of Radiation Oncology, Tata Memorial Centre and Advanced Centre for Treatment, Research and Education in Cancer, Homi Bhabha National Institute, Mumbai, India*



- N=60 (all N+ on PSMA PET)
- All SBRT
  - Prostate: 35- 36.25Gy/5#
  - Pelvis: 25 Gy/5#
  - **PSMA PET guided Nodal boost (if residual): 30-35Gy**

Median follow up : **30 months**

3 year disease free survival : 70%

3 year overall survival : 89%

Simulation

SHOULD BE USED

- Bladder Protocol
  - Void → Drink 500ml water and hold for 45 mins
- Empty Rectum: No Gas
  - Low residue/Fibre

- COMFORTABLE, Supine, with arms folded on the chest
- Knee Rest/Ankle stocks
- CT MRI fusion

- **MAY BE USED!**
  - ORFIT
  - VACLOC
  - Gold Markers
  - RECTAL BALLOON
  - SPACER
  - IV Contrast

International Prostate Symptom Score (I-PSS)

Patient Name: _____ **Date of birth:** _____ **Date completed** _____

In the past month:	Not at All	Less than 1 in 5 Times	Less than Half the Time	About Half the Time	More than Half the Time	Almost Always	Your score
1. Incomplete Emptying How often have you had the sensation of not emptying your bladder?	0	1	2	3	4	5	
2. Frequency How often have you had to urinate less than every two hours?	0	1	2	3	4	5	
3. Intermittency How often have you found you stopped and started again several times when you urinated?	0	1	2	3	4	5	
4. Urgency How often have you found it difficult to postpone urination?	0	1	2	3	4	5	
5. Weak Stream How often have you had a weak urinary stream?	0	1	2	3	4	5	
6. Straining How often have you had to strain to start urination?	0	1	2	3	4	5	
	None	1 Time	2 Times	3 Times	4 Times	5 Times	
7. Nocturia How many times did you typically get up at night to urinate?	0	1	2	3	4	5	
Total I-PSS Score							

Score: 1-7: *Mild* 8-19: *Moderate* 20-35: *Severe*

Quality of Life Due to Urinary Symptoms	Delighted	Pleased	Mostly Satisfied	Mixed	Mostly Dissatisfied	Unhappy	Terrible
If you were to spend the rest of your life with your urinary condition just the way it is now, how would you feel about that?	**0**	**1**	**2**	**3**	**4**	**5**	**6**

Contouring Guidelines

Contents lists available at ScienceDirect

Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com

ESTRO ACROP guideline

ESTRO ACROP consensus guideline on CT- and MRI-based target volume delineation for primary radiation therapy of localized prostate cancer

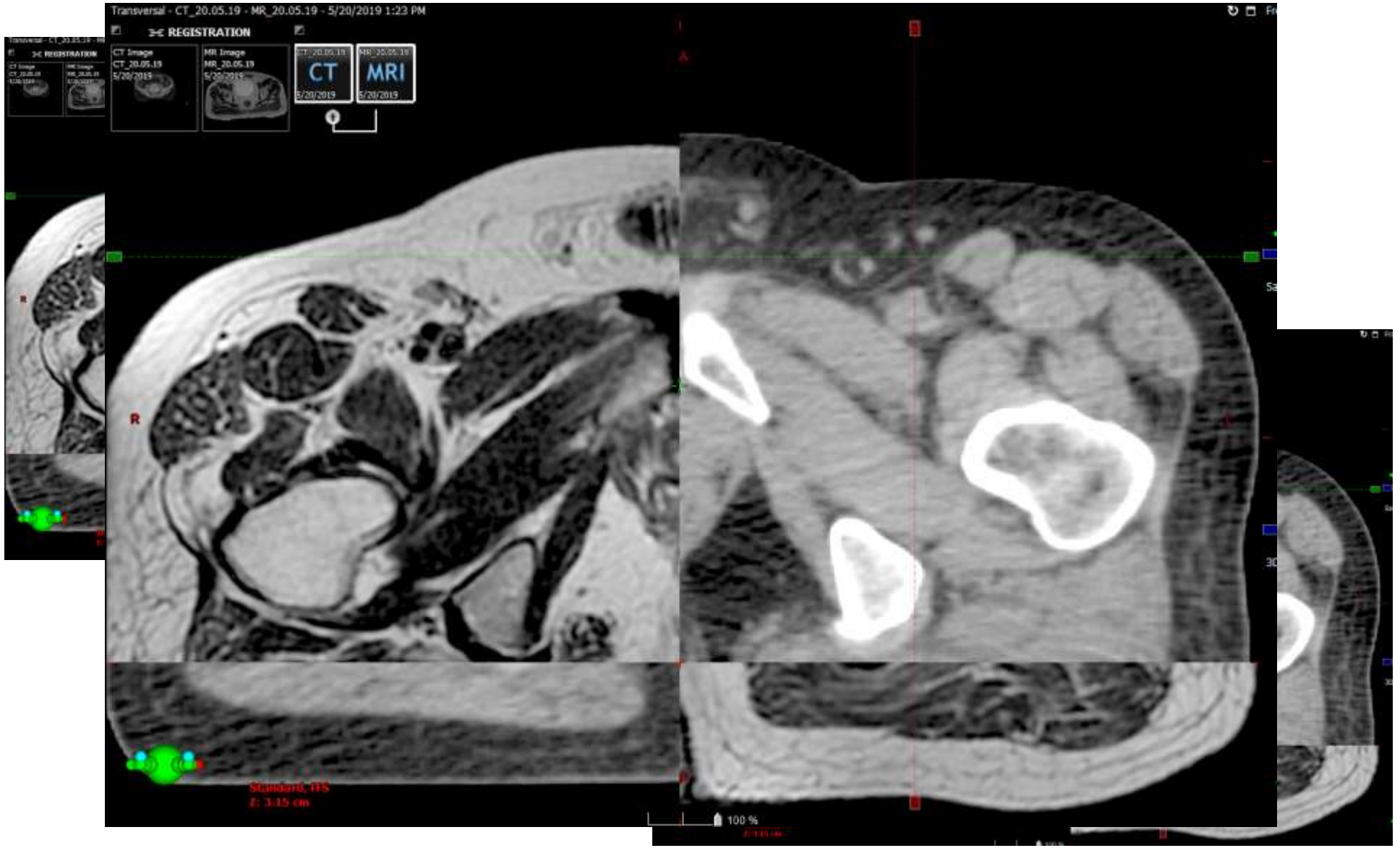
Carl Salembier[a], Geert Villeirs[b], Berardino De Bari[c], Peter Hoskin[d], Bradley R. Pieters[e], Marco Van Vulpen[f], Vincent Khoo[g], Ann Henry[h], Alberto Bossi[i], Gert De Meerleer[j], Valérie Fonteyne[k,*]

- Prostate:
- GTV – gross tumor delineated by newer imaging
- CTV – GTV + Prostate (low risk), GTV + Prostate + SV (intermediate and high risk)
- PTV – CTV + Margins
- Pelvic nodes (if involved)
- OARs: rectum, bladder, proximal femur, bowel bag

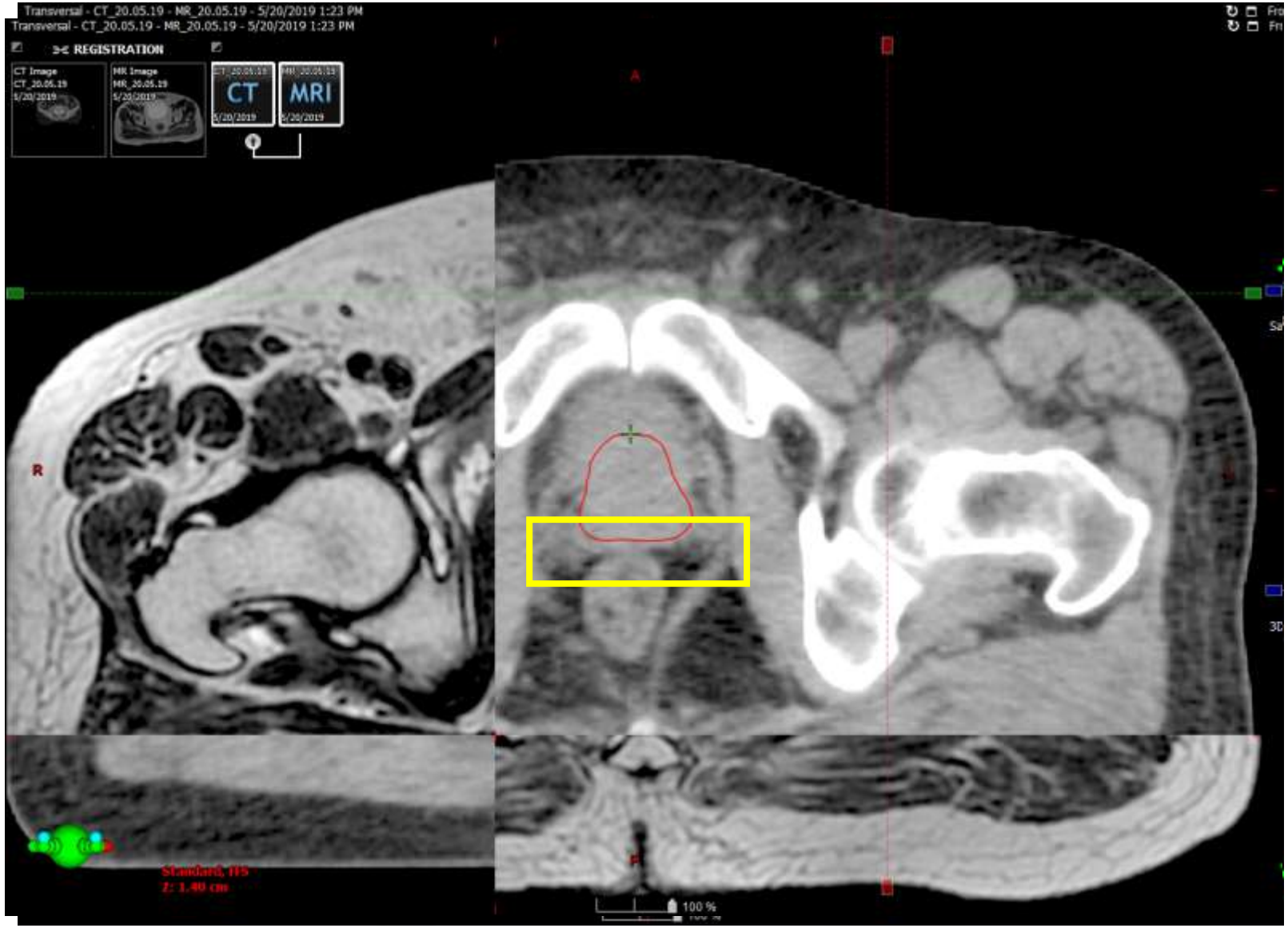
Difficulties encountered contouring

- Delineation of Prostate on CT scan
- Delineation of the apex
- Differentiating base of prostate from the fibromuscular bundle
- Capsule from the NV bundle
- Muscle vs prostate
- SV extent

