L'approccio alle stazioni linfonodali in presentazione di malattia ed all'eventuale recidiva nodale:

il punto di vista del radio-oncologo

Pietro Gabriele

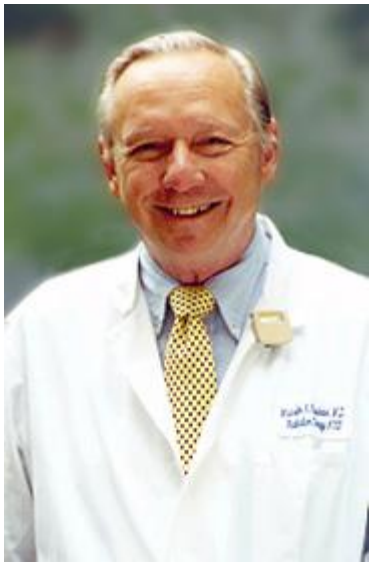
Istituto di Candiolo

IRCCS

Fondazione del Piemonte per l'Oncologia
CANDIOLO

Irradiazione dei linfonodi nel cancro prostatico

Extended field radiation therapy for carcinoma of the prostate: a progress report
Bagshaw MA.
Cancer Chemother Report 59: 165-73, 1975.



- Radiotherapeutic treatment of prostatic carcinoma with pelvic node involvement.

  Bagshaw MA.

  Urol Clin North Am 11: 297-304, 1984.

  Survival with N+: 20% “In spite of this relatively low level of survival, the firm documentation of survival without evidence of lymph node disease in 9 out 60 patients is ample justification for irradiation of regional lymphatics in these high-risk patients.

Int. J. Radiation Oncology Biol. Phys., Vol. 80, No. 1, pp. 6–16, 2011

0360-3016/$ - see front matter

doi:10.1016/j.ijrobp.2010.11.074

CRITICAL REVIEW

PELVIC NODAL RADIOTHERAPY IN PATIENTS WITH UNFAVORABLE INTERMEDIATE AND HIGH-RISK PROSTATE CANCER: EVIDENCE, RATIONALE, AND FUTURE DIRECTIONS

LISA K. MORIKAWA, M.D.,*† AND MACK ROACH III, M.D.‡

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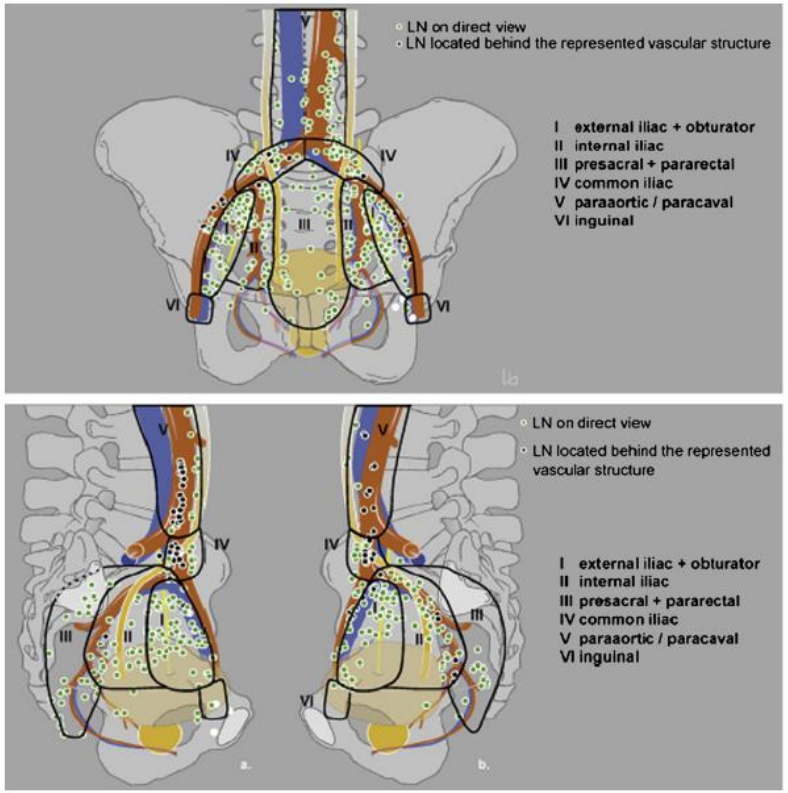

Fig. 1. Anteroposterior (A) and lateral (B) lymphatic drainage maps based on intraprostatic injections of technetium followed by single photon emission tomography (SPECT) combined with either computed tomography or magnetic resonance imaging fusion confirmed by surgery. Lymph nodes were color coded and subsequently transferred into a template projection of the pelvis according to their relation with vascular structures. From Mattei *et al.* (45).

Table 1. Contemporary trials comparing outcomes with whole pelvic vs. prostate only external beam radiotherapy (from Roach *et al.*)58

First Author	Institution		Key Findings	
Seaward	University of California, San Francisco	Retrospective single institutional analysis of patients undergoing prostate only or WPRT with and without hormonal therapy.	WPRT defined at superior border L5-S1. Noted WPRT associated with improved PSA control rate. Greatest benefit seen for those with risk between 15 and 30%.	↑ PSA
Pan	University of Michigan	Compared men treated with definitive 3D-CRT (n = 1,832) divided into three categories based on the estimated risk (Partin table) of LN involvement: 0–5%; >5–15%; and >15%.	Significant benefit for whole pelvic radiotherapy in men with risk of lymph node involvement of 5–15% with an improved 2-year PSA control rate, 90.1% vs. 80.6% (p = 0.02).	↑ PSA
Roach	RTOG	Phase Randomized Trial III (n ~1,200) comparing sequence of hormonal therapy and role of whole pelvic vs. prostate only radiotherapy. Primary endpoint: PFS including PSA, clinical failure, death from any cause	WPRT associated with improvement in PFS when preceded by CAB but not when administered before CAB	↑ PFS
Jacob	Fox Chase Cancer Center	Retrospective analysis patients with risk +LN >15% treated with "whole" pelvic radiotherapy vs. partial pelvic radiotherapy, or prostate only fields (n = 420). Concluded radiation dose was the major determinant of PSA control in patients with a lymph node risk >15%, with no benefit to pelvic radiotherapy or hormonal therapy	None of the patients received WPRT (defined as superior border L5-S1) as defined by RTOG 9413. All patients' pelvic fields would have been included in prostate only arm of RTOG 9413	↔
Spiotto	Stanford	Retrospective analysis of post op patients undergoing prostate only or WPRT with and without hormonal therapy.	Use of WPRT associated with an improvement in PSA control rate in the setting of salvage radiotherapy with greatest benefit seen in patients with adverse features	↑ PSA
Pommier	Multi-Center French Trial	444 patients with T1b-T3N0M0 randomized to 66–70 Gy to prostate ± 46 Gy to pelvis with the superior border set to S1/S2. RT preceded by 4–8 months of CAB is some "high-risk" patients (≥T3, GS ≥7, or PSA ≥3× normal). Most patients had LN risk <15% (55%) using Roach formula	None of the patients received WPRT (defined as top L5-S1) most were low risk for lymph node involvement (median PSA 12, ~25% T3, and ~10% GS 8–10), and some did not receive CAB	↔
Da Pozzo	Italy	Retrospective study 250 consecutive patients with + nodes. Compared outcomes in 129 men treated with WPRT (51.6%) and ADT and 121 patients (48.4%) received ADT alone	Multivariable analysis use of WPRT and the number of + lymph nodes major predictors of PSA control (p = 0.002 and p = 0.003) and cause specific survival (p = 0.009 and p = 0.01)	↕
Aizer	Yale	Retrospective review of 277 consecutive patients with estimated risk of lymph node involvement ≥15%	After adjusting for other factors WPRT group had improved 4-year biochemical control rate (69.4% vs. 86.3%).	↑ PSA
Milecki	Greater Poland Cancer Center	Retrospective analysis including men with high risk disease (n = 162) with and without WP RT.	The 5-year actuarial cause specific survival (CSS) were A = 90% and B = 79% (p = 0.01) and PSA control rates 52% versus 40% (p = 0.07), respectively.	↑ PSA

Abbreviations: ADT = androgen deprivation therapy; CAB = combined hormonal blockade; GS = Gleason score; LN = lymph node; PFS = progression-free survival; PSA = prostate-specific antigen; RTOG = Radiation Therapy Oncology Group; 3D-CRT = three-dimensional conformal radiotherapy; WPRT = whole pelvic radiotherapy.

Int. J. Radiation Oncology Biol. Phys., Vol. 80, No. 1, pp. 6–16, 2011

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CRITICAL REVIEW

PELVIC NODAL RADIOTHERAPY IN PATIENTS WITH UNFAVORABLE INTERMEDIATE AND HIGH-RISK PROSTATE CANCER: EVIDENCE, RATIONALE, AND FUTURE DIRECTIONS

LISA K. MORIKAWA, M.D.,*† AND MACK ROACH III, M.D.‡

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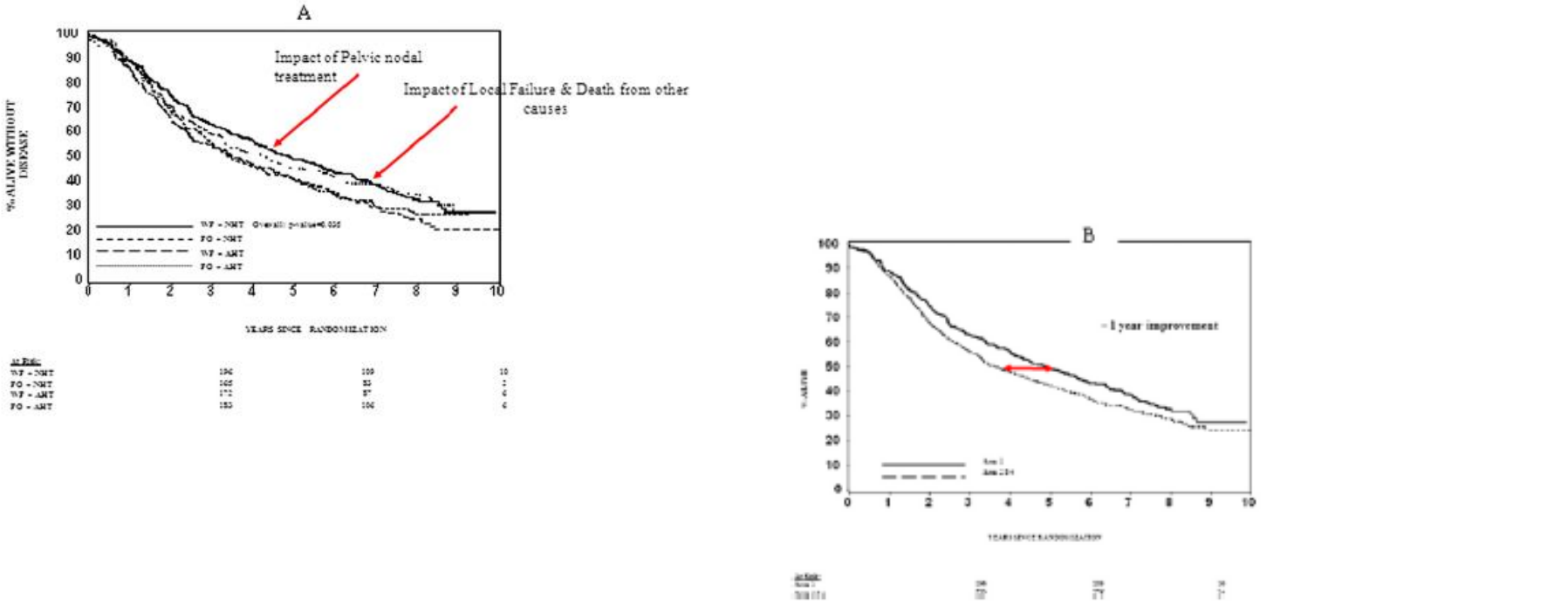

Fig. 3. (A) Progression-free survival in all arms per Radiation Therapy Oncology Group-9413 protocol definition (includes death from any cause). (B) Progression-free survival in whole pelvic radiotherapy (WPRT) + neoadjuvant hormone therapy (NHT) vs. arms prostate only radiotherapy (PORT) + NHT, WPRT + AHT (Adjuvant hormonal therapy) and, PORT + AHT (update by Lawton and colleagues) (60).

Cancer Treatment Reviews 38 (2012) 956–967

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Controversy

Management of prostate cancer patients with lymph node involvement: A rapidly evolving paradigm

Gilles Créhange [a,b,*], Chien Peter Chen [a,d], Charles C. Hsu [a,d], Norbert Kased [a,d], Fergus V. Coakley [c,e], John Kurhanewicz [c,f], Mack Roach III [a,d]

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Table 2
Summary of investigational imaging tools for patients with occult nodal involvement from prostate cancer in the context of radiation oncology.

	Requirements	Advantages	Disadvantages
MR Lymphangiography with USPIO	-Conventional MR scan -At least 1.5T IV injection of ferumoxtran-10 24–36 h before	-Non invasive -High sensitivity (82–90%) and specificity (96–98%) -Reproducible results -Detection of LNM ⩽ 2 mm -Better contrast with soft tissues and LN border delineation	-High false positive rate -Lack of FDA and EMA approval -Fusion CT/MR for treatment planning
Sentinel node SPECT/CT	-TRUS-guided injection of Technetium in each lobe 1–3 h before -SPECT camera combined with a CT scanner	-Visualization of lymph flow pathway -Fusion CT/CT for treatment planning	-Minimally invasive -It shows where are the SLN but not whether SLN are involved -Assumes that prostate cancer is not a systemic disease -Prostate must not be removed -Bulky N+(PSA > 20 ng/mL) may compromise Technetium uptake -May miss LNM or nodes distant from the camera
Choline-based PET/CT	-PET camera combined with a CT scan -Injection of the tracer 2 min. beforehand -Cyclotron needed for 11C-labeled choline tracers	-Non invasive -High specificity (96%) and NPV (92%) -Visualize distant nodes and extranodal metastatic disease (one-stop diagnostic procedure) -Fusion CT/CT for treatment planning	-Low sensitivity (vs. SN dissection or ePLND) -Low detection rate if PSA < 4 ng/mL -Distribution of tracers to institution depends on half life of each tracer -Low spatial resolution of cameras (LNM ⩾ 5 mm only) -Lack of FDA approval

LNM: Lymph Node Metastasis; LN: Lymph Nodes; FDA: Food and Drug Administration; European Medical Agency; PSA: Prostate Specific Antigen; SLN: Sentinel Lymph Node; ePLND: extensive Pelvic Lymph Node Dissection; CT: computed tomography; MR: Magnetic Resonance imaging; T: Teslas; TRUS: Trans-Rectal Ultra-Sonography.

MR Lymphoangiography vs PET choline vs SPECT - Sentinel node

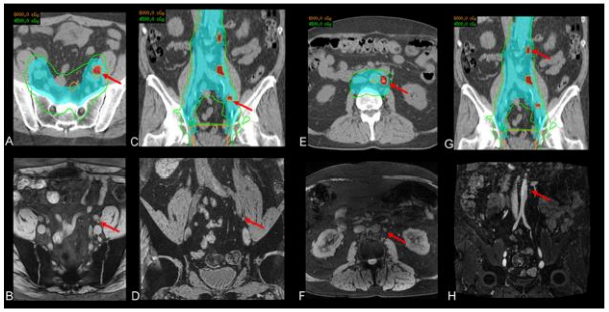

Fig. 1. Magnetic Resonance Lymphangiography Guided Treatment for Prostate Cancer. Legend: This figure shows a treatment plan and associated magnetic resonance lymphangiography (MRL) for a patient with recurrent prostate cancer. For dose to nodes identified by MRL can be boosted to 6000 cGy. In the currently presented patient, multiple lymph nodes involving the left external iliac and para-aortic areas were identified. The clinical target volume was therefore extended from the standard whole pelvic nodal volume to include the para-aortic nodes. Doses to target volumes are depicted as 6000 cGy (orange) and 4500 cGy (green). (A) Planning CT (axial) with pelvic nodal volume depicted in cyan and an involved external iliac node, detected by MRL in red. (B) MRL (axial) with involved external iliac node identified with a red arrow. (C) Planning CT (coronal) showing the same involved external iliac node as seen in (A) and (B). (D) MRL (coronal) with the same involved external iliac node shown in (A) and (B) identified with a red arrow. (E) Planning CT (axial) with para-aortic nodal volume depicted in cyan and an involved para-aortic node, detected by MRL in red. (F) MRL (axial) with involved para-aortic node identified with a red arrow. G) Planning CT (coronal) showing the same involved para-aortic node as seen in (E) and (F). (H) MRL (coronal) with the same invo

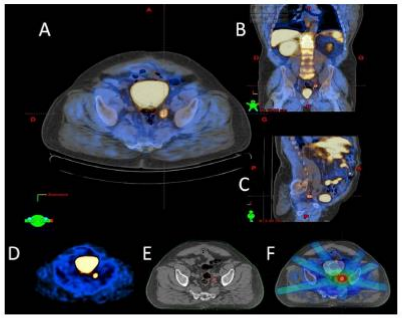

Fig. 2. Fluorocholine (18F) Positron Emission Tomography (PET) combined with Computed Tomography (CT) guided treatment for isolated nodal relapses after prostatectomy. Legend: This figure shows a treatment plan and associated how (18F) PET/CT for a patient with recurrent prostate cancer in a single node. In the currently presented patient, a single left iliac node was identified. Treatment was delivered under stereotactic conditions. In the current presented patient, a biochemical failure occurred 61 months after radical prostatectomy. Initially, the pathologist has reported an adenocarcinoma, Gleason 7 (3 + 4), staged pT3 R0, pN0. After the PSA rose up, the patient underwent a salvage radiation to the prostatic fossa. FCH PET/CT demonstrated isolated pararectal uptake. A salvage PET-guided IMRT delivered 66 Gy (5 × 2 Gy/week). Two years after the treatment, the patient is still controlled without any androgen deprivation therapy. (A) (18F) PET/CT (axial) with the involved iliac node, as detected on Fluorocholine PET/CT in yellow. (B) (18F) PET/CT (coronal) with involved external iliac node identified with a red arrow. (C) (18F) PET/CT (sagittal) showing the (B) to

Table 3

The evolving place of conventional and investigational imaging modalities in the work-up of prostate cancer patients with respect to different situations.

	Imaging available for lymph node staging					
	CT	MRI	PSMA-based SPECT	MRL (USPIO)	SPECT/CT	Choline PET
High-risk prostate cancer requiring whole pelvic radiotherapy	+	+	+	+++	+++	+++
Postoperative radiotherapy (Undetectable PSA)	+	+	–	++	–	–
Postoperative radiotherapy (Detectable or rising PSA)	+	+	–	++	–	++
Rising PSA after external radiotherapy and/or brachytherapy	+	+	–	++	++	++

CT: Computed Tomography scan; MRI: Magnetic Resonance Imaging; MRL: Magnetic Resonance Lymphangiography with Ultra Superparamagnetic Particles of Iron Oxide; SPECT/CT: Single Photon Emission Computed Tomography/Computed Tomography; PET: Positron Emission Tomography; –: not recommended; +: not optimal; ++: recommended; +++: highly recommended.

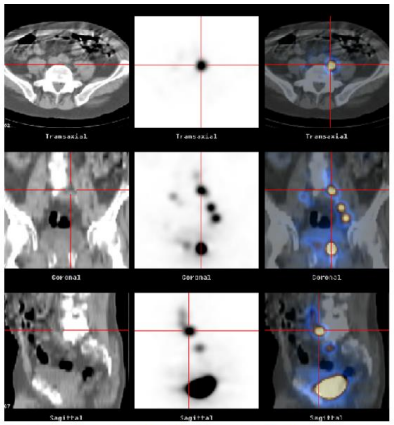

Fig. 3. 3D SPECT/CT imaging example with three sentinel lymph nodes (iliac left), radionuclide filled bladder (courtesy of Ute Ganswindt, with permission[100]). Legend: Transmission and emission scans were acquired 1.5 to 3 h after intraprostatic injection of 150 to 362 (median 205) MBq 99mTc-nanocolloid (Nanocoll, GE Healthcare Buchler GmbH, Braunschweig, Germany) depending on the individual prostate volume, followed by an anatomic-functional image fusion (SPECT/CT). The injection was performed in both lobes of the prostate.

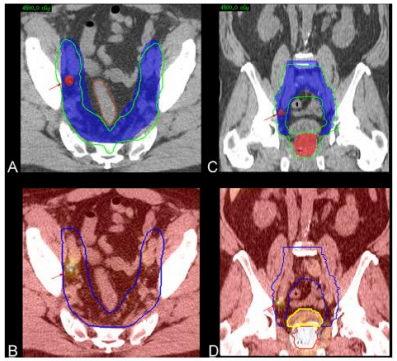

Fig. 4. Sentinel Lymphangiography Guided Treatment for a high-risk Prostate Cancer. Legend: This figure shows a treatment plan and associated sentinel lymph node lymphangiography (SLNL) for a patient with locally advanced prostate cancer at a high risk of nodal involvement (Gleason 4 + 5). SLNL can identify sentinel lymph nodes and demonstrate lymph node drainage patterns, which can help practitioners decide on the extent of the nodal clinical target volume. Nodes identified by SLNL should be included in the clinical target volume. In the currently presented patient, a right external iliac sentinel lymph node was identified with no para-aortic sentinel lymph nodes. Hence, the clinical target volume was limited to a standard whole pelvic nodal volume. Doses to target volumes are depicted as 4500 cGy (green). (A) Planning CT (axial) with pelvic nodal volume depicted in blue and a potential right sentinel lymph node detected by SLNL in red. (B) SLNL (axial) with identified focus of uptake in the right pelvis side wall region identified with a red arrow. (C) Planning CT (coronal) showing the same involved external iliac node as seen in (A) and (B). (D) SLNL (coronal) with the same focus of uptake shown in (A) and (B) identified with a red arrow. The blue, yellow, and red contours are the clinical nodal volume, bladder, and prostate, respectively.

Role of choline-PET

BJUI
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[18F]fluoromethylcholine (FCH) positron emission tomography/computed tomography (PET/CT) for lymph node staging of prostate cancer: a prospective study of 210 patients

Mads H. Poulsen*§, Kirsten Bouchelouche†, Poul F. Høilund-Carlsen†§, Henrik Petersen†, Oke Gerke†, Signe Inglev Steffansen†, Niels Marcussen‡§, Niels Svolgaard*, Werner Vach¶, Ulla Geertsen* and Steen Walter*§

CONCLUSIONS

BJU Int. 2012 Apr 23

- Due to a relatively low sensitivity and a correspondingly rather low PPV, FCH PET/CT is not ideal for primary LN staging in patients with prostate cancer.
- However, FCH PET/CT does convey important additional information otherwise not recognised, especially for bone metastases.

G Bauman[1], T Belhocine[2], M Kovacs[2], A Ward[3], M Beheshti[4] and I Rachinsky[2]

2012

ORIGINAL ARTICLE

18F-fluorocholine for prostate cancer imaging: a systematic review of the literature

Conclusion: on the basis of the review, we suggest potential scenarios where this metabolic imaging might be considered for further evaluation in clinical trials for guiding PCa management

Review Article

Lymph Node Staging with Choline PET/CT in Patients with Prostate Cancer: A Review

Andrea Skanjeti[1] and Ettore Pelosi[2]

Conclusion: "To date, there are no concordant results on the role of choline PET in lymph node staging of patients with new diagnosis of prostate cancer…. However, it should be pointed out that in this setting, other imaging modalities are less accurate, and so PET represents the best non invasive choice. …... Finally, the evaluation of novel treatments has potential advantages from the use of choline PET…"

Esiste una letteratura che associa una RT ipofrazionata con una WPRT?

International Journal of Radiation Oncology biology • physics

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Critical Review

Whole-Pelvic Nodal Radiation Therapy in the Context of Hypofractionation for High-Risk Prostate Cancer Patients: A Step Forward

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Received Nov 29, 2012, and in revised form Feb 4, 2013. Accepted for publication Feb 5, 2013

Esiste una letteratura che associa una RT ipofrazionata con una WPRT?

Table 1 Acute and late toxicity of hypofractionated radiation therapy to the prostate combined with whole-pelvic radiation therapy

Author (reference), y	Technique	N	Median follow-up	Prostate dose (fx dose) (Gy)	Pelvis dose (fx dose) (Gy)	Toxicity scale	Grade 3-4 toxicity
Hong (45), 2006	TomoTherapy	8	NR (short)	70 (2.5)	56 (2)	Modified RTOG NCI-CTC v. 3.0 (skin)	No grade 3
McCammon (33), 2009	SIB-IMRT	30	2 y	78 (2.5)	50.4 (1.8)	CTCAE	Late grade 3 GI in 1 patient*
Lim (36), 2008	SIB-IMRT	66	1.5 y	67.5 (2.7)	45 (1.8)	CTCAE	Acute: Grade 3 GU, 7.6% No grade 3 acute GI
Di Muzio (46), 2009	TomoTherapy	29	1 y	74.2 (2.65)	51.8 (1.85)	RTOG	Acute: 2 of 60 patients had grade 3 GU toxicity (not mentioned if they were in WPRT group) No grade 3 GI
Pervez (47), 2010	TomoTherapy	60	3 mo	68 (2.72)	45 (1.8)	RTOG	Acute: 5 (8.62%) with grade 2 GU toxicity at 3 mo
Adkison (48), 2012	SIB-IMRT	53	2.1 y	70 (2.5)	56 (2)	RTOG/CTCAE	Acute: No grade 3 toxicity Late: 2% grade 3 but no grade 3-4 GI
Quon (38), 2011, 2012	3D-CRT–IMRT† or SIB-IMRT	97	3.25 y	67.5 (2.7)	45 (1.8)	RTOG for late/ CTCAE for acute toxicity	Acute: No grade 3-4 acute GI 4.3% grade 3 GU Late: No grade 3-4 rectal 6% GU grade 3-4
Fonteyne (49), 2009	SIB-IMRT	31	6 mo	80 (3.2)	45 (1.8)	RTOG/CTCAE/ LENT-SOMA	Acute: No grade 3-4 GI ~~6% grade 3 GU~~

Abbreviations: 3D-CRT = 3-dimensional conformal radiation therapy; CTCAE = Common Terminology Criteria for Adverse Events; EORTC = European Organization for Research and Treatment of Cancer; fx = fraction; GI = gastrointestinal; GU = genitourinary; LENT-SOMA = Late Effects in Normal Tissues—Subjective, Objective, Management, and Analytic; NCI-CTC = National Cancer Institute Common Toxicity Criteria; NR = not reported; RTOG = Radiation Therapy Oncology Group toxicity criteria; SIB-IMRT = simultaneous integrated boost intensity modulated radiation therapy.

* The patient had preexisting ulcerative colitis.

† No statistically significant differences were seen between the 2 groups with regard to early or late GU/rectal toxicity or biochemical failure.

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Mise au point

Apports de la radiothérapie avec modulation d'intensité guidée par l'image dans les cancers prostatiques

Benefit of intensity modulated and image-guided radiotherapy in prostate cancer

I. Latorzeff[a,*], J. Mazurier[a], C. Boutry[b], P. Dudouet[b], P. Richaud[c], R. de Crevoisier[d]

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Cancer/Radiothérapie 16 (2012) 430–438

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Mise au point

Radiothérapie guidée par l'image des cancers prostatiques : concepts et implications

Image-guided radiotherapy in prostate cancer: Concepts and implications

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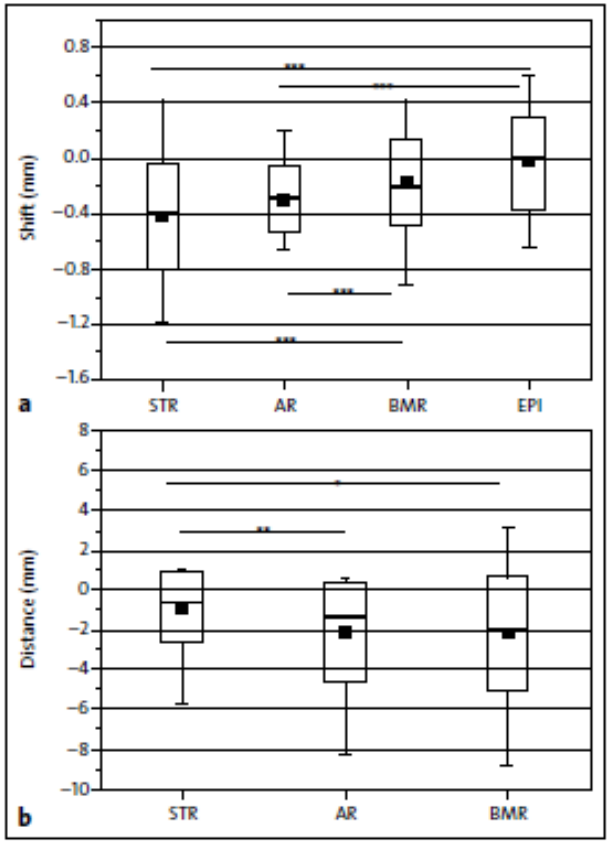
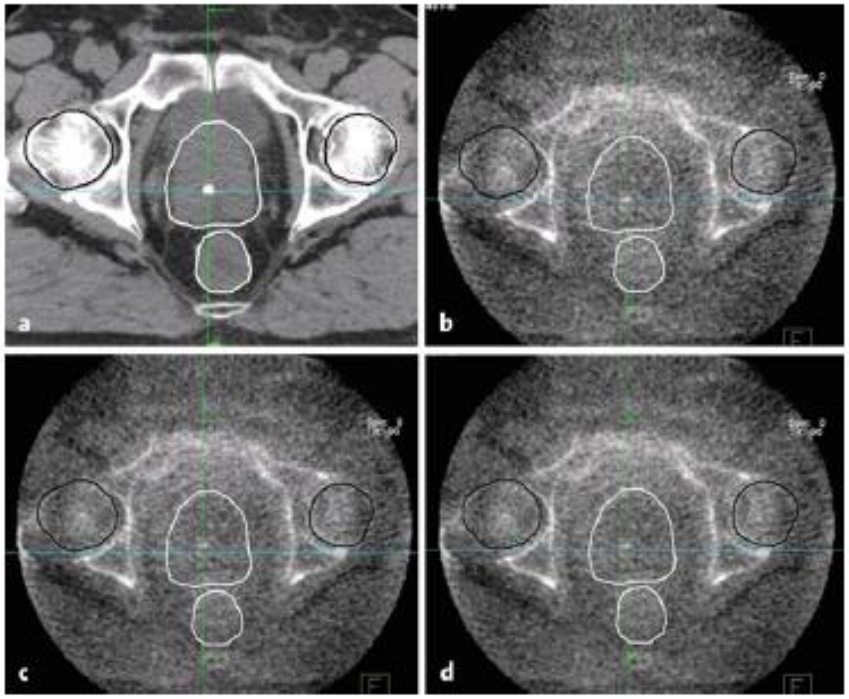
Prostate Image-Guided Radiotherapy by Megavolt Cone-Beam CT

Sergio Zucca, Barbara Carau, Ignazio Solla, Elisabetta Garibaldi, Paolo Farace, Giancarlo Lay, Gianfranco Meleddu, Pietro Gabriele[1]

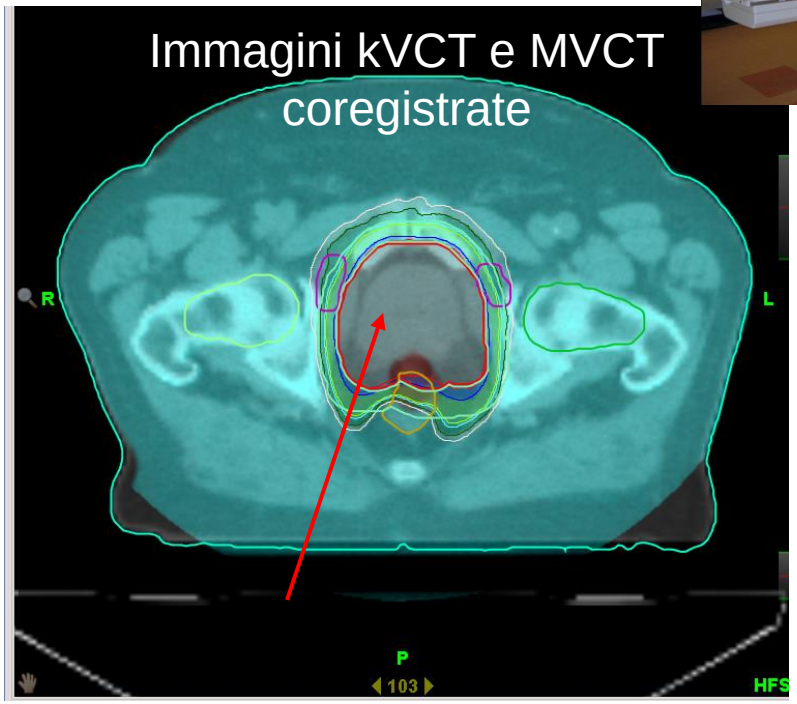


Figures 1a and 1b. Patients shifts (**a**) and calcification displacements (**b**) along the AP axis, calculated by electronic portal imaging (EPI), and MV-CBCT after automated (AR), soft tissue (STR) and bone markers (BMR) registration. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

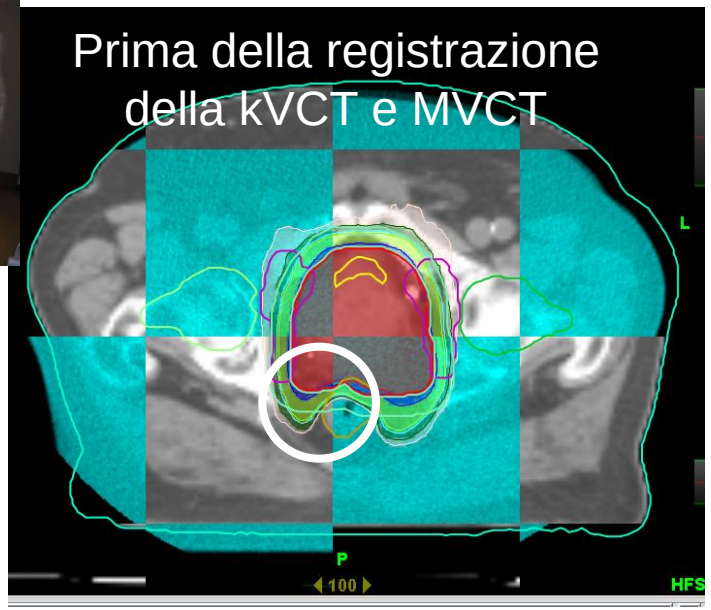


Figures 2a to 2d. The contours of bone, prostate, and rectum were delineated on planning CT (**a**) and overlaid on the MV-CBCT after registration by manual soft tissue (**b**), manual bone landmark (**c**), and automated registration (**d**). A cross-line, centered on a calcification in the planning CT, was overlaid on the differently registered MV-CBCT. The distance between the cross-line and the calcification visible on MV-CBCT is clearly lower in (**b**) than in (**c**), particularly along AP direction. An intermediate distance was observed in (**d**).

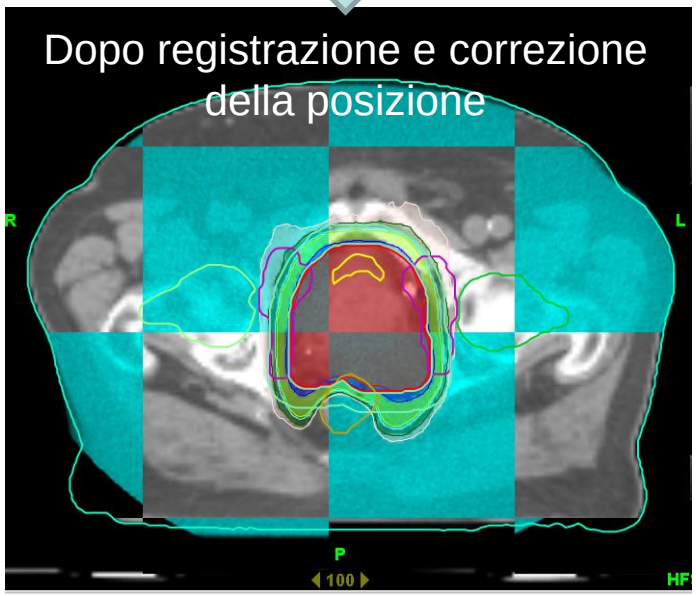
Fondazione del Piemonte per l'Oncologia



Preparazione del retto non ottimale: maggior dose alla parete anteriore del retto -> il paziente scende dal lettino e riesegue la preparazione



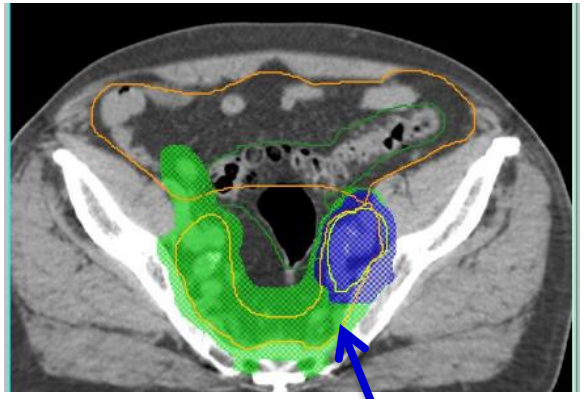
Buona preparazione retto



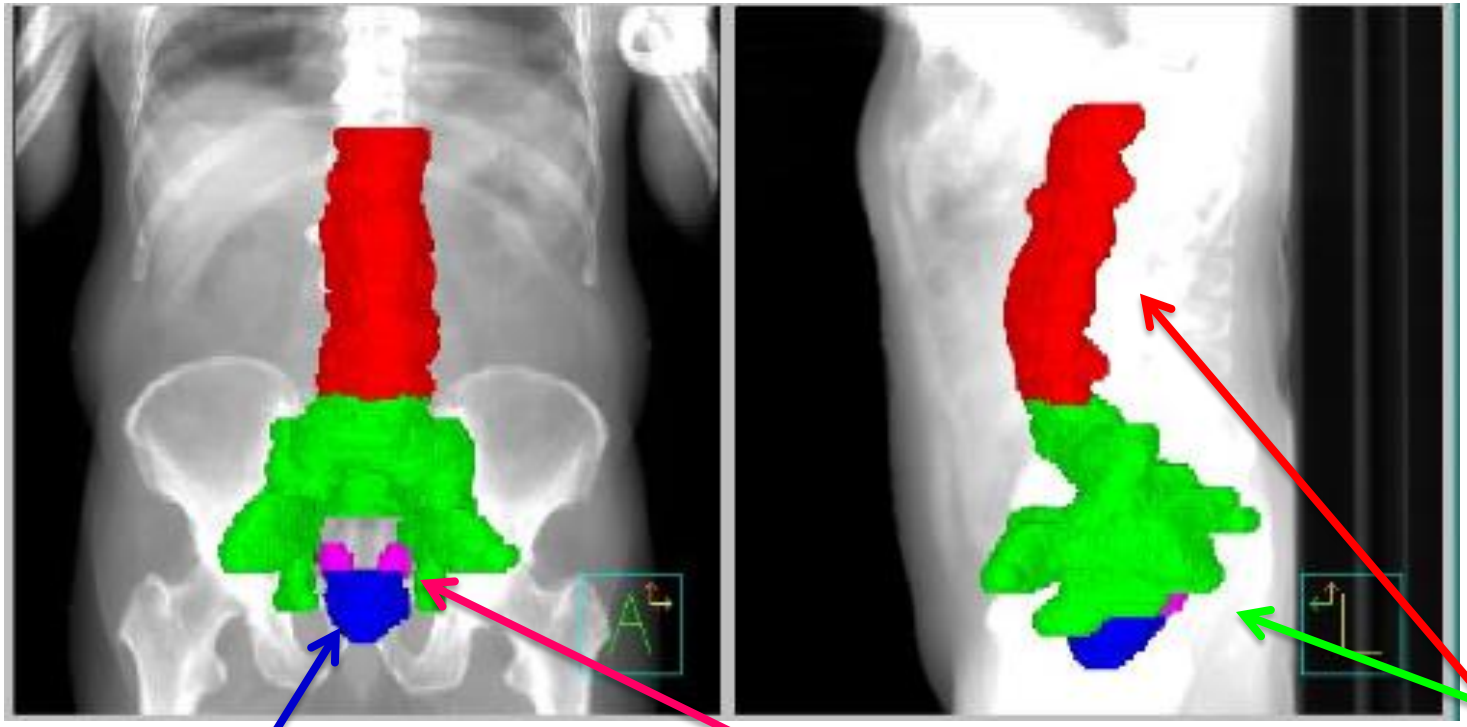
Fondazione del Piemonte per l'Oncologia

Volumes & dose prescriptions: H/VHR PCa

Volumes	Doses (Gy)	Dose/fr
PTV 1 (P)	75.2	2.35
PTV 2 (SV)	67.2 (≤ cT3a) 75.2 (cT3b)	2.1-2.35
PTV 3 N+	60.8-67.2	1.9-2.1
PTV 4 N-	54.4	1.7
Fraction number	32	



PTV 3 (positive nodes: N+) 60-66 Gy



PTV 1 (Prostate) 75.2 Gy

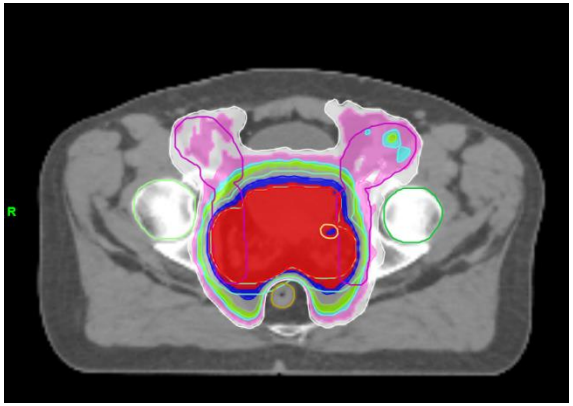
PTV 2 (Seminal Vesicles) 67.2 ((≤ cT3a) 75.2 Gy(cT3b)

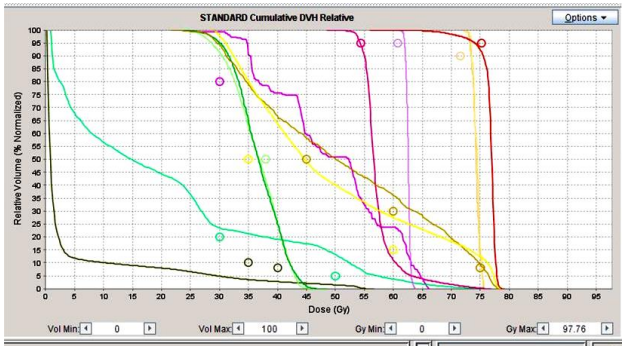
PTV 4 (negative nodes: N-) 51-54-54.4 Gy

Updated June 2013

Dosimetric characteristics	H/VHR PCa
OAR	**Doses**
Rectum	V75= 2.4 ± 2.1 Gy V70= 15.8 ± 4.9 Gy V65= 22.3 ± 6.2 Gy V60= 28.2± 8.7 Gy V50= 40.2 ± 12.1 Gy
Bladder	Average dose: 49.3 ± 6.9 Gy
R-Femour	Dmax 45 ± 3.6 Gy
L-Femour	Dmax 44 ± 3.8 Gy
Small bowel	V45: 124 ± 51 Gy
R-Urethers	31.3 ± 5.5 Gy
L-Urethers	Average dose: 31.6 ± 6.4 Gy
Target Volumes	**D95%**
PTV Prostate	74.9 ± 0.9 Gy
PTV P+SV	66.3 ± 1.5 Gy
N+	63.1 ± 2.9 Gy
N-	53.7 ± 1.3 Gy

QUANTEC





Updated June 2013

Bresciani et al. Radiation Oncology 2013, 8:247
http://www.ro-journal.com/content/8/1/247

RADIATION ONCOLOGY

RESEARCH Open Access

Dose to organs at risk in the upper abdomen in patients treated with extended fields by helical tomotherapy: a dosimetric and clinical preliminary study

Sara Bresciani[1*], Elisabetta Garibaldi[2], Gabriella Cattari[2], Angelo Maggio[1], Amalia Di Dia[1], Elena Delmastro[2], Domenico Gabriele[3], Michele Stasi[1] and Pietro Gabriele[2]

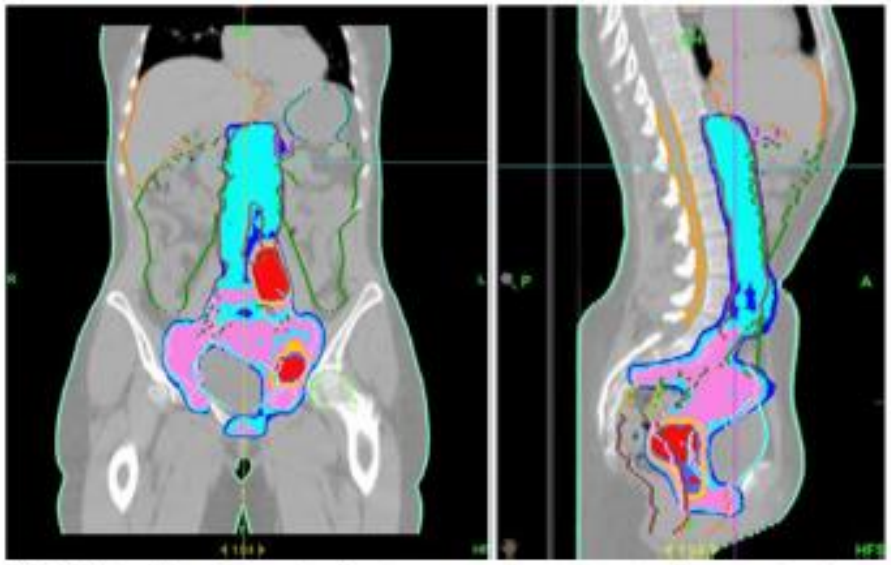


Figure 1 Example of extended field irradiation for cervical carcinoma. Isodose distribution for sagittal and coronal projections through the patient's midline is provided (red = 66Gy, pink = 54Gy, blue = 51Gy).

Table 1 Normal tissue tolerance

Critical structure	Volume	Dose/volume	Toxicity rate	Toxicity endpoint
Liver	Mean	<30-32 Gy	<5%	RILD (in normal liver function)
Kidney, bilateral	Mean	<15-18 Gy	<5%	Clinical dysfunction
Kidney, bilateral	Mean	<28 Gy	<50%	Clinical dysfunction
Kidney, bilateral	V12	<55%	<5%	Clinical dysfunction
Kidney, bilateral	V20	<32%	<5%	Clinical dysfunction
Kidney, bilateral	V23	<30%	<5%	Clinical dysfunction
Kidney, bilateral	V28	<20%	<5%	Clinical dysfunction
Stomach	D100	<45 Gy	<7%	Ulceration
Small bowel (peritoneal cavity)	V45	<195 cc	<10%	Grade 3+ toxicity

Table 2 Mean doses and standard deviations to organs at risk

Organs at risk	D_{mean} (Gy)	D_{max} (Gy)
Pancreas	28.1 ± 6.4	49.9 ± 9.2
Spleen	10.3 ± 6.5	25.8 ± 15.7
Stomach	16.1 ± 5.6	46.3 ± 10.2
Liver	10.0 ± 9.6	49.2 ± 11.8
Right kidney	11.8 ± 3.1	27.4 ± 7.3
Left kidney	13.5 ± 7.5	35.6 ± 12.9

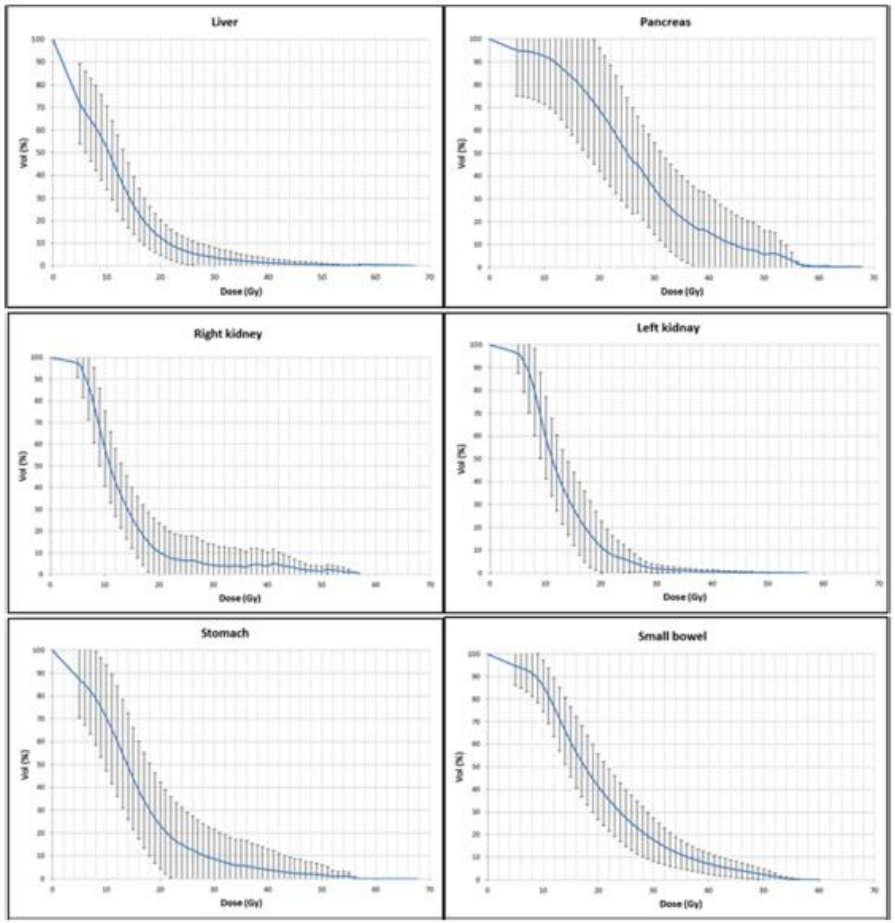


Figure 2 Average DVHs of the patients. The average DVHs of the pancreas, stomach, liver, kidneys and small bowel (intestinal cavity).

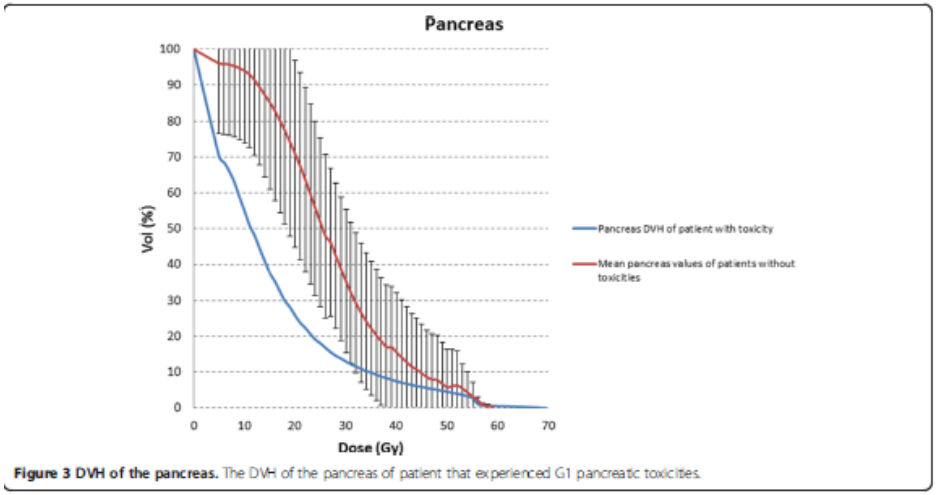


Figure 3 DVH of the pancreas. The DVH of the pancreas of patient that experienced G1 pancreatic toxicities.

Bresciani et al. Radiation Oncology 2013, 8:247
http://www.ro-journal.com/content/8/1/247

RADIATION ONCOLOGY

RESEARCH Open Access

Dose to organs at risk in the upper abdomen in patients treated with extended fields by helical tomotherapy: a dosimetric and clinical preliminary study

Sara Bresciani[1*], Elisabetta Garibaldi[2], Gabriella Cattari[2], Angelo Maggio[1], Amalia Di Dia[1], Elena Delmastro[2], Domenico Gabriele[3], Michele Stasi[1] and Pietro Gabriele[2]

Table 4 Acute toxicity as a function of patient and disease characteristics

Patient characteristics		Acute GI toxicity		Acute hematological toxicity		Acute epatobyliary toxicity		Acute pancreatic toxicity		Acute renal toxicity	
	total	G0-G1	≥G2	G0-G1	≥G2	G0-G1	≥G2	G0-G1	≥G2	G0-G1	≥G2
Total	29	26	3	21	8	29	0	29	0	29	0
Median age (y)	65.1	66.1	54	67.9	57.6	65.1	0	65.1	0	65.1	0
Primary prostate cancer	4	3	1	3	1	4	0	4	0	4	0
Nodal recurrence of prostate cancer	17	17	0	16	1	17	0	17	0	17	0
Postoperative endometrial cancer	3	3	0	1	2	3	0	3	0	3	0
Primary cervical cancer	5	3	2	1	4	5	0	5	0	5	0
History of abdominal surgery	15	15	0	12	3	15	0	15	0	15	0
History of prior RT	13	13	0	12	1	13	0	13	0	13	0
Paraaortic RT	10	10	0	9	1	10	0	10	0	10	0
Paraaortic + pelvic nodes RT	19	16	3	12	7	19	0	19	0	19	0
Intracavitary brachytherapy	5	5	0	1	4	5	0	5	0	5	0
Concurrent chemotherapy	7	6	1	2	5	7	0	7	0	7	0

Table 5 Acute and sub-acute toxicity

Toxicity type	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Acute						
Gastrointestinal	16	10	3	0	0	0
Hematological	14	7	4	4	0	0
Epatobyliary	24	5	0	0	0	0
Pancreatic	26	3	0	0	0	0
Renal	29	0	0	0	0	0
Sub-acute						
Gastrointestinal	29	0	0	0	0	0
Hematological	26	1	2	0	0	0
Epatobyliary	27	2	0	0	0	0
Pancreatic	28	1	0	0	0	0
Renal	29	0	0	0	0	0

Outline

1. Esiste una letteratura specifica sulla RT della malattia prostatica sicuramente estesa ai linfonodi?
2. Esiste una letteratura che associa una RT ipofrazionata con una WPRT?
3. Possibili soluzioni proposte dal punto di vista del livello tecnico (IMRT-SIB-IGRT con Linac vs stereotassi Linac vs cyberknife)
4. Quale il bilancio rischio-beneficio?
5. Il trattamento delle recidive linfonodali: problemi e soluzioni
6. Quali pazienti trattare
7. La nostra esperienza (2010-2013)
8. Riflessioni

Background

In these cases the standard treatment is OT until disease progression

But after?

Few therapeutic chances

Second line OT

Chemotherapy

Local therapies (thermoablation with RF, crioablation, surgery, RADIOTHERAPY)

Background

Local therapies particularly employed in order to posticipate as possible the use of OT

VOLUME 25 · NUMBER 8 · MARCH 10 2007

JOURNAL OF CLINICAL ONCOLOGY

REVIEW ARTICLE

Stereotactic Body Radiation Therapy in Multiple Organ Sites

Robert D. Timmerman, Brian D. Kavanagh, L. Chinsoo Cho, Lech Papiez, and Lei Xing

Radiotherapy and Oncology 93 (2009) 14–17

Contents lists available at ScienceDirect

Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com

Robotic stereotactic radiotherapy

Linac-based or robotic image-guided stereotactic radiotherapy for isolated lymph node recurrent prostate cancer

Barbara A. Jereczek-Fossa [a,g,*], Laura Fariselli [e,f], Giancarlo Beltramo [e], Gianpiero Catalano [a], Flavia Serafini [a], Cristina Garibaldi [b], Raffaella Cambria [b], Lorenzo Brait [e], Marco Possanzini [e], Livia C. Bianchi [e], Andrea Vavassori [a], Dario Zerini [a], Franco Orsi [d], Ottavio de Cobelli [c,g], Roberto Orecchia [a,g]

Background

ARTICLE IN PRESS

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0360-3016/$ - see front matter

ELSEVIER

doi:10.1016/j.ijrobp.2010.11.031

CLINICAL INVESTIGATION

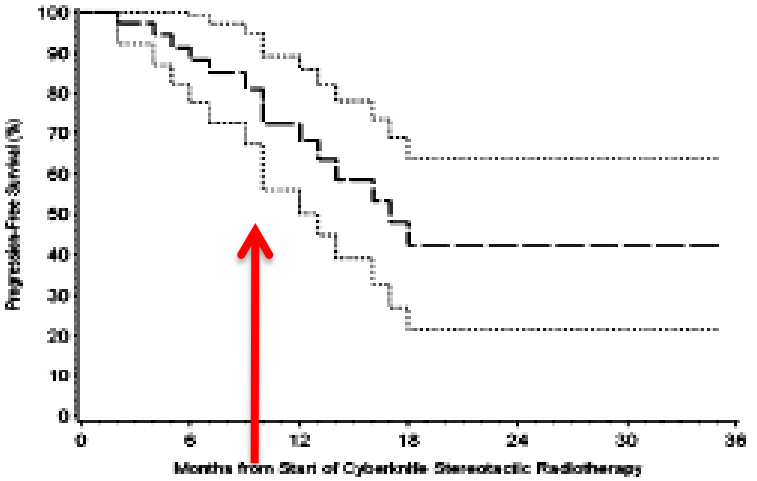
ROBOTIC IMAGE-GUIDED STEREOTACTIC RADIOTHERAPY, FOR ISOLATED RECURRENT PRIMARY, LYMPH NODE OR METASTATIC PROSTATE CANCER

Barbara Alicja Jereczek-Fossa, M.D., Ph.D.,*† Giancarlo Beltramo, M.D.,‡ Laura Fariselli, M.D.,§ Cristiana Fodor, M.Sc.,* Luigi Santoro, M.Sc.,‖ Andrea Vavassori, M.D.,* Dario Zerini, M.D.,* Federica Gherardi, M.D.,*† Carmen Ascione, M.D.,*¶ Isa Bossi-Zanetti, M.D.,*† Roberta Mauro, M.D.,*† Achille Bregantin, M.Sc.,‡ Livia Corinna Bianchi, M.D.,‡ Ottavio De Cobelli, M.D.,# and Roberto Orecchia, M.D.*†

Departments of *Radiotherapy, #Urology, and ‖Epidemiology and Statistics, European Institute of Oncology, Milan, Italy; †University of Milan, Milan, Italy; ‡CyberKnife Center CDI, Milan, Italy; §Radiotherapy Unit, Carlo Besta Neurological Institute Foundation, Milan, Italy; and ¶Seconda Università degli Studi di Napoli, Naples, Italy

Table 1. Patient characteristics (n = 34 patients)

Characteristics	All patients (n = 34)
Age at CBK-SRT	
n	34
Mean ± SD (y)	68.8 ± 6.2
Median (range) (y)	68.3 (57–82)
KPS at CBK-SRT	
90	4 (12%)
100	30 (88%)
Initial PSA*	
n	31
Median (range) (ng/mL)	9.8 (1.5–43.0)
Initial Gleason score†	
n	30
Median (range)	7 (4–9)
Initial disease category (NCCN 2008) (1)	
Low	4 (12%)
Intermediate	9 (26%)
High	14 (41%)
Very high	4 (12%)
Unknown	3 (9%)
Initial treatment	
RT ± ADT	20 (59%)
RRP ± LND ± ADT ± RT	14 (41%)
Interval between diagnosis of prostate cancer and CBK-SRT [mean (range)] (mo)	66 (24–180)
Former radiotherapy	
Yes	31 (91%)
EBRT	30 (88%)
BRT	1 (3%)
No	3 (9%)
Status at last observation (May 2010)	
No evidence of disease	19 (56%)
Alive with disease	15 (44%)



Quali pazienti trattare?

1. pazienti ad alto rischio
2. pazienti ad altissimo rischio con malattia linfonodale dimostrata mediante RM o PET colina
3. pazienti con recidiva di malattia linfonodale dopo precedente PR o RT a dosi radicali su P/VS
4. pazienti con malattia linfonodale dimostrata ed una lesione ossea (oligometastasi)
5. pazienti con recidiva di malattia linfonodale dimostrata ed una lesione ossea (oligometastasi)

Pazienti:

- in condizioni generali buone KI = 80-100
- Non malattie addominali in atto (RCU, M. Chron)
- non malattie epatiche/renali in atto
- complianti per trattamenti di circa 20 minuti (non dolore osseo)
- consenso informato

PROTOCOLLO CLINICO RADIOTERAPIA

ADAPTIVE 1.1

PATOLOGIA: Adenocarcinoma della prostata non operato ad alto, altissimo rischio

TITOLO: **Trattamento dell'adenocarcinoma prostatico ad Alto/Altissimo Rischio mediante Tomoterapia Elicoidale (HT)**

PRINCIPALI CRITERI DI INCLUSIONE UTILI PER LA STADIAZIONE:

1. Pazienti alto/altissimo rischio: >cT3a (o N+) e/o PSA > 20 e/o GS > 7 (8-10)
1. Esami ematologici, dosaggi del PSA ripetuti, esame urine completo, funzionalità epatica, renale, pancreatica
2. Esame istologico che conferma l'adenocarcinoma della prostata
3. Rx torace in 2 proiezioni e/o TC torace-addome
4. Scintigrafia ossea total body con ^{99m}TC
5. RM con endocoil della prostata
6. PET/CT con Colina in pazienti con sospetta diffusione loco-regionale di malattia (opzionale).
7. Consenso informato

TIPOLOGIA DI TRATTAMENTO:

Macchinario utilizzato: Tomotherapy HD

Durata del trattamento: 25 minuti a seduta per 32 sedute giornaliere, per un totale di sei settimane e mezza circa di trattamento

MEDICI STRUTTURATI DI RIFERIMENTO:

Pietro Gabriele (Direttore) pietro.gabriele@ircc.it
Elisabetta Garibaldi elisabetta.garibaldi@ircc.it
Elena Delmastro elena.delmastro@ircc.it

MEDICO NON STRUTTUTATO, RICERCATORE DI RIFERIMENTO:

Gabriella Cattari gabriella.cattari@ircc.it

DATA MANAGER DI RIFERIMENTO:

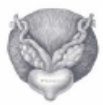
Monica Garibaldi garibaldi.monica@gmail.com

NOTE:

Studio di fase II dell'IRCCS di Candiolo – FPO (GIC urologico; Dir.: Dr. P. Gabriele)
La radioterapia è eseguita in associazione con due/tre anni di ormonoterapia (Servizio di Oncologia; Dir. M. Aglietta; oncologo responsabile di patologia: Cinzia Ortega cinzia.ortega@ircc.it)

PROTOCOLLO CLINICO RADIOTERAPIA

ADAPTIVE 1.4



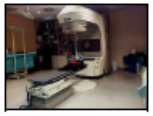
PATOLOGIA: Adenocarcinoma della prostata, recidivo

TITOLO: **Protocollo di trattamento delle recidive da adenocarcinoma della prostata mediante Tomoterapia Elicoidale (HT)**

PRINCIPALI CRITERI DI INCLUSIONE UTILI PER LA STADIAZIONE:

- Pazienti con metastasi linfonodali (oligometastatici) con o senza recidiva locale
- Documentazione delle precedenti terapie eseguite (radioterapia, interventi chirurgici, ormonoterapie)
- Valutazione collegiale urologica
- PET/CT con Colina
- RM con endocoil (quando indicato)
- Scintigrafia Ossea Total Body con ^{99m}TC (quando indicato)
- Emocromo, enzimi epatici e pancreatici, azotemia, glicemia, creatinina, esame completo delle urine
- Consenso informato

TIPOLOGIA DI TRATTAMENTO:



Macchinario utilizzato: Tomotherapy HD o LINAC

Durata del trattamento: 25 minuti al giorno, per un totale di 30 sedute giornaliere in sei settimane e mezza circa di trattamento

MEDICI STRUTTURATI DI RIFERIMENTO:

Pietro Gabriele (Direttore) pietro.gabriele@ircc.it
Elisabetta Garibaldi elisabetta.garibaldi@ircc.it
Elena Delmastro elena.delmastro@ircc.it

MEDICO NON STRUTTUTATO, RICERCATORE DI RIFERIMENTO:

Gabriella Cattari gabriella.cattari@ircc.it

DATA MANAGER DI RIFERIMENTO:

Monica Garibaldi garibaldi.monica@gmail.com

NOTE:

Studio di fase II dell'IRCCS di Candiolo – FPO (GIC urologico dir: P. Gabriele)
N.B.: La Radioterapia è associata all'ormonoterapia (oncologo responsabile: Cinzia Ortega cinzia.ortega@ircc.it)

Trends in Cancer Research

Original Communication

A personalised treatment with image guided intensity modulated radiotherapy for high-very high risk and metastatic prostate cancer patients: Preliminary results

Elisabetta Garibaldi[1,*], Gabriella Cattari[1], Domenico Gabriele[4], Elena Delmastro[1], Barbara Carau[5], Claudia Cutaia[2], Sara Bresciani[2], Cinzia Ortega[3] and Pietro Gabriele[1]

[1]Radiotherapy, [2]Medical Physics and [3]Medical Oncology Units, IRCCS – FPO Candiolo, Torino, Italy, [4]Physiology Institute, Neuroscience Department, University of Torino, Italy, [5]Radiotherapy Unit, Businco Oncology Hospital, Cagliari, Italy

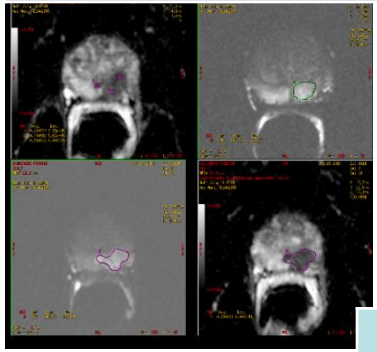
Between October 2010 and June 2013, 93 patients with histologically confirmed high-very high risk prostate cancer or with nodal or distant metastatic disease were treated at IRCCS – FPO Cancer Institute of Candiolo, Torino, Italy, with definitive IMRT-SIB-IGRT technique using Tomotherapy ± ADT. Patients were stratified in high-very high risk and metastatic prognostic groups according to NCCN guidelines. Ten patients were lost at the follow-up and so the cohort of the study is composed by 83 patients assessable in terms of toxicity and outcome with a median follow-up of 14 months.

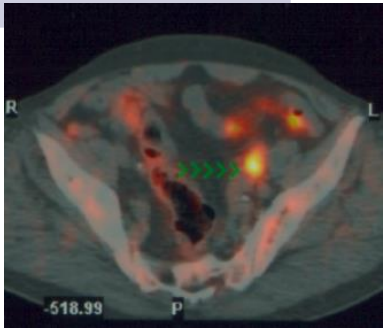
Table 1. Demographics and anamnestic characteristics.

Age	Average (yy) Median (yy) Range (yy)	71 73 56 to 84
Anti-aggregation or anticoagulant therapy	YES NO	27% 73%
Diabetes	YES NO	8% 92%
Hemorrhoids	YES NO	13% 87%
Obesity	YES NO	1% 99%
Diverticulosis	YES NO	8% 92%
Cardiovascular diseases	YES NO	33% 67%
Hypertension	YES NO	46% 54%
Pre-RT urinary symptoms	YES NO	37% 63%
Pre-RT major abdominal surgery	YES NO	27% 73%
Pre-RT prostate conservative surgery (not RP)	YES NO	5% 95%

Our experience: diagnostic workup

	Endocoil MRI	Fluorocholine PET-CT	Both
HR PCa	43 (55%)	12 (16%)	8 (10%)
VHR PCa	14 (73%)	14 (73%)	9 (53%)
Tot	**57 (58%)**	**26 (27%)**	**17 (19%)**





Changing stage	Endocoil MRI	Fluorocholine PET-CT
HR PCa	25 (63%)	8 (70%)
VHR PCa	11 (82%)	11 (90%)
Tot	**36 (67%)**	**19 (81%)**

Updated June 2013

Trends in Cancer Research

Original Communication

A personalised treatment with image guided intensity modulated radiotherapy for high-very high risk and metastatic prostate cancer patients: Preliminary results

Elisabetta Garibaldi[1,*], Gabriella Cattari[1], Domenico Gabriele[4], Elena Delmastro[1], Barbara Carau[5], Claudia Cutaia[2], Sara Bresciani[2], Cinzia Ortega[3] and Pietro Gabriele[1]

[1]Radiotherapy, [2]Medical Physics and [3]Medical Oncology Units, IRCCS – FPO Candiolo, Torino, Italy, [4]Physiology Institute, Neuroscience Department, University of Torino, Italy, [5]Radiotherapy Unit, Businco Oncology Hospital, Cagliari, Italy

Table 2. Staging statistics.

iPSA	Average (ng/mL)	30.82	
	Median (ng/mL)	12.96	
	SD (ng/mL)	59.74	
	Min (ng/mL)	2.3	
	Max (ng/mL)	386	
Gleason score	3 + 3	14%	
	3 + 4	14%	
	4 + 3	16%	71%
	4 + 4	33%	
	3 + 5	2%	
	5 + 3	7%	
	4 + 5	11%	
	5 + 4	0%	
	5 + 5	2%	
Clinical and radiological staging	I	1%	
	IIA	0%	
	IIB	39%	
	III	30%	60%
	IV	30%	
Prognostic classes	High risk	59%	
	Very high risk	10%	
	Metastatic	31%	

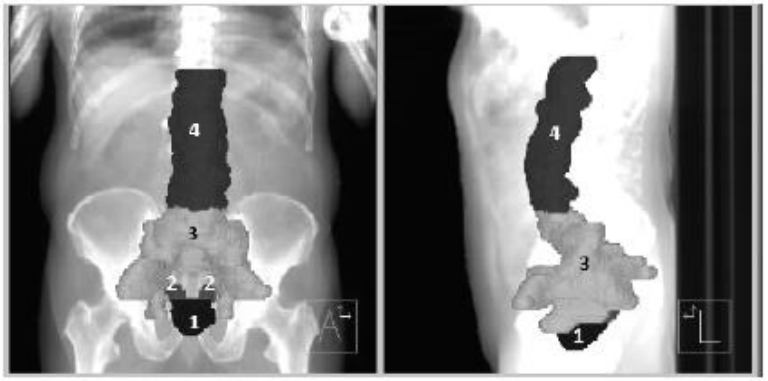


Figure 1. Irradiated volumes: prostate (1), seminal vesicles (2), pelvic prophylactic nodes (3), lumbar-aortic prophylactic nodes (4).

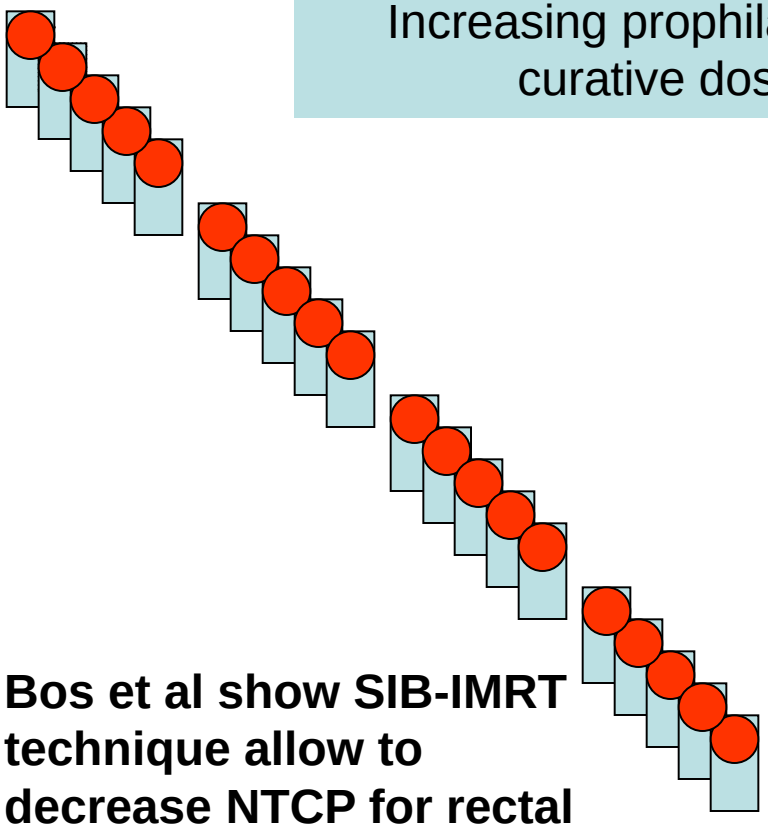
Table 3. Delivered doses and volumes of treatment.

Prostate	D95% ± SD (Gy)	73.8 ± 2.6
	Dmean ± SD (Gy)	75.9 ± 5
Seminal vesicles	D95% ± SD (Gy)	68.8 ± 3.7
	Dmean ± SD (Gy)	72.7 ± 2.7
Prophylactic pelvic nodes	D95% ± SD (Gy)	54.1 ± 2.3
	Dmean ± SD (Gy)	56.2 ± 2.4
N positive nodes	Mean volume ± SD (mL)	67 ± 72
	D95% ± SD (Gy)	62.5 ± 3
	Dmean ± SD (Gy)	64.5 ± 3

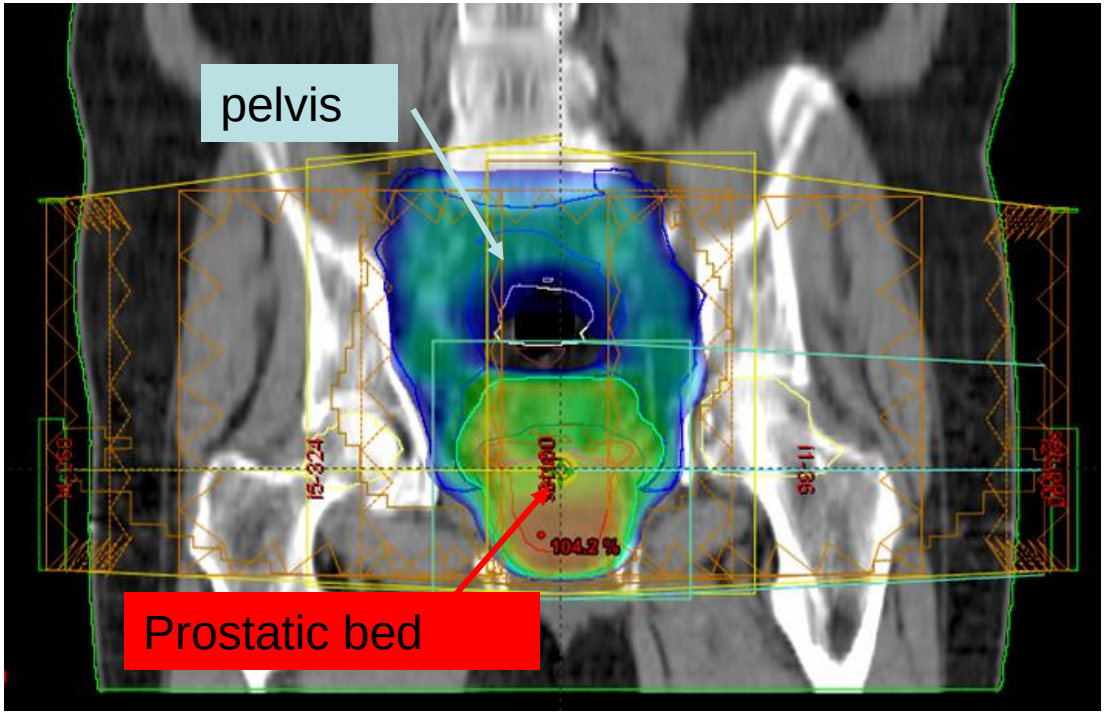
Intensity Modulated RadioTherapy with Simultaneous Integrated Boost (IMRT-SIB)

Increasing prophilactic and curative doses

Irradiating, concurrently, different volumes with different level doses



Bos et al show SIB-IMRT technique allow to decrease NTCP for rectal wall contrary to IMRT with sequential boost



Trends in Cancer Research

Original Communication

A personalised treatment with image guided intensity modulated radiotherapy for high-very high risk and metastatic prostate cancer patients: Preliminary results

Elisabetta Garibaldi[1,*], Gabriella Cattari[1], Domenico Gabriele[4], Elena Delmastro[1], Barbara Carau[5], Claudia Cutaia[2], Sara Bresciani[2], Cinzia Ortega[3] and Pietro Gabriele[1]

[1]Radiotherapy, [2]Medical Physics and [3]Medical Oncology Units, IRCCS – FPO Candiolo, Torino, Italy, [4]Physiology Institute, Neuroscience Department, University of Torino, Italy, [5]Radiotherapy Unit, Businco Oncology Hospital, Cagliari, Italy

Table 4. OAR doses and volumes.

Rectum	V75 (%), mean ± SD	3.2 ± 4.6
	V70 (%), mean ± SD	14.3 ± 7.4
	V50 (%), mean ± SD	40.1 ± 7.5
	Dmax (Gy), mean ± SD	75.9 ± 4.2
Small bowel	Volume (mL), mean ± SD	2956 ± 1380
	V45 (mL), mean ± SD	118 ± 52
Urinary bladder	Volume (mL), mean ± SD	274 ± 164
	V70 (%), mean ± SD	18.2 ± 9.7
	Dmean (Gy), mean ± SD	47.7 ± 6.6
	Dmax (Gy), mean ± SD	78.3 ± 1.5
Ureters	Dmean (Gy), mean ± SD	30.5 ± 6.5
	Dmax (Gy), mean ± SD	68.9 ± 5
Femoral heads	Dmean (Gy), mean ± SD	28.6 ± 6.2
Penile bulb	Dmean (Gy), mean ± SD	62.9 ± 10.3

Table 5. Acute and late toxicity (RTOG-EORTC scale).

Acute genito-urinary	0	24%
	1	54%
	2	14%
	3	3%
	4	5%
Acute gastro-intestinal	0	44%
	1	40%
	2	15%
	3	1%
	4	0%
Acute skin toxicity	0	90%
	1	6%
	2	4%
	3	0%
	4	0%
Late genito-urinary	0	72%
	1	22%
	2	6%
	3	0%
	4	0%
Late gastro-intestinal	0	70%
	1	20%
	2	7%
	3	3%
	4	0%

Results: outcome

Average iPSA	25.9 ng/ml (range: 2.54-366)
Average 3 months-PSA (93 pts)	0.38 ng/ml (range 0.003-5.15)
Average 6 months-PSA (73 pts)	0.29 ng/ml (range 0.03-3.9)
Average 12 months-PSA (53 pts)	0,2 ng/ml (range 0.001-2.16).

Biochemical failure (2 patient): 2,1%
Clinical failure (1 patient): 1% (PET choline positive)

Updated June 2013

Trends in Cancer Research

Original Communication

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Elisabetta Garibaldi[1,*], Gabriella Cattari[1], Domenico Gabriele[4], Elena Delmastro[1], Barbara Carau[5], Claudia Cutaia[2], Sara Bresciani[2], Cinzia Ortega[3] and Pietro Gabriele[1]

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In our cohort a high percentage of patients was staged with MRI (71%) and with PET/CT (37%) allowing to disclose 20 N+ patients and 5 M+ patients. Thanks to the high RT doses delivered even in the metastatic sites, no patient has until now relapsed in the RT fields; however it should be taken into consideration that the result is only preliminary due to the short 14 months median follow-up and the ongoing ADT in a high percentage of patients. Acute and late toxicities are acceptable and, apart from nausea, no collateral effect has been observed on bowel or upper abdomen.

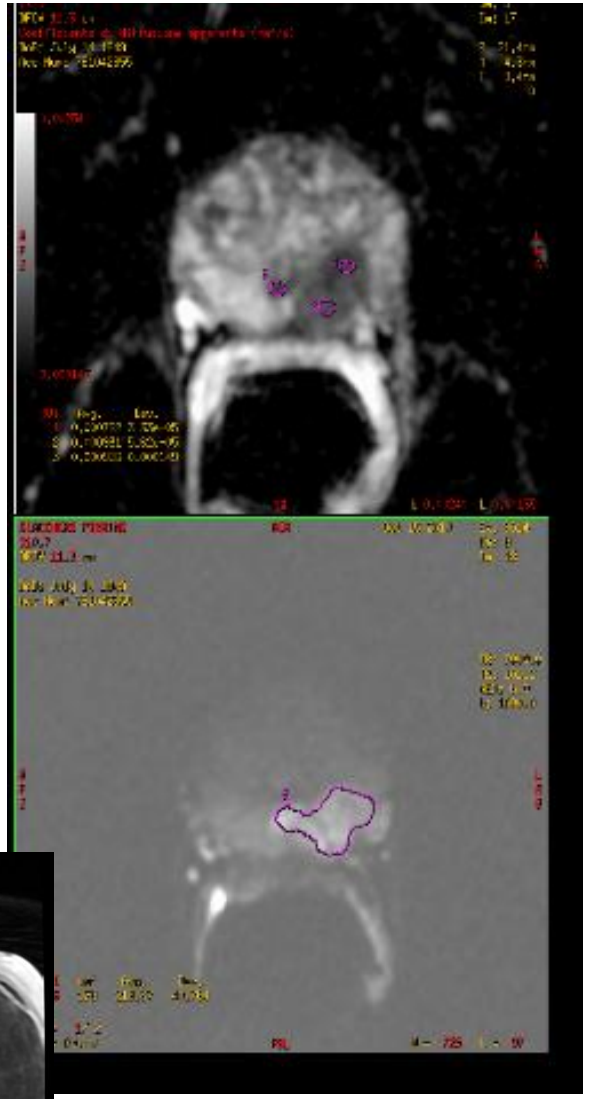
CONCLUSION

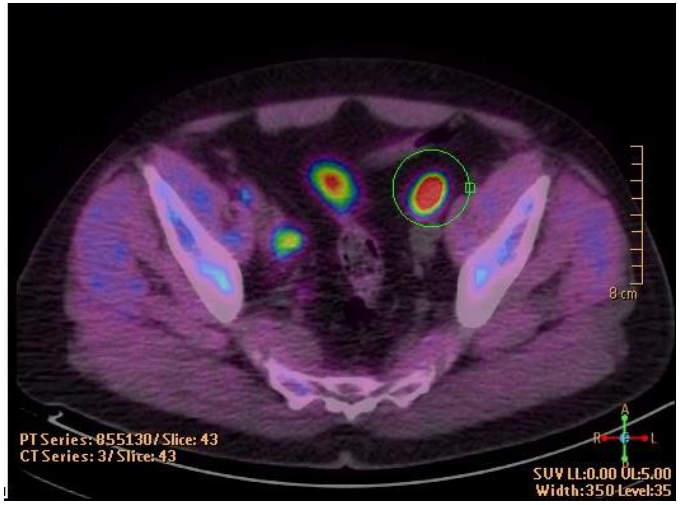
Our study shows the feasibility of wide field, high dose radiotherapy on high-very high and metastatic prostate cancer patients treated with radical intent in association with long term hormone-therapy; in fact irradiation included pelvic prophylactic nodes, positive nodes or distant metastasis if apparent, and in some patients also prophylactic lumbar-aortic nodes.

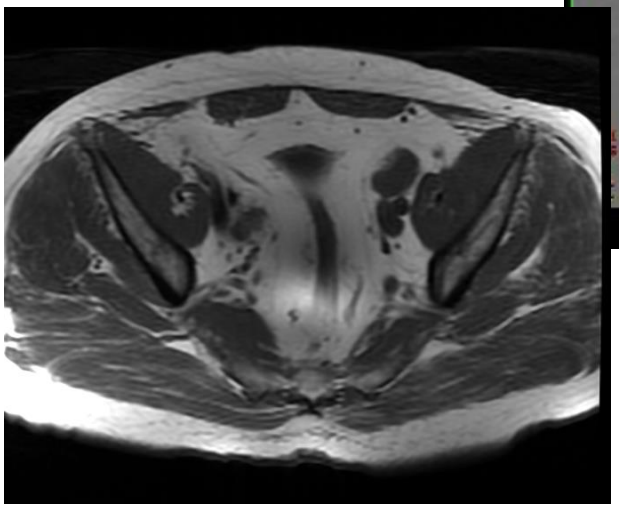
In our series we observed 2 recurrent patients, one of whom, with lumbar-aortic recurrence, was at diagnosis pelvic N1. We irradiated lumbar-aortic nodes only when imaging became positive in this area. Perhaps patients with pelvic N1 at diagnosis could benefit from a prophylactic lumbar-aortic irradiation. Studies are needed to define the utility of such irradiation.

Clinical case (GP)

- (GP) Patient 61 years old
- In August 2010 **PSA: 121** ng/ml
- September 2010: Prostate biopsy → adenoca, GS 8 (5+3)
- Bone scan: negative
- Endocoil-MRI & choline-PET: **cT3bN1** (external bilateral iliac and right common iliac N+)







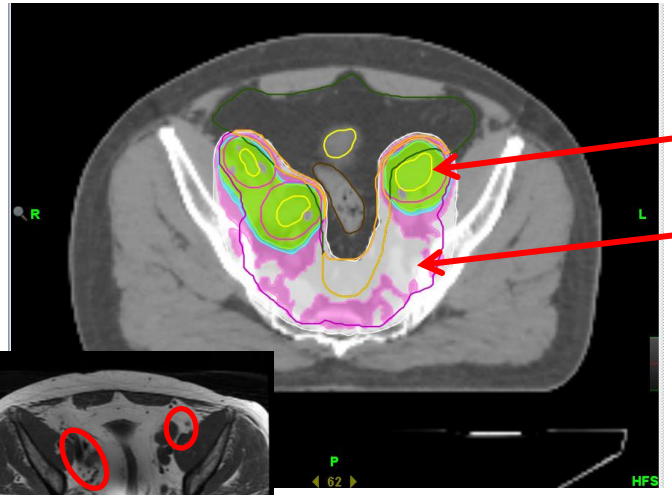
Clinical case (GP)

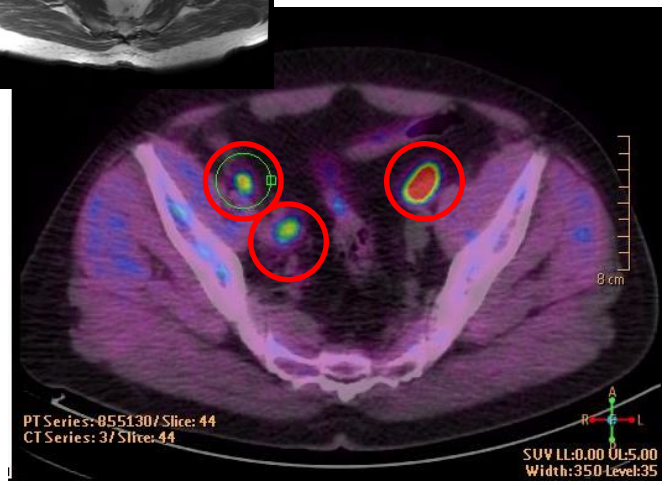
Prostate adenoca, GS 8 (5+3),iPSA 121, cT3bN1 → HT + Tomotherapy

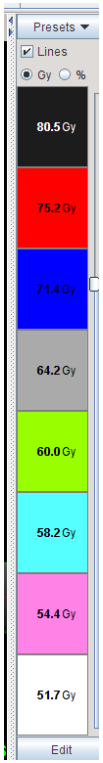
PTV prostate and VS bed = 75.2 Gy (2.35 Gy/die)

PTV N+ = 64 Gy (2 Gy/die)

PTV N- = 54.4 Gy (1.7 Gy/die)

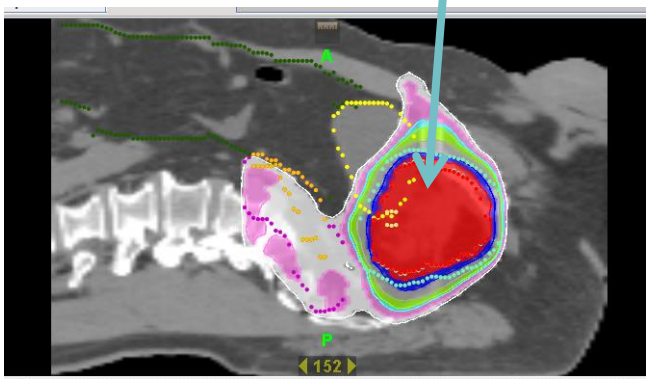


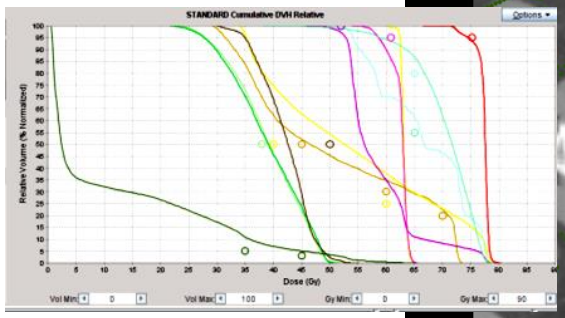


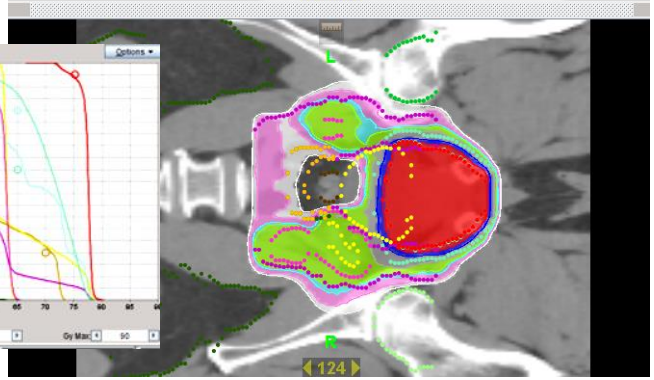


IMRT-SIB

OFF RT 12/2010

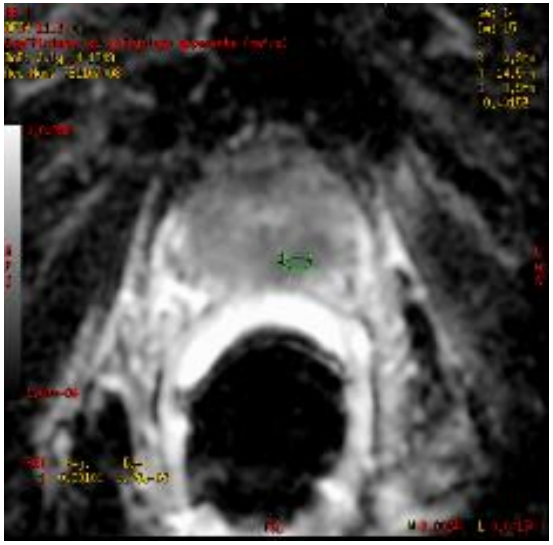




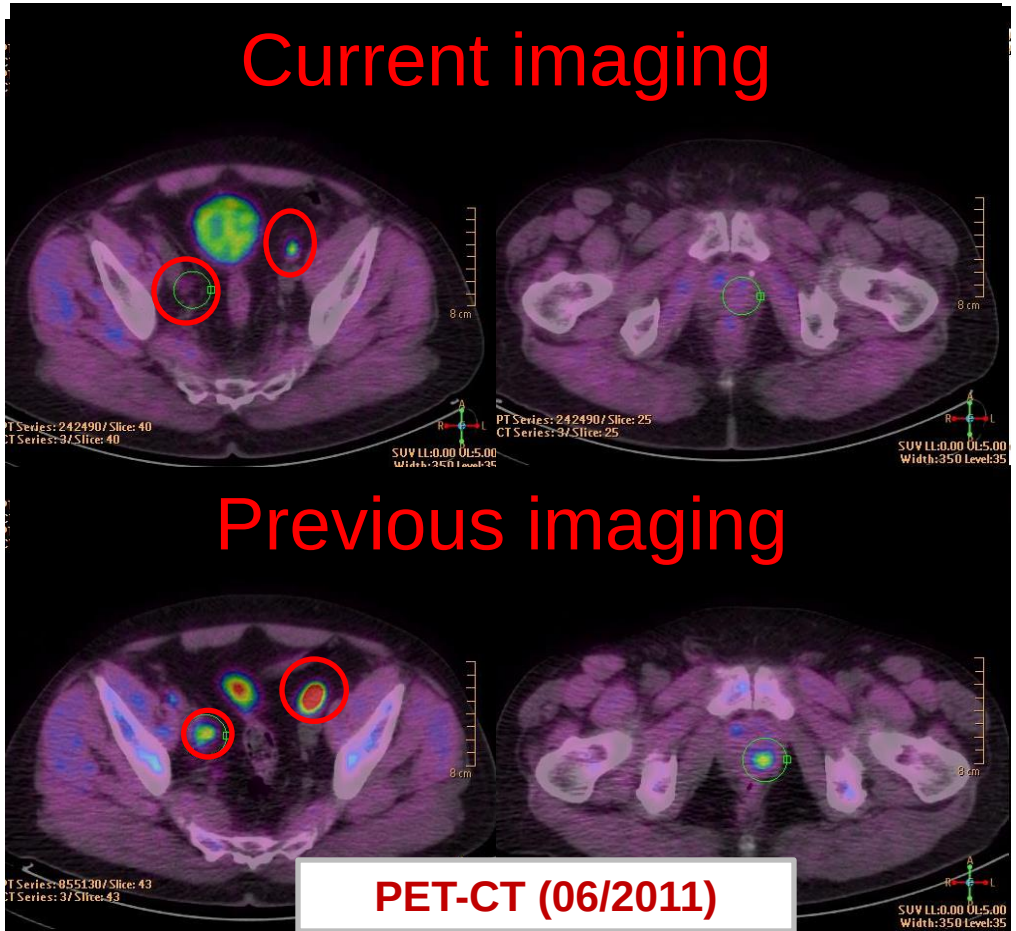


Clinical case (GP)

Prostate adenoca, GS 8 (5+3),iPSA 121, cT3bN1 → HT + Tomotherapy



MRI (02/2011): Volumetric reduction of intraprostatic lesions and of extracapsular extension. N-



PSA (04/2011) 2,29 ng/ml

PSA (07/2011) 1,31 ng/ml

PSA (12/2011) 0,6 ng/ml

PSA (07/2012) 0,4 ng/ml

PSA (11/2013) 0,21 ng/ml

(suspended HT 8/2013)

ADAPTIVE RADIOTHERAPY

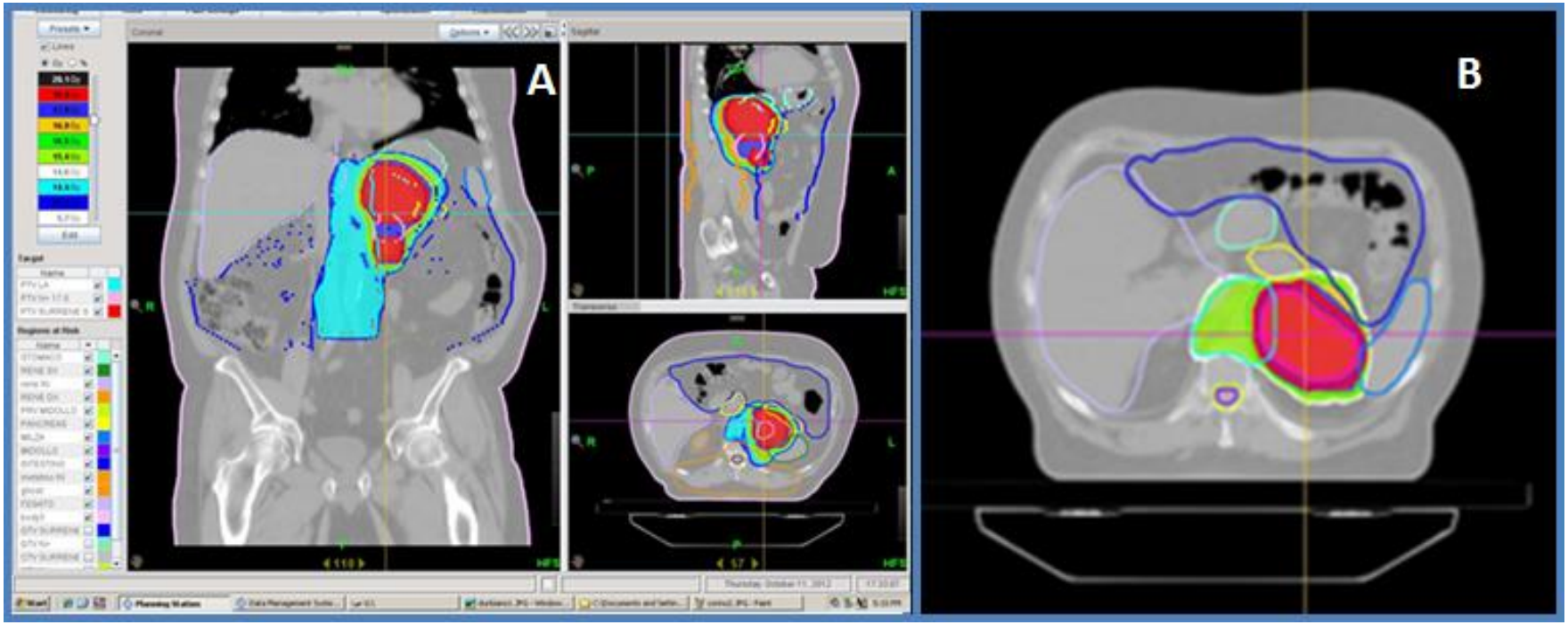


Figure 2: graphic representation of the treatment planning with dose distribution (in colorwash) on the left adrenocortical mass (72.8 Gy), PET positive lymph node (70.4 Gy) and on the prophylactic lumbar-aortic lymph nodes (50.4 Gy). In A the first treatment planning. In B the re-planning after 14 fractions, showing an increasing of tumor size.

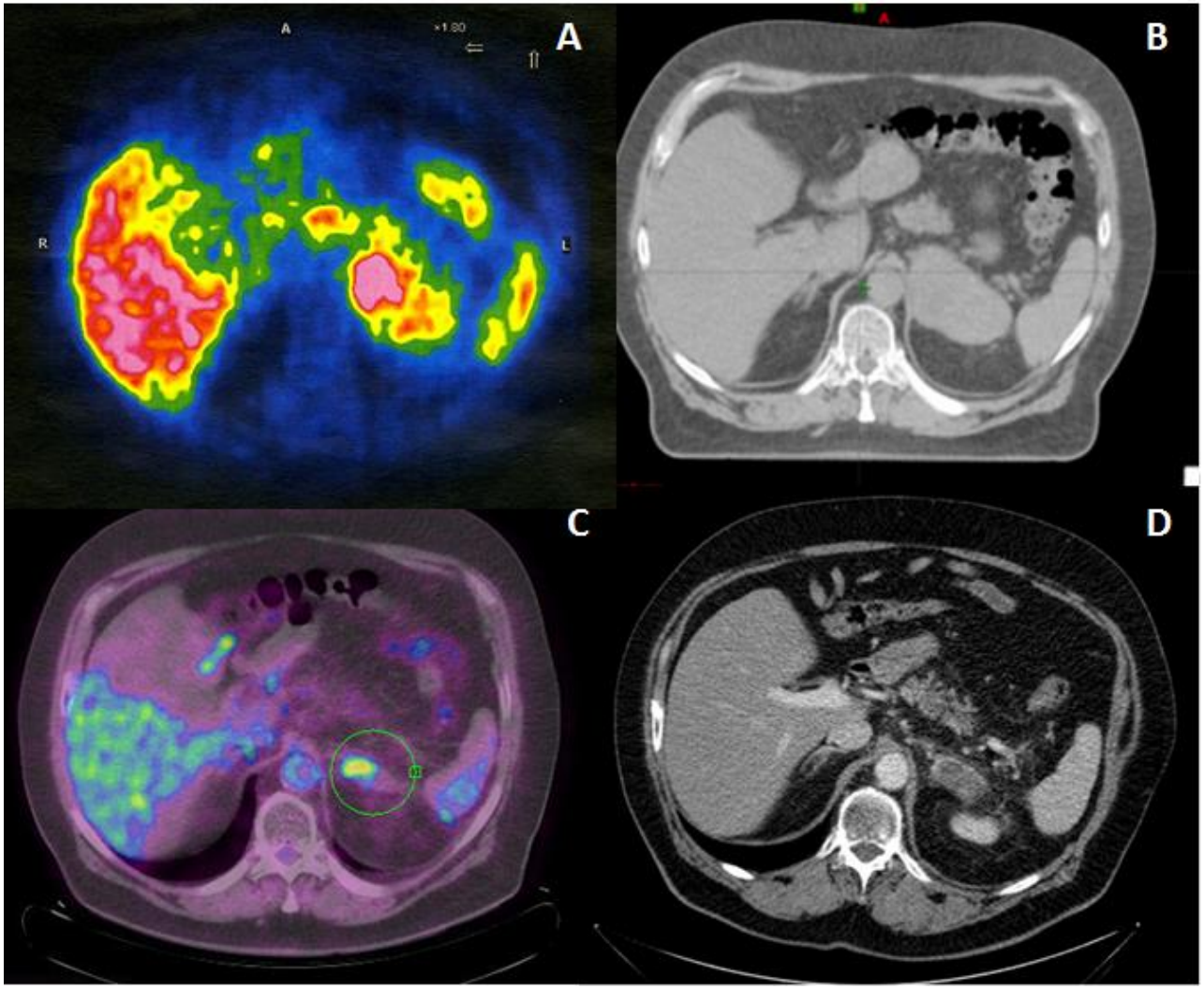


Figure 1: A) choline PET (A) and CT scan (B) performed before radiotherapy, showing an enhancing left adrenocortical mass of 9 cm. C) choline PET performed 3 months after radiotherapy.
D) CT scan performed 6 months after treatment.

QUANTEC nd

QUANTEC nd

OARs	D mean (Gy)	D max (Gy)
Pancreas	39.9	68.6
Spleen	31.7	69.2
Stomach	26.8	67.2
Liver	14.2	56.8
Right Kidney	8.0	29.5
Left Kidney	20.3	67.5
Small bowel	V45 220 cc	

Target Volumes	D mean (Gy)	D max (Gy)	D 95% (%)
PTV 1	74.3	77.2	99.2
PTV 2	74.8	77.6	100.1
PTV 3	59.3	72.2	99.3

Table 1: mean and maximum doses at organ at risks and target volumes coverage.

Reirradiation on N+: our experience

October 2010 – August 2011:

13 patients:

- **13** pts with **N+ recurrence** after radical treatment → **protocol 2**

N+ in pelvic and/or lumbar-aortic chains

Patient caractheristics	Protocol 2 N+ recurrences
N° pts	13
Mean age	64,9 (range 50-75)
Comorbidity n° pts (%)	CVD: 2 (15%) AI: 5 (38,5%) Diabetes: 0 lowerGID: 1 (7,7%) upperGID: 0
Urinary Sinptoms preRT: n° pts (%)	3 (23%)
Previous RT: P&SV bed	9 (69%)
Previous RT: pelvis+P&SVbed	2 (15,4%)
Previous abdominal surgery	5 (38,5%)
Previous other local therapies	--
Ormonal therapy	13 (100%)

Updated March 2012

Our experience: diagnostic workup

Protocol 2
N+ recurrences

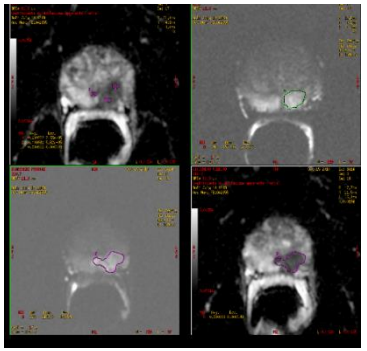
Bone scan
Choline-PET

Eur Radiol (2009) 19: 761–769
DOI 10.1007/s00330-008-1174-8

UROGENITAL

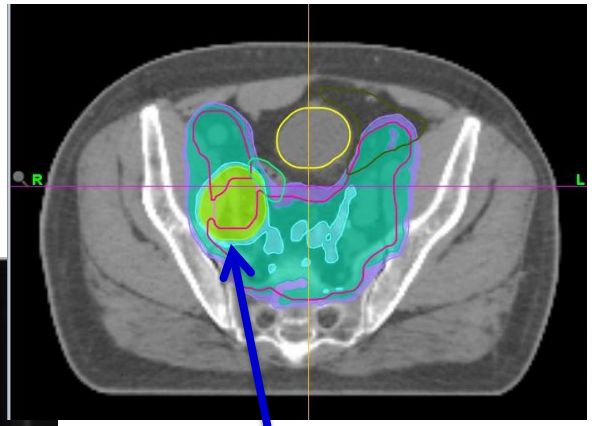
Stefano Cirillo
Massimo Petracchini
Lorenza Scotti
Teresa Gallo
Annalisa Macera
Maria Cristina Bona
Cinzia Ortega
Pietro Gabriele
Daniele Regge

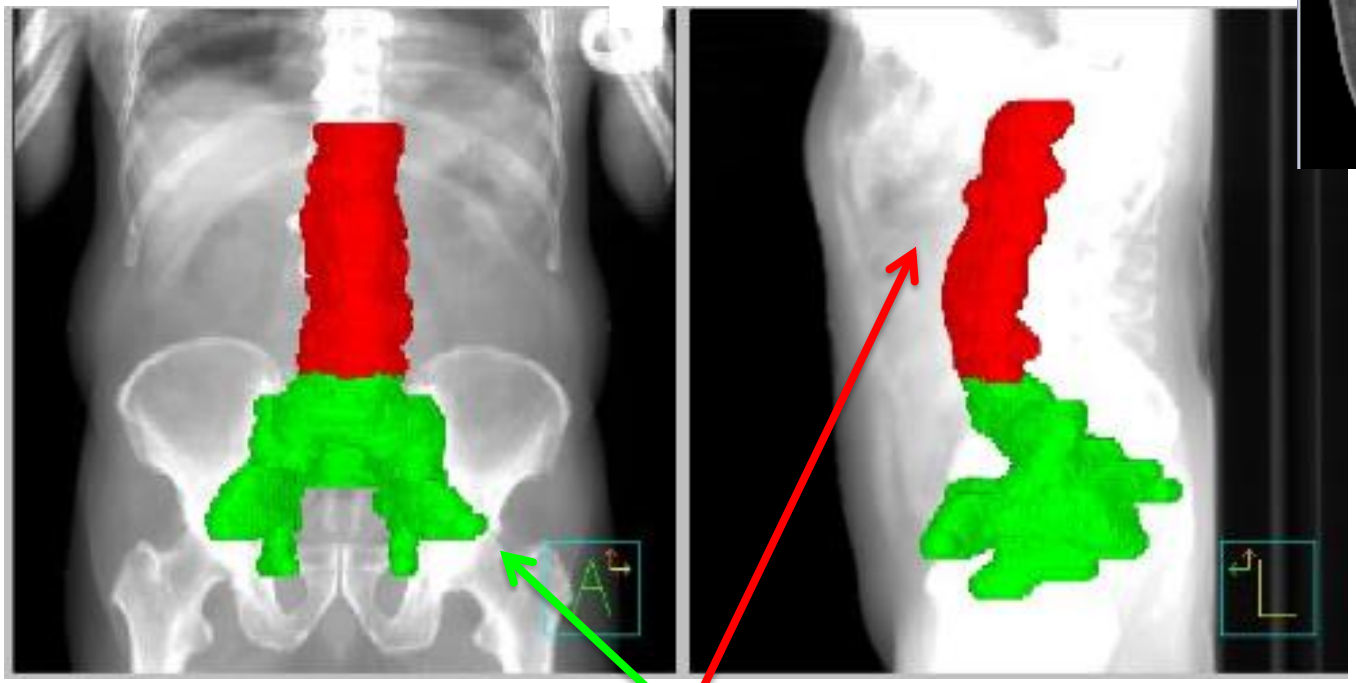
Endorectal magnetic resonance imaging at 1.5 Tesla to assess local recurrence following radical prostatectomy using T2-weighted and contrast-enhanced imaging



Volumes & dose prescriptions. Protocol 2:
N+ recurrences

Volumes	Doses (Gy)	Dose/fr
PTV 1 N+	60-66 Gy	2-2.2
PTV 2 N-	51-54 Gy	1.7-1.8
Fraction number	30	





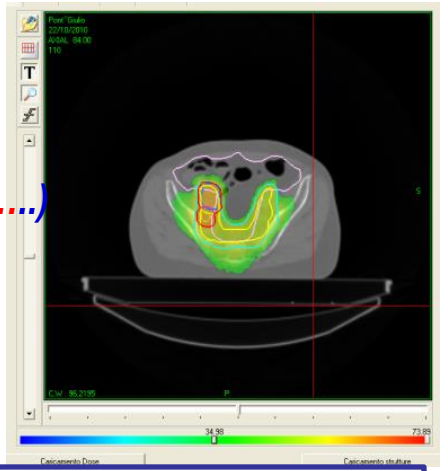
PTV 2 (positive nodes: N+) 60-66 Gy

PTV 2 (negative nodes: N-) 51-54 Gy

Updated March 2012

Re-irradiation by Tomotherapy: evaluation of the previous RT plan

ARTIVIEW- AQUILAB



- *Import DICOM RT Doses from all TPS (Tomotherapy, Pinnacle, Eclipse, **CyberKnife,**…..)*
- *Dose Visualization in all plan and modalities*
- *DVH Calculation*
- ***Dose summation and subtraction***
- *Export of volume information , DVHs and indices computed in Excel format.*

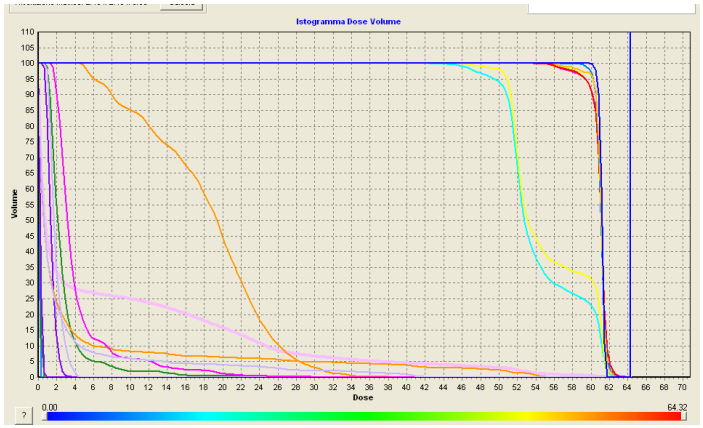
Pz: 64 years old

May 2003: Prostate + seminal vesicles treatment.

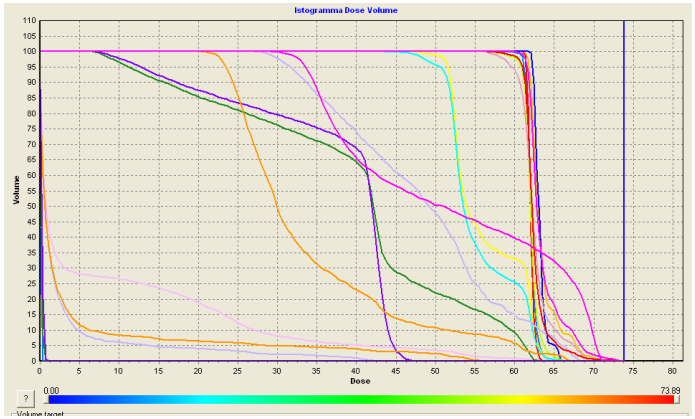
7/10/2010: Prostate Carcinoma recurrence on nodes.

5/11/2010: 51 Gy/30 fr ->pelvic lymph nodes + 60 Gy/30 fr -> positive PET Lymph nodes

Tomotherapy treatment Plan



Tomotherapy Plan + OLD plan



Our experience. Results: toxicity

All patients complited treatment

Acute upper GI	Protocol 2 N+ recurrences (13 pts)
G0	10/13
G1	3/13
G2	0/13
G3	0/13
G4	0/13

Acute GU	Protocol 2 N+ recurrences (13 pts)
G0	12/13
G1	1/13
G2	0/13
G3	0/13
G4	0/13

Acute lower GI	Protocol 2 N+ recurrