



Case study

Single kidney patient turned down for therapy has treatment on **Elekta Unity**

Institution

Advanced Radiation Oncology Department (ARO), IRCCS Ospedale "Sacro Cuore – don Calabria", Via Don A. Sempredoni 5, 37024 Negrar (Verona)

Location

Italy

Medical staff

Prof. Filippo Alongi, Dr. Michele Rigo,
Dr. Rosario Mazzola, Dr. Ruggero Ruggieri



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Treat moving targets and spare healthy tissue with confidence and certainty

Oligometastases and SBRT

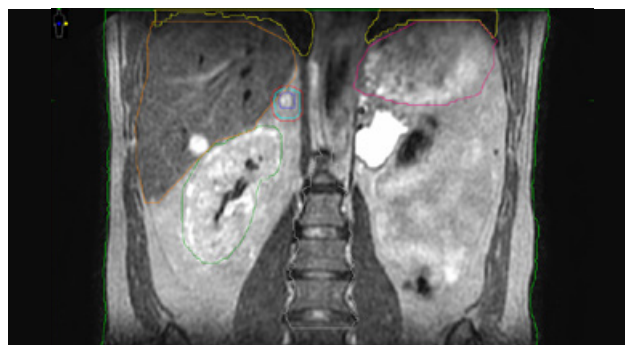
Oligometastatic cancer is a disease defined as a state of limited metastases for which the addition of ablative therapies could increase the chances of cure, including such treatments as SBRT and surgery. In the absence of randomised phase 3 trials, early clinical studies show improved survival when radical local therapy is added to standard systemic therapy for oligometastatic disease.¹

Why MRgRT?

Magnetic Resonance guided Radiation Therapy (MRgRT) can provide advantages over conventional radiation therapy treatment methods for most abdominal lesions, with superior visualization of mobile structures such as stomach, duodenum, liver and kidneys. The possibility to adapt the dose to the daily anatomical situation, increases the chance to deliver a local ablative treatment.

Patient Details

A 48-year old male with a single kidney was diagnosed with primary kidney cancer and synchronous surrenal oligometastases. Because of the clinical complexity of his case associated with the high-risk of causing permanent radiation-induced damage to his single kidney, and the potential to then render him renal dialysis dependent, the clinical team sought to obtain Radiation Therapy using particle therapy (because of the steep dose gradient), but were turned down.



Daily T2 3D navigated image



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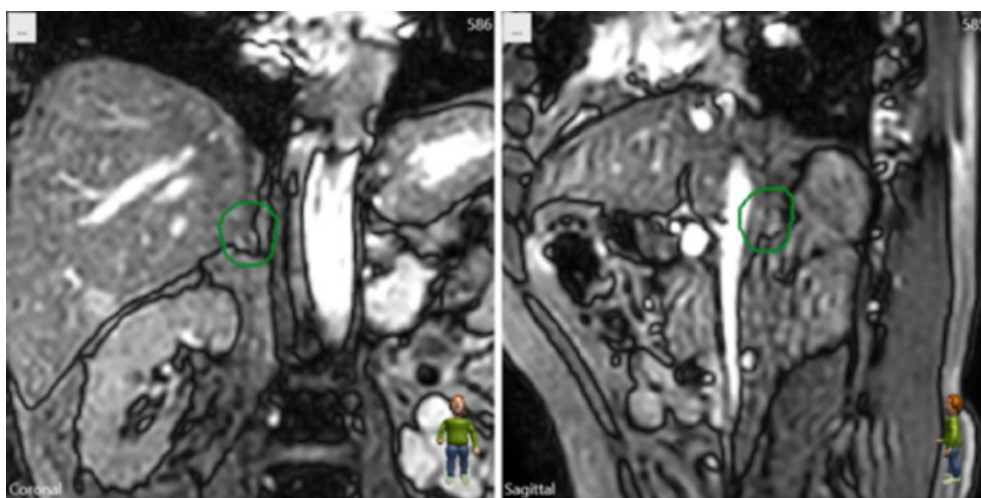
Why Elekta Unity?

The team at the Sacro Cuore-Don Calabria Advanced Radiation Oncology Department in Negrar Verona were able to provide the patient with localized SBRT treatment to the surrenal lesion whilst precisely achieving dose constraints to the kidney and liver.

Elekta Unity enables unparalleled acquisition of diagnostic quality MR (1.5T) images before and in real-time during the treatment itself. In this case, superior soft tissue contrast (compared to CBCT-based RT), enabled direct visualization of the surrenal lesion and surrounding anatomy, allowing for daily online deformable adaptive strategies to improve lesion coverage, while avoiding nearby critical structures, including this patient’s solitary kidney.

The combination of imaging with online deformable plan adaptation and stereotactic treatment delivery capabilities meant the team could confidently deliver a high and precise dose, in this high-risk case.

Treatment planning for Unity is achieved with simple application of templates that contain mainly anatomical structures, avoiding the complex and tedious task of creating help structures. This includes functionality that ensures the dose to organs at risk are as low as possible, whilst maintaining target coverage. Parameters promote robustness and treatment efficiency meaning that, stereotactic treatment delivery with 10 IMRT beams can still be delivered fast.



Exceptional image quality of cine imaging Surrenal Metastasis PTV

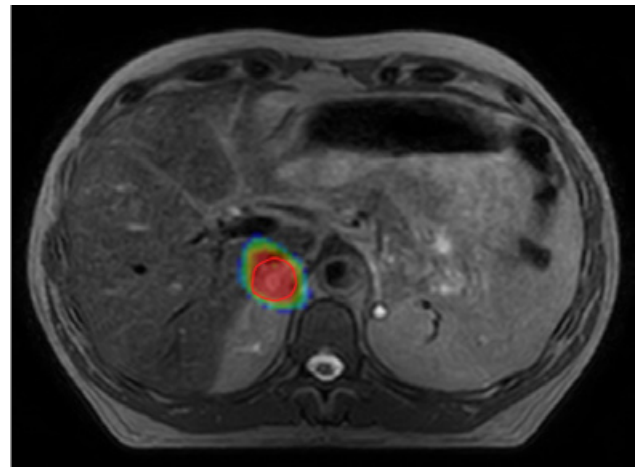
Metric	[1] FX01	[2] FX02	[3] FX03	[4] FX04	[5] FX05	[6] FX06
1 Volume (%) of the PTV covered by 38.50 (Gy)	GOOD 1.001	GOOD 0.791	ACCEPTABLE 2.773	GOOD 1.225	GOOD 0.519	GOOD 0.310
2 Volume (%) of the PTV covered by 34.20 (Gy)	GOOD 97.364	GOOD 96.694	ACCEPTABLE 94.879	GOOD 96.804	ACCEPTABLE 94.876	GOOD 96.761
3 Dose (Gy) covering 1.00 (cc) of the Kidney RT	PASS 9.040	PASS 11.501	PASS 9.571	PASS 11.181	PASS 10.591	PASS 11.341
4 Mean dose (Gy) to the Kidney RT	PASS 0.680	PASS 0.788	PASS 0.663	PASS 0.783	PASS 0.664	PASS 0.771
5 Mean dose (Gy) to the LIVER	GOOD 4.110	GOOD 4.650	GOOD 3.995	GOOD 4.512	GOOD 4.699	GOOD 4.540
6 Dose (Gy) covering 1.00 (cc) of the DUODENUM	PASS 10.647	PASS 13.221	PASS 11.506	PASS 14.110	PASS 10.036	PASS 10.479
7 Mean dose (Gy) to the DUODENUM	GOOD 3.225	ACCEPTABLE 4.541	GOOD 3.379	ACCEPTABLE 4.857	GOOD 2.746	GOOD 3.920
8 Dose (Gy) covering 30.00 (cc) of the STOMACH	PASS 5.031	PASS 3.933	PASS 6.169	PASS 5.865	PASS 2.723	PASS 7.985
9 Mean dose (Gy) to the STOMACH	GOOD 1.050	GOOD 0.889	GOOD 1.035	GOOD 0.971	GOOD 0.818	GOOD 1.392
10 Dose (Gy) covering 0.10 (cc) of the Spinal Cord	GOOD 6.727	GOOD 8.566	ACCEPTABLE 10.722	GOOD 9.294	GOOD 8.285	GOOD 8.500

All dosimetric criteria were met and within constraints for the entire treatment.

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Treatment Details

- Patient treatment deemed not possible by other centers due to clinical complexity
- 36 Gy in 6 fractions with 10 beams SBRT
- Daily online deformable adaptive workflow for MRgRT
- Only One Kidney: D1cc <15Gy
- Liver: Dmean <5Gy
- MR Treatment sequence: T2 3D Navigated (Navigated can correct for any motion that occurs during image acquisition)
- Continuous motion monitoring of PTV
- Total treatment time 39 minutes



36 Gy in 6 Fx with 10 beams

Sequencing Parameters: Step & Shoot IMRT

Segment Shape Optimization

High Precision Leaf Positions (Requires More Memory)

Speed: [Slider]

Min. Segment Area (cm²): 4.000

Min. Segment Width (cm): 0.70

Fluence Smoothing: High

Min. MU / Segment: 8.00

Max. # of Segments Per Plan: 200

Park Leaf Gap Under Jaw

OK Cancel

Final plan statistics:

Number of segments: 24

Number of monitorunits (# MU): 1349.56 MU

Estimated total delivery time: 232.96 seconds

Minimum # MU for ideal delivery: 1349.56 MU

Estimated MU efficiency: 100 %

Modulation Degree: 2.115

Influence of the VLW (Virtual Leaf Width)

Results

After the treatment, the patient reported zero radiation therapy-related toxicity.

Structure	Cost Function	Ena...	Status	Ma...	Weight	Reference Dos...	Multicri...	Isocon...	Isoef...	Relative ...
Kidney_RT	Serial	☑	On	☑	0.01		☑	3.000	0.596	
	Quadratic Overdose	☑	On	☑	4.00	10.000	☑	0.100	0.120	++++
PTV	Target Penalty	☑	On	☑	1.00			36.000	35.028	
	Quadratic Overdose	☑	On	☑	3.00	37.500		0.250	0.077	+++
	Underdose DVH	☑	On	☑	0.01	34.200		99.00	97.75	
LIVER	Serial	☑	On	☑	0.79		☑	10.000	3.864	+++
BODY	Conformality	☑	On	☑	0.14		☑	0.80	0.56	++
	Quadratic Overdose	☑	On	☑	0.14	30.000	☑	0.050	0.017	++
	Maximum Dose	☑	On	☑	3.00			38.500	37.561	++++
	Quadratic Overdose	☑	On	☑	3.38	18.000	☑	0.180	0.190	++++
Heart	Quadratic Overdose	☑	On	☑	0.01	1.000	☑	0.100	0.000	
Duodenum	Serial	☑	On	☑	0.30		☑	7.000	3.733	+++
Stomach	Serial	☑	On	☑	3.30		☑	9.000	1.096	++++
Spinal_Canal+4mm	Quadratic Overdose	☑	On	☑	0.01	10.000	☑	0.100	0.060	
ITV										
CTV										

Stereotactic Approach of planning – Automated MCO in stage 1 and Manual Weight Optimization in stage 2

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As a leader in precision radiation therapy, Elekta is committed to ensuring every patient has access to the best cancer care possible.

We openly collaborate with customers to advance sustainable, outcome-driven and cost-efficient solutions to meet evolving patient needs, improve lives and bring hope to everyone dealing with cancer.

To us, it's personal, and our global team of 4,700 employees combine passion, science, and imagination to profoundly change cancer care.

We don't just build technology, we build hope.



Hope for everyone dealing with cancer.

Elekta AB

Box 7593
SE-103 93
Stockholm, Sweden
T +46 8 587 254 00
F +46 8 587 255 00

Europe, Middle East, Africa

T +46 8 587 254 00
F +46 8 587 255 00

North America

T +1 770 300 9725
F +1 770 448 6338

Latin America, South America

T +55 11 5054 4550
F +55 11 5054 4568

Asia Pacific

T +852 2891 2208
F +852 2575 7133

Japan

T +81 3 6722 3800
F +81 3 6436 4231

China

T +86 10 5669 2800
F +86 10 5669 2900

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References

[1] Guckenberger, M et al. Characterisation and classification of oligometastatic disease: a European Society for Radiotherapy and Oncology and European Organisation for Research and Treatment of Cancer consensus recommendation. The Lancet Oncology, Volume 21, Issue 1, e18 - e28