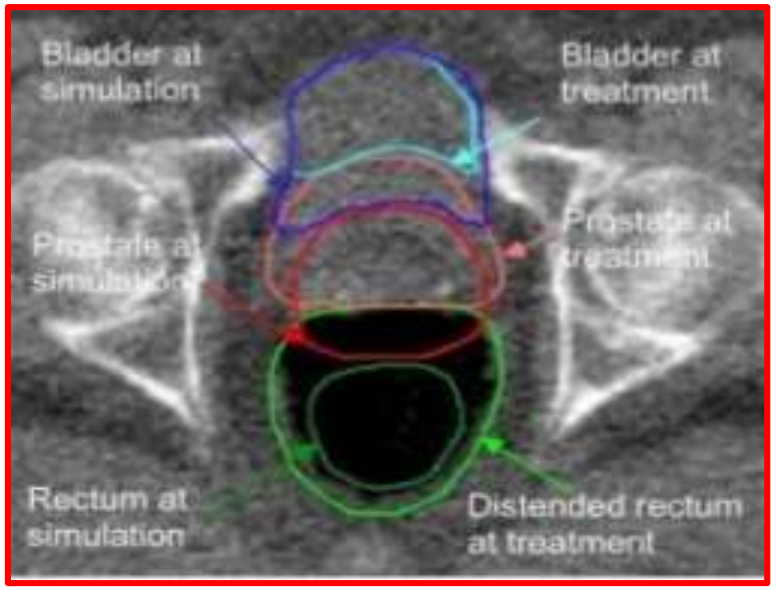
CT-MRI fusion- Apex delineation

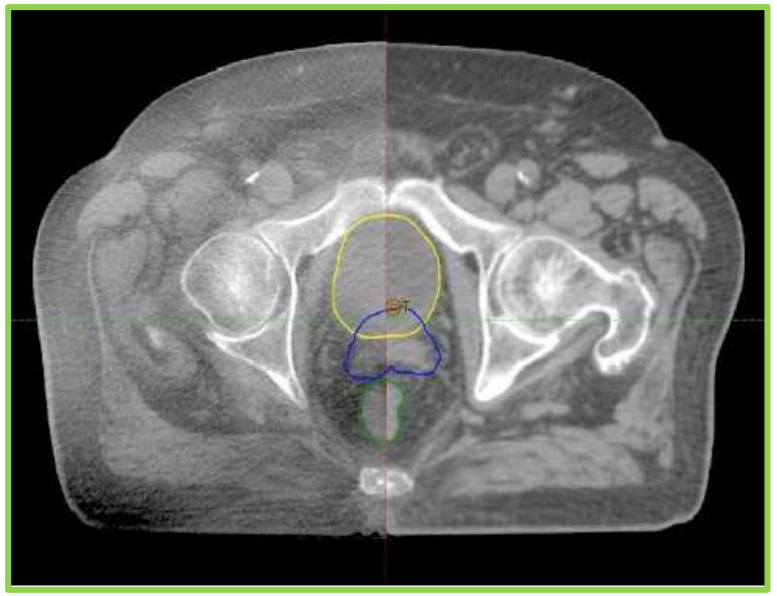


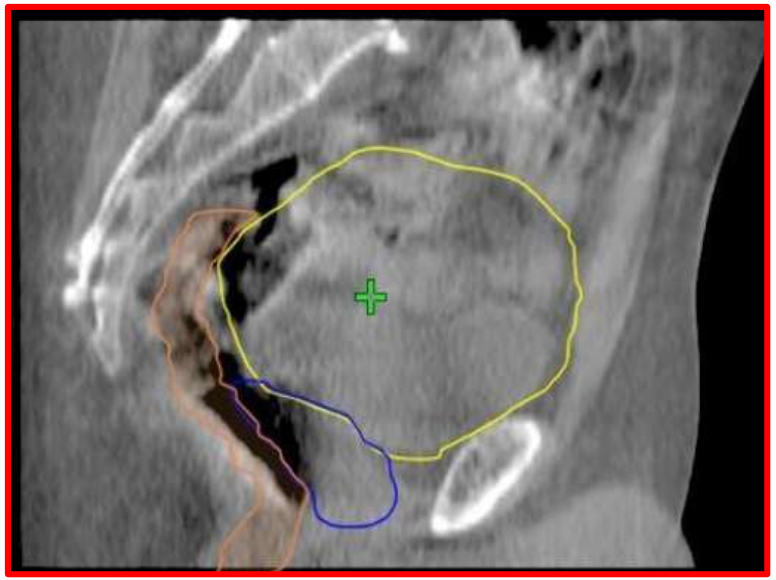
Caution : Check fusion in each slice

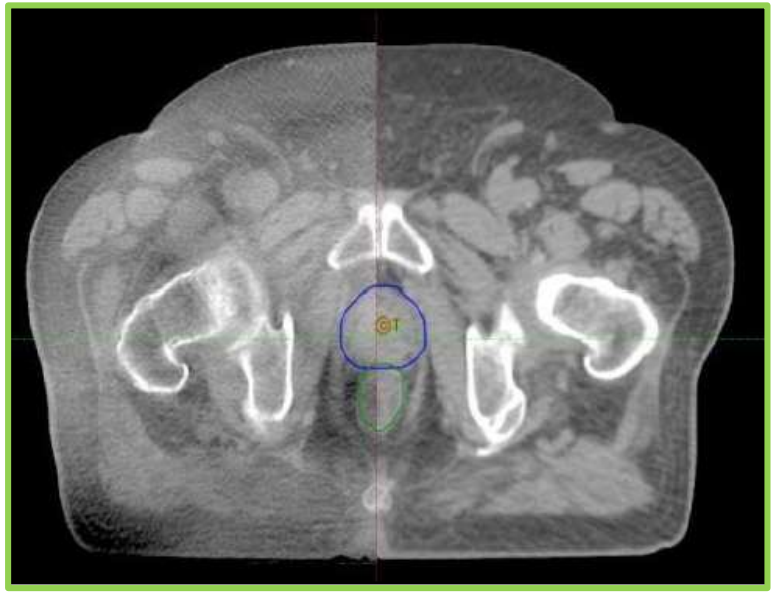


IGRT is MANDATORY for EVERY fraction



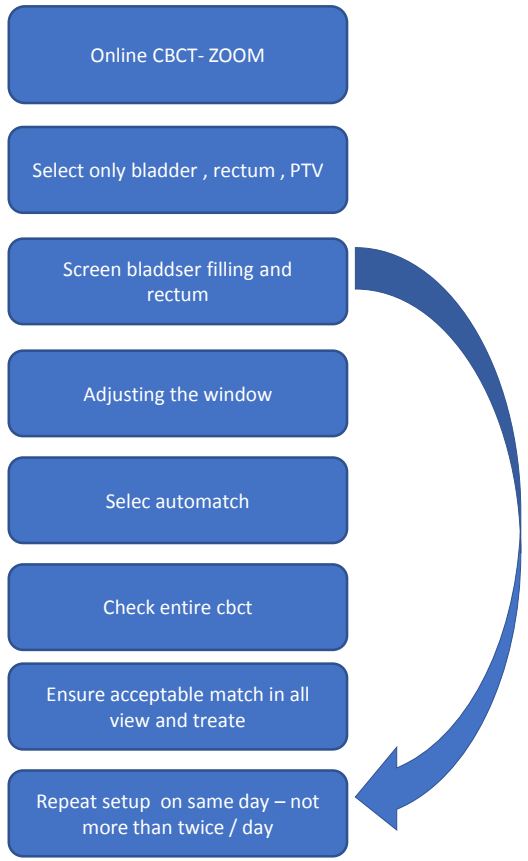






TMH –ONLINE VERIFICATION PROTOCOL

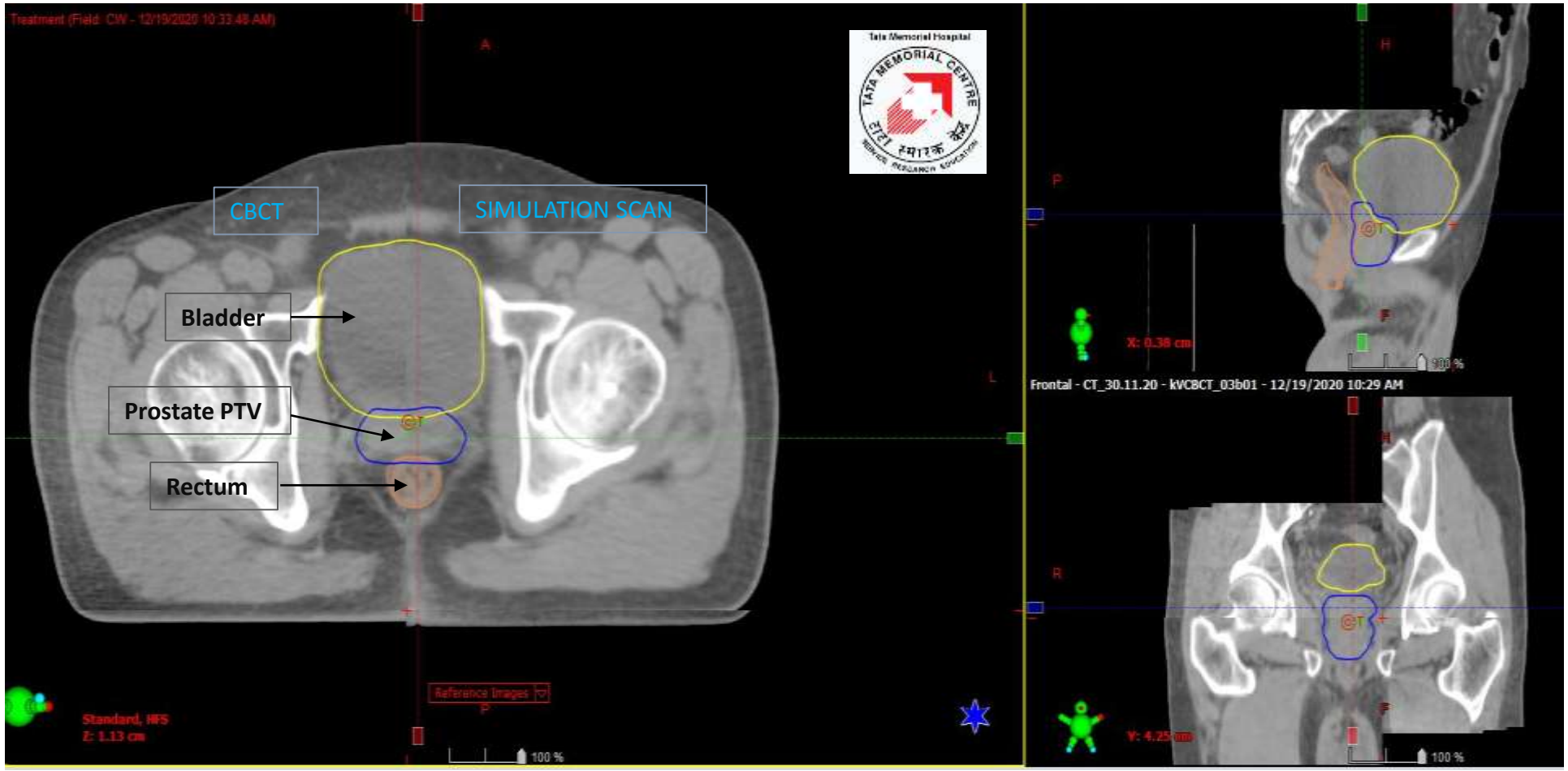
8 steps



- **Gross inadequate bladder filling , rectum distension , clear PTV miss**
- **Shifts more than 7 mm**
- **Geographic miss after final matching**
- **Part of rectum in PTV**

Have a low threshold for re set up in case of SBRT as accuracy is paramount.
Patient can be called another day easily

IDEAL/ACCEPTABLE MATCH



Bladder and rectum almost replicative of that of simulation scan
Target appearing well within the contoured PTV volume

Plan evaluation Sheet

SBRT dose : 36.25Gy/5# to PTV_Prostate +/- 25Gy/5# to PTV_Nodes
Scheduling : Alternate day

	D98		D95
CTVp	98%		
PTVp	95%		
PTVn	D95: 95% (_____)		

36.25 Gy/5#			**V14**	**PLAN**	**V17.5**	**PLAN**	**V28**	**PLAN**	**V31.5**	**PLAN**	**V35**	**PLAN**
PO RT	**Bladder**	*Optimal*	25%		15%		7%		5%		3%	
		Acceptable	35%		20%		10%		8%		4%	
	Rectum	*Optimal*	40%		30%		10%		8%		3%	
		Acceptable	45%		35%		15%		10%		5%	
WP RT	**Bladder**	*Optimal*	30%		25%		10%		5%		3%	
		Acceptable	35%		28%		12%		8%		5%	
	Rectum	*Optimal*	45%		30%		12%		8%		3%	
		Acceptable	50%		35%		15%		10%		5%	
Bowel							80cc					
Femur			5%	Left -		Right-						

CLINICAL GOALS

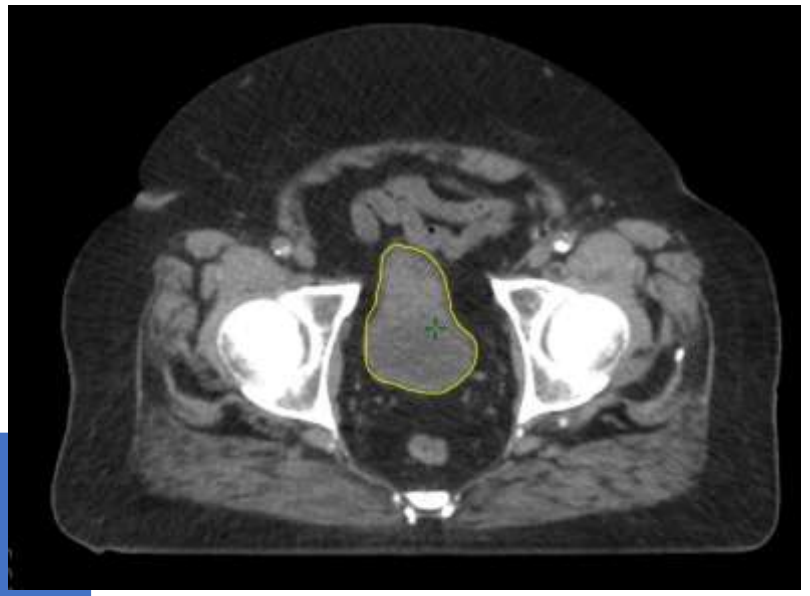
Plan			FINAL_PM
Total Dose			3625.0 cGy
Clinical Goal Summary			2 3 12
CTV_VM/RK	P1	D 98.0 % ≥ 98.0 %	98.89 %
PTV_25/5	P1	D 95.0 % > 65.6 %	66.48 %
PTV_36.25/5	P1	D 95.0 % > 95.0 %	95.74 %
	P1	D 98.0 % > 95.0 %	92.66 %
Anorectum	P2	V 3500 cGy < 3.0 %	4.45 %
	P2	V 3150 cGy < 8.0 %	9.10 %
	P2	V 2800 cGy < 12.0 %	12.37 %
	P2	V 1750 cGy < 30.0 %	22.52 %
	P2	V 1400 cGy < 45.0 %	28.35 %
Bladder	P2	V 3500 cGy < 3.0 %	1.52 %
	P2	V 2800 cGy < 10.0 %	5.13 %
	P2	V 1750 cGy < 25.0 %	23.05 %
	P2	V 3150 cGy < 5.0 %	3.10 %
	P2	V 1400 cGy < 30.0 %	29.77 %
BODY	R	Dmax < 107.0 %	108.20 %
Femur_Head_L	P3	V 1400 cGy < 5.0 %	2.65 %
Femur_Head_R	P3	V 1400 cGy < 5.0 %	2.43 %

EMPTY -RT

Toxicity with empty bladder protocol during prostate stereotactic body radiotherapy : A phase 2 study.

PI: V Murthy

Can we avoid the bladder protocol and make prostate SBRT more patient friendly?



N=100

Simulate with an empty bladder

Contour and plan

Constraints=Full bladder

Treat

(Empty RT)

- **Primary end point-Acute and late bowel and bladder toxicity.**
- **Secondary End point- Bladder Volume variability.**
- **Feasibility of planning SBRT with empty bladder.**

SBRT for RCC

Can I do it in my centre?

- YES

- What you need:
  - Conviction!
  - Convincing ability
  - “Modern LA” with IGRT
  - Dose: 40-50Gy in 3-5#
  - Physics Support

Generic RT

Gantry-mounted LA

Ring Gantry LA

Robotic LA

MRI LINAC

Questions to answer today

You may ask yourself

- What is the local control?
- Is it really safe?

- Can I pull it off, I have a standard LA?

- What is the best fractionation?

- What are the issues with motion management, Planning and contouring?

Your urologist may ask you

- Patient doesn't want Sx so why not **RFA**/Thermal Ablation?

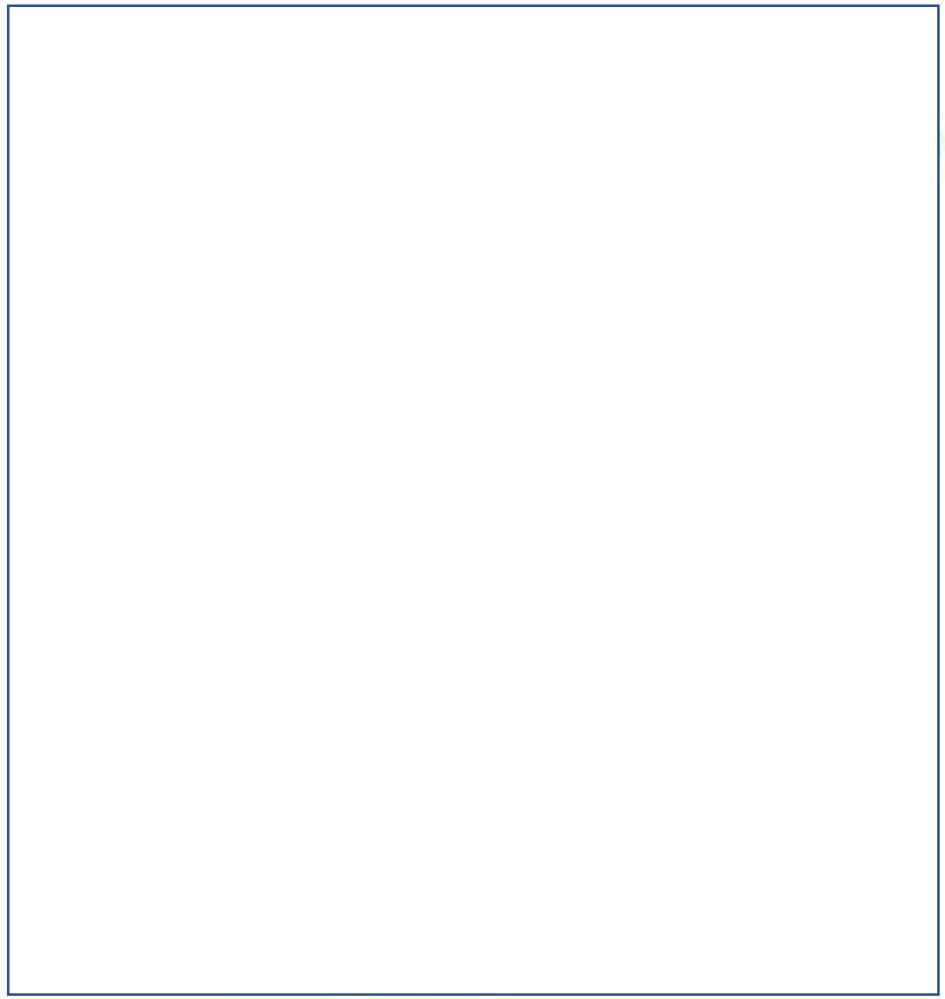
- Can you really do it in a **single** Kidney?
- It's a 6 cm tumour, **are you sure**?

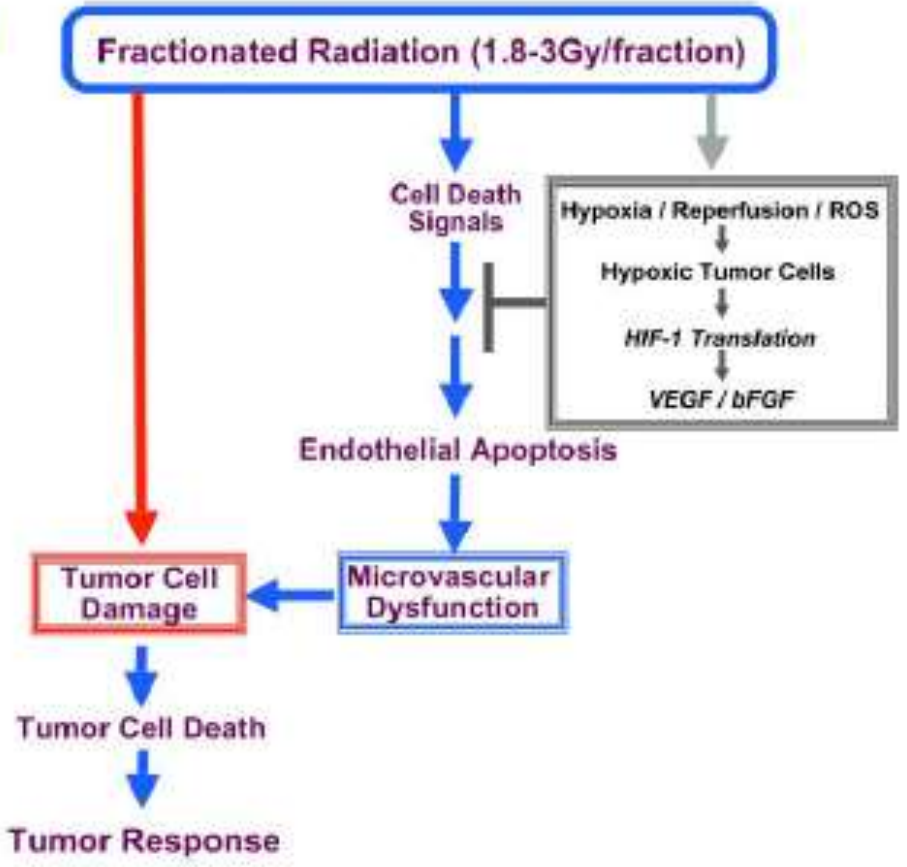
- How do you follow up?
  - What happens to the **GFR**?
  - When do we **biopsy** to prove Local control?

Conventional Wisdom

RT doesn’t work in RCC

Overcoming radioresistance: Large fraction size





Why SBRT?

Summarising the switch

Leveraging Technology

Diagnostic Imaging
Patient immobilization
Techniques: SRS, SABR
Image guidance
Motion management

Leveraging Biology

SM to ceramide
Endothelial cell apoptosis
Resistant to Hypoxia
Augmentation of anti-tumor immune response

Challenge Conventional Wisdom

RT does work in RCC

iROCK

INTERNATIONAL RADIOSURGERY ONCOLOGY CONSORTIUM FOR KIDNEY

2016

CONSENSUS STATEMENT

For reprint orders, please contact: reprints@futuremedicine.com

Consensus statement from the International Radiosurgery Oncology Consortium for Kidney for primary renal cell carcinoma

1. *Peter MacCallum Cancer Centre* – Shankar Siva
2. *Karolinska Institutet* – Peter Wersäll, Karin Lindberg
3. *University of Munich* - Alexander Muacevic
4. *Yamanashi University* – Hiroshi Onishi
5. *NIRS Hospital for Charged Particle Therapy* - Takuma Nomiya
6. *Harvard University* – A. Mahadevan, I. Kaplan
7. *Houston Methodist* – Bin Teh
8. *Case Western University Hospital* – L. Ponsky, N. Zaorsky

5-year outcomes after stereotactic ablative body radiotherapy for primary renal cell carcinoma: an individual patient data meta-analysis from IROCK (the International Radiosurgery Consortium of the Kidney)

Shankar Siva, PhD • Muhammad Ali, MBBS • Rohann J M Correa, PhD • Prof Alexander Muacevic, MD •

THE LANCET Oncology

2022

N=190

FU 5 yrs

Characteristic	Patients (N=190)
Age (years) – median (IQR)	73.6 (66.2, 82)
Medically inoperable	96 (75%)
Pathologic confirmation	157 (82.6%)
Max dimension (cm)-mean ± SD	**4.2** (± 2.2)
Solitary kidney	56 (29.5%)
BED10- median (range)	**87.5 Gy** (33.6, 180)

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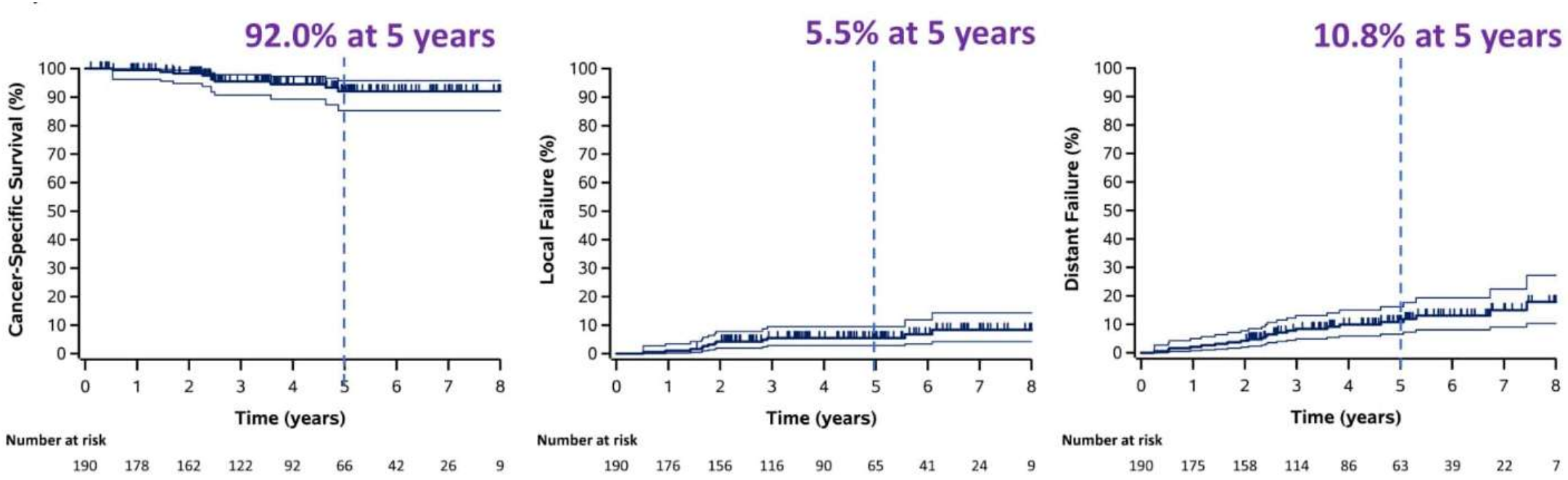


Patient selection

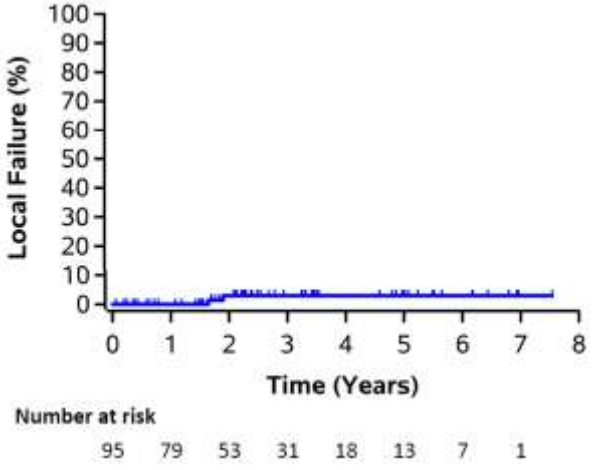
SABR for large renal mass (>4cm)

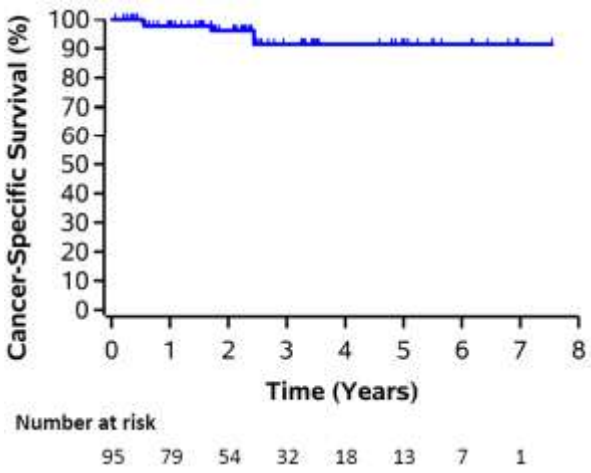
Stereotactic Ablative Radiotherapy for ≥T1b Primary Renal Cell Carcinoma: A Report From the International Radiosurgery Oncology Consortium for Kidney (IROCK)

Shankar Siva, PhD, MBBS, FRANZCR,*,† Rohann J.M. Correa, MD, PhD,†

DOES SIZE MATTER?

- N= 95. (30% solitary)
- Median tumor diameter 4.9 cm





On MVA, per 1 cm increase in tumor size associated with

- Decreased CSS (HR 1.41; p<0.001)
- Decreased PFS (HR 1.1; p=0.03)
- Not significant for local failure (HR 1.15; p=0.056)

T1a versus T1b (≥ 4 cm): No difference in CSS, PFS or local failure rate

SABR in Solitary kidney

Stereotactic Radiotherapy as a Treatment Option for Renal Tumors in the Solitary Kidney: A Multicenter Analysis from the IROCK

Median follow up of 2.6 years	N=81 (Solitary)
Median tumor diameter	3.7 cm (IQR 2.5-4.3)
T size ≥ 4 cm	37%
Mean eGFR decrease	-5.8 ± 10.8 mL/min (Solitary)
Dose/Fx	25 Gy SF for 71%

- No patient with a solitary kidney required HD
- Tumors ≥ 4 cm → GFR ↓ ≥ -15 mL/min (HR, 4.1; p=0.029)
- Solitary kidney should not deter from SF-SABR

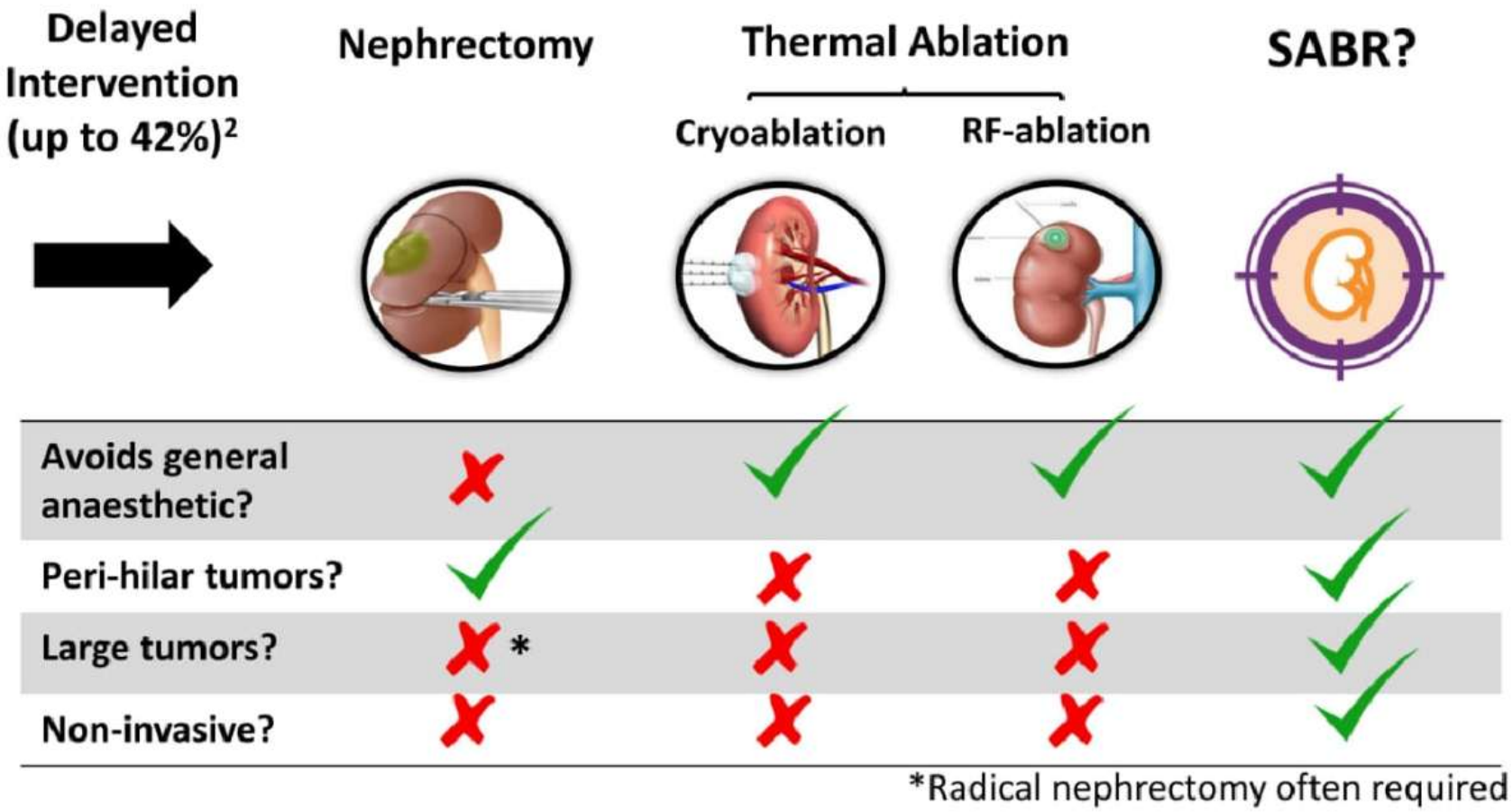
Choice:

1. Remove kidney → 100% dialysis
2. Treat tumor → Good LC and renal function, Spare dialysis

ASTRO 2018

Correa, Louie, Staehler etal. J Urol 2019.

Advantages of SABR over TA

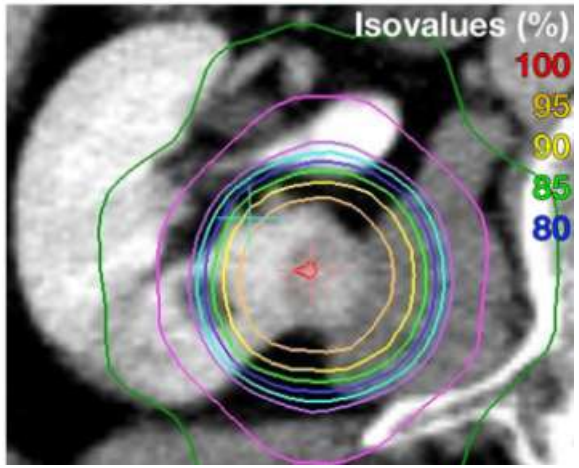


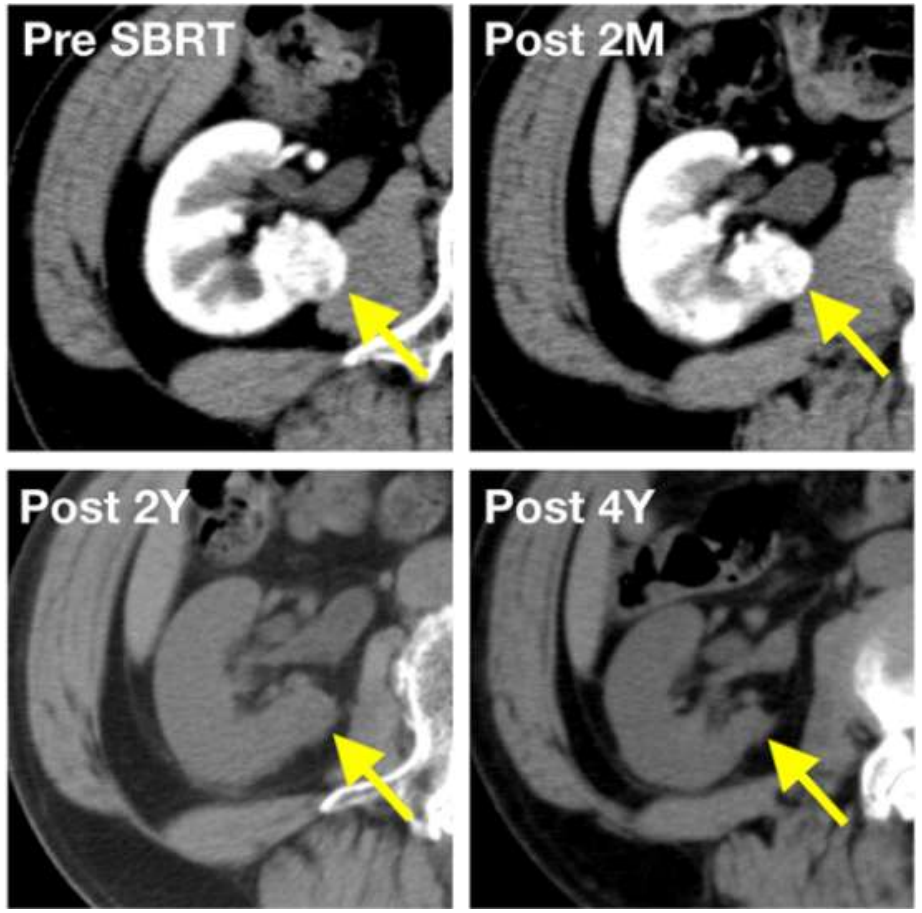
Slide courtesy – S Siva

Assessing response

Tumour

Slow but continuing response





Funayama et al. Tech Cancer Res Treatment 2019.

Assessing response

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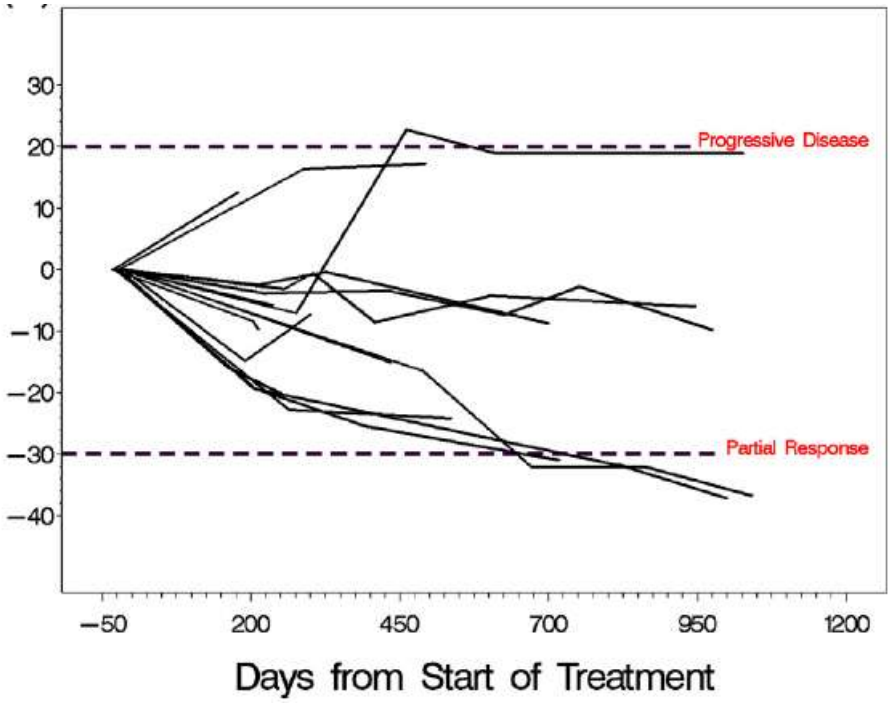
Slow but continuing response



Years post-SABR

Ponsky et al.
Radiother Oncol 2015

Funayama et al.
Tech Cancer Res Treatment 2019

Assessing response :

Renal Function

5-year outcomes after stereotactic ablative body radiotherapy for primary renal cell carcinoma: an individual patient data meta-analysis from IROCK (the International Radiosurgery Consortium of the Kidney)

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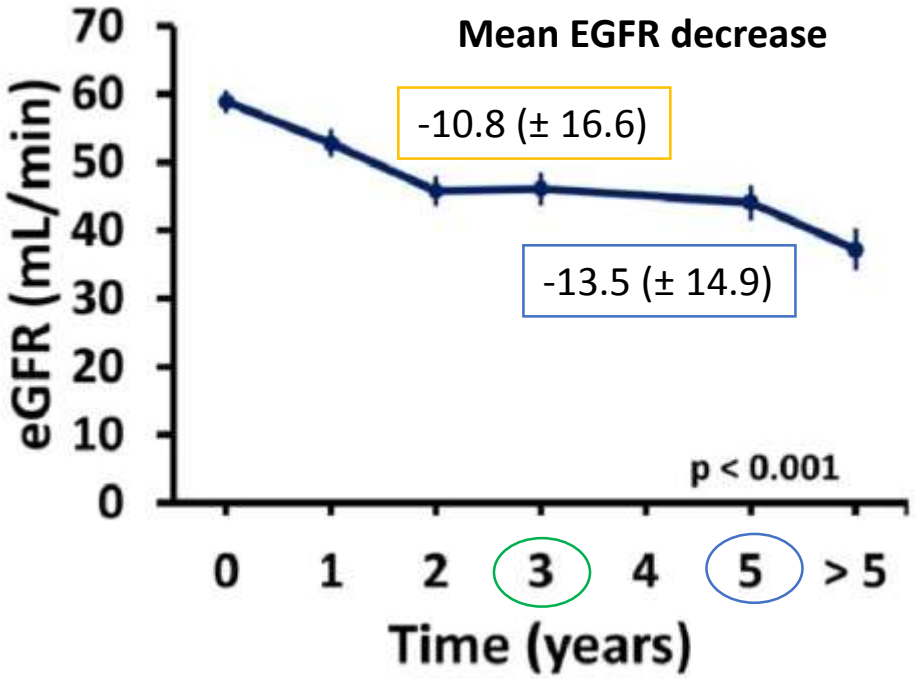


Moving SBRT into the guidelines

National Comprehensive Cancer Network®

NCCN Guidelines Version 2.2023
Kidney Cancer

[e] Stereotactic body radiotherapy (SBRT) may be considered for medically inoperable patients with Stage I kidney cancer (category 2B) or with Stage II/III kidney cancer (both category 3).

EAU Guidelines on
Renal Cell Carcinoma

Summary of evidence	LE
Most population-based analyses show a significantly lower cancer-specific mortality for patients treated with surgery compared to non-surgical management.	3
In AS cohorts, the growth of small renal masses is low in most cases and progression to metastatic disease is rare (1–2%).	3
Low-quality studies suggest high disease recurrence rates after RFA of tumours > 3 cm and after cryoablation of tumours > 4 cm.	3
Low-quality studies suggest a higher local recurrence rate for TA therapies compared to partial nephrectomy, but quality of data does not allow definitive conclusions.	3

Recommendations	Strength rating
Offer active surveillance (AS) or thermal ablation (TA) to frail and/or comorbid patients with small renal masses.	Weak
Perform a percutaneous renal mass biopsy prior to, and not concomitantly with TA.	Strong
When TA or AS are offered, discuss with patients about the harms/benefits with regards to oncological outcomes and complications.	Strong
Do not routinely offer TA for tumours > 3 cm and cryoablation for tumours > 4 cm.	Weak

studies, the local control rate was 97.2% and the mean change in eGFR was 7.7 mL/min/1.73 m^2. Grade 3 or 4 toxicities occurred in 1.5% of patients. However, viable tumour cells are often seen in post-SABR biopsies, although their clinical significance remains unclear [393]. Although early results of SABR are encouraging, more evidence from randomised trials is needed.

Where does it fit in?

Patient Evaluation

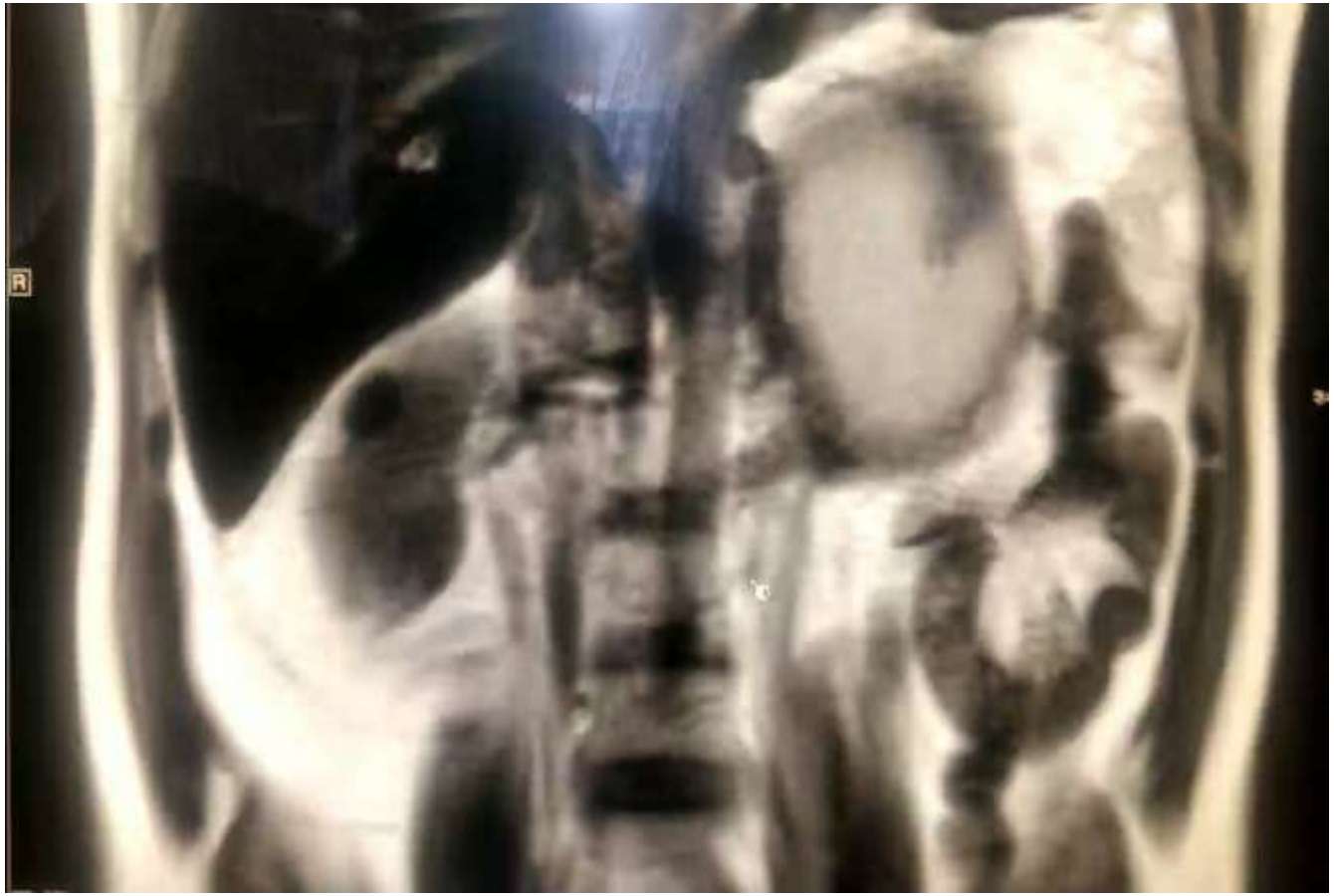
- Medically inoperable early stage primary RCC
- Patients refusing surgery
- Too big/unsuitable for RFA/NSS (T1b or involving the Pelvis)
- RCC in patients with single kidney
- Incidentally detected as synchronous/metachronous cancer
- Oligo-metastatic for cytoreduction (Abscopal effect)

Tips

- **Presimulation Checklist:**
  - GFR
  - Biopsy
- **Simulation**
  - Immobilisation: Vacloc/body bag
  - Slow IV contrast (when possible)
  - Per oral contrast
  - 1-3 mm slice thickness
  - mpMRI with Gadolinium useful if no contrast
- **Motion Management**
  - 4DCT MIP
  - Breath hold
  - None: ITV
- Fiducials +/-
- **Planning**
  - FFF
  - Intrafraction break:CBCT

What technology is needed?

- Tumor visualisation
- High precision planning/delivery
- Robust image-guidance
- Quick delivery
- Intrafraction motion management
- **“4D CT Based Planning”**



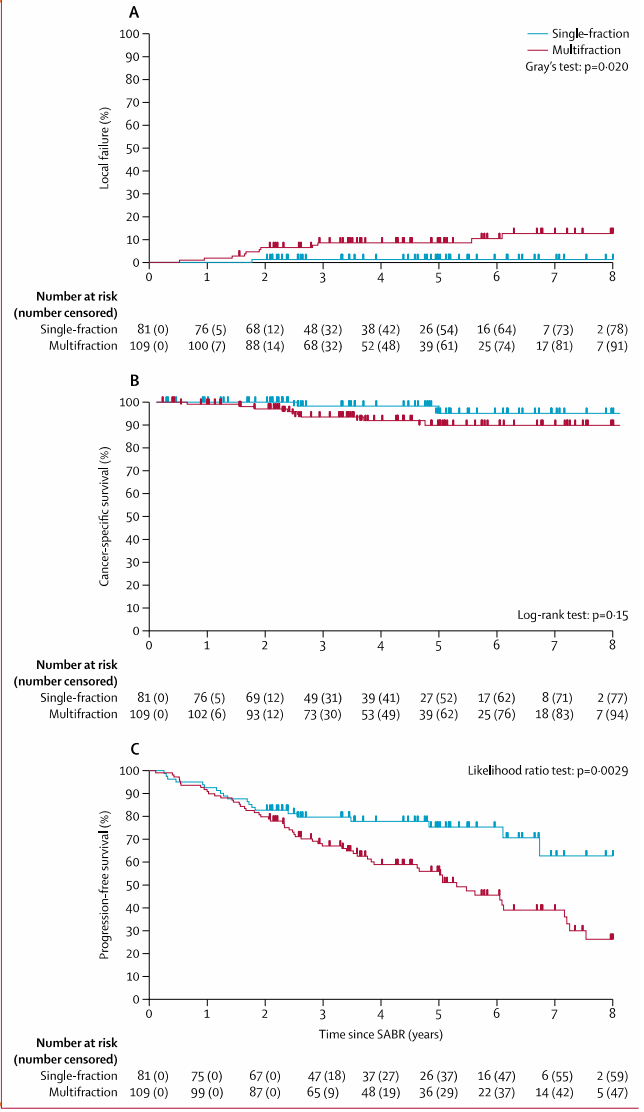
Dose-fractionation

5-year outcomes after stereotactic ablative body radiotherapy for primary renal cell carcinoma: an individual patient data meta-analysis from IROCK (the International Radiosurgery Consortium of the Kidn

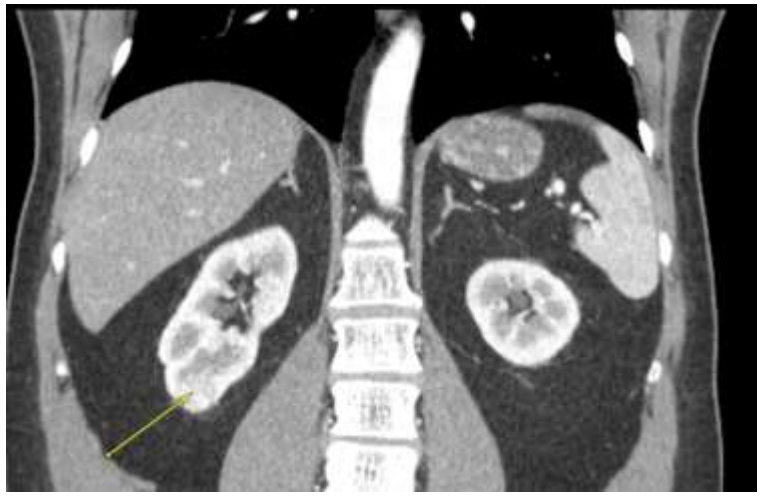
Shankar Siva, PhD • Muhammad Ali, MBBS • Rohann J M Correa, PhD • Prof Alexa

THE LANCET Oncology

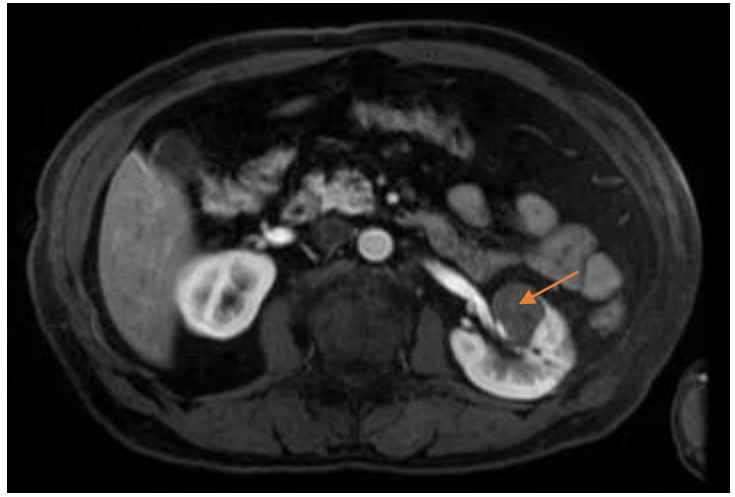
	Single-fraction SABR (n=81)	Multifraction SABR (n=109)	
Total dose, Gy	25·0 (25·0–25·0)	42·0 (35·0–48·0)	<0·0001
Number of fractions	1	4 (3–5)	..
Fraction dose, Gy	25·0 (25·0–25·0)	8·0 (7·0–14·0)	<0·0001
$BED_{2.6}$, Gy	265·4 (265·4–265·4)	202·2 (163·1–268·2)	0·0002
$BED_{6.9}$, Gy	115·6 (115·6–115·6)	112·2 (84·8–131·5)	0·35
BED_{10}, Gy	87·5 (87·5–87·5)	96·0 (67·2–105·6)	0·22



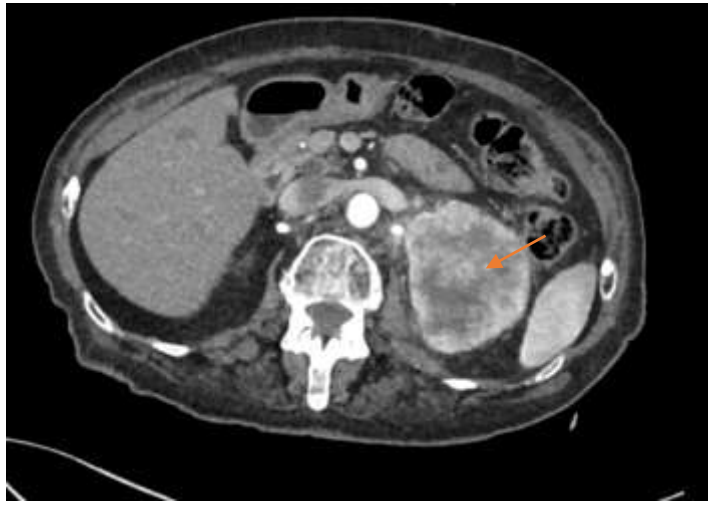
Single vs Multifraction?

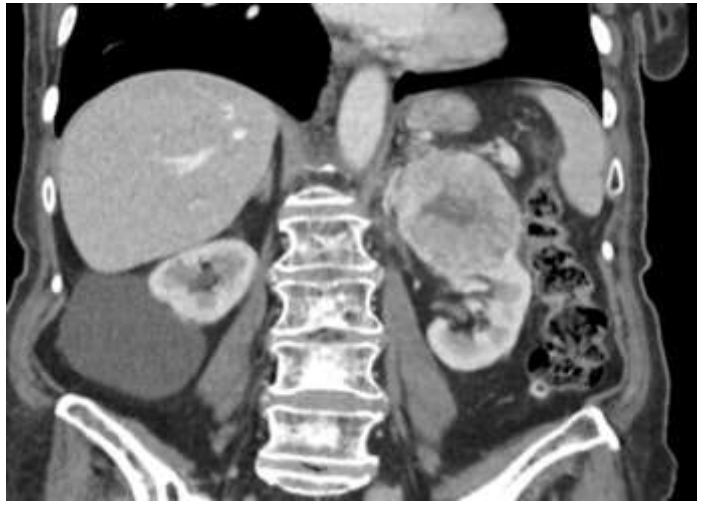


SF ✓
MF



SF ✓
MF ✓





SF
MF ✓

Dose Constraints

Organ at risk constraint	Fractionation schedule			
	1 fraction	*3 fractions*	*5 fractions*	*Carbon ions (10fractions)*
Spinal cord	<1 cc to 8 Gy <0.03 cc to 12 Gy	<0.03 cc to 18 Gy Max 22.2 Gy	<0.5 cc to 23 Gy <0.03 cc to 27.5 Gy	45 Gy (BED 2 Gy)
Small bowel	<20 cc to 14 Gy Full circumference <12.5 Gy†	<10 cc to 11.4 Gy <1 cc to 24 Gy Max 30 Gy	<5 cc to 20 Gy Max 30 Gy	60 Gy (BED 2 Gy)
Stomach	<10 cc to 11 Gy <5 cc to 22.5 Gy	<10 cc to 16.5 Gy 5 cc to <22.5 Gy Max 30 Gy	<5 cc to 18 Gy Max 30 Gy	60 Gy (BED 2 Gy)
Large bowel	ALARA	ALARA, minimize volume receiving >30 Gy	Max 38 Gy <20 cc to 25 Gy	60 Gy (BED 2 Gy)
Chest wall	N/A	<700 cc to 30 Gy	<70 cc to 37 Gy	80 Gy (BED 2 Gy)
Skin (5 mm from external contour)	Max 24 Gy	<10 cc to 30 Gy	<10 cc to 15 Gy <0.03 cc to 30 Gy	80 Gy (BED 2 Gy)
Liver		<700 cc to 15 Gy V17 <66%	<700 cc to 15 Gy	N/A
Heart	15 cc to <16 Gy	Max 27.9	<15 cc to 32 Gy Max 38 Gy	N/A
Contralateral kidney‡	ALARA	V10 < 33% V5 <14 Gy	ALARA	ALARA

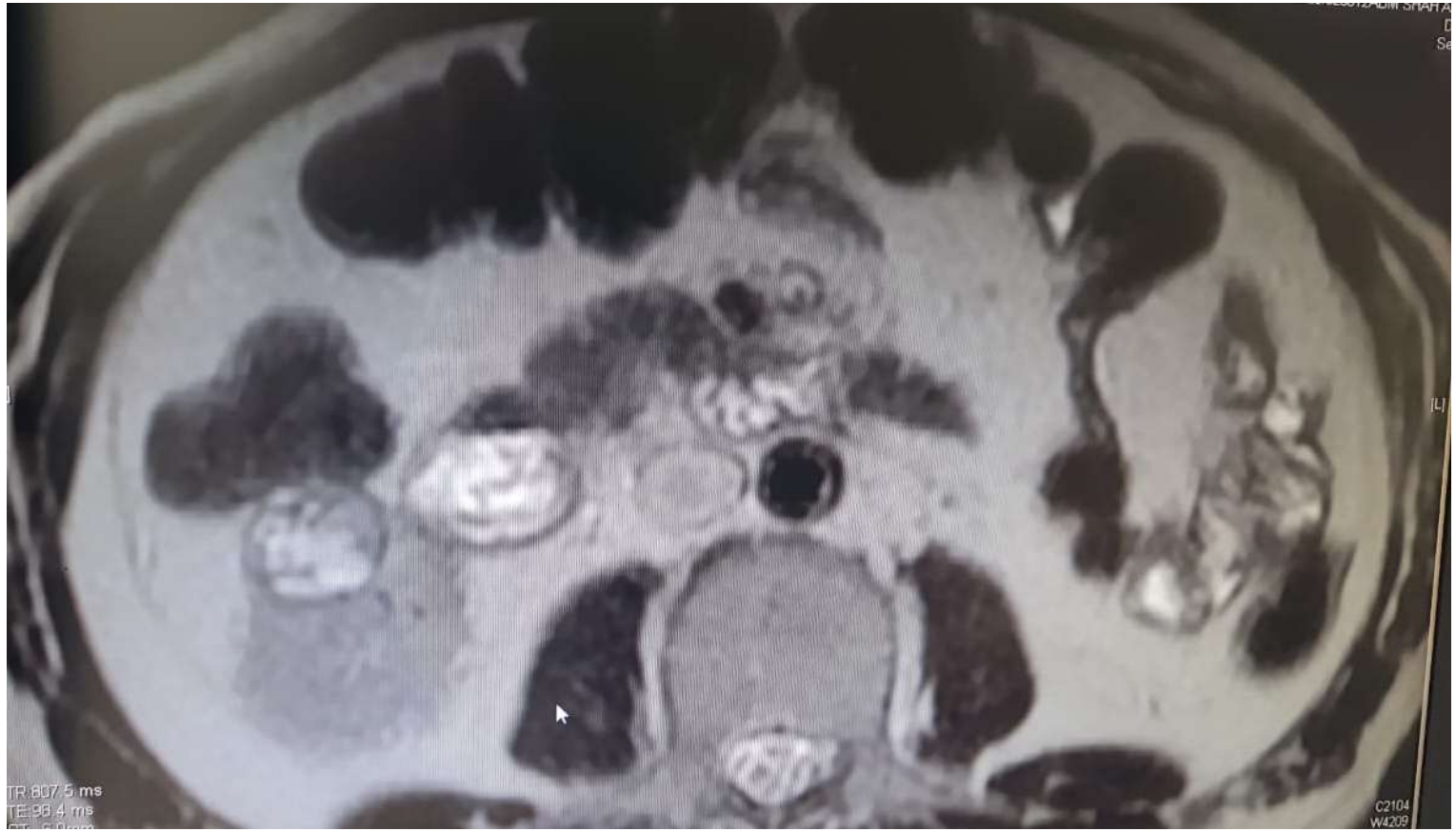
1. **iROCK consensus statement 2016**
2. **FASTRACK II protocol**

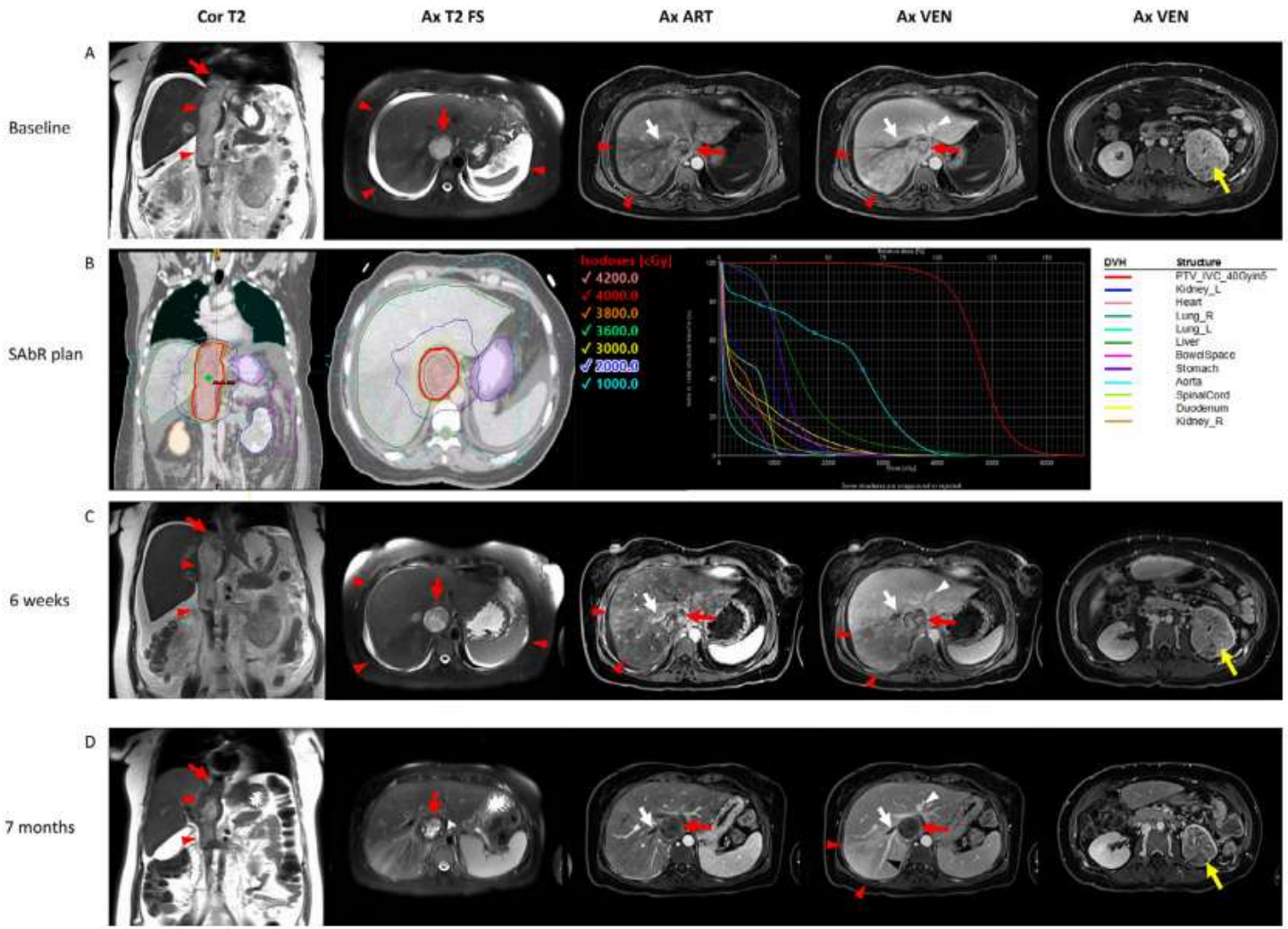
When to back off?

- 67y/M
- Single Kidney

(Previous RCC)

- GFR 60ml/m





ELSEVIER

Urologic Oncology: Seminars and Original Investigations 000 (2021) 1–5

UROLOGIC ONCOLOGY

Clinical-kidney cancer

Stereotactic ablative radiation therapy for renal cell carcinoma with inferior vena cava tumor thrombus

Yuval Freifeld[a,b,*], Ivan Pedrosa[a], Mark Mclaughlin[a], Rohann M. Correa[c], Alexander V. Louie[c], J. Alberto Maldonado[d], Chad Tang[d], Brian Kadow[e], Alexander Kutikov[e], Robert G. Uzzo[e], Camillo Porta[f], Nicholas W. Bucknell[g], Shankar Siva[g], James Brugarolas[a], Vitaly Margulis[a], Robert Timmerman[a], Raquibul Hannan[a,**]

Summary

- SBRT to primary RCC is a **real option in clinical practice**
  - It is safe (1-2% Gr 3 Tox)
  - It can be done on a standard Modern LA
  - Larger and solitary tumours amenable for SBRT
- Post SBRT responses are slow and steady (**do not biopsy**)
- Post SBRT GFR drop is 10-15ml/min over long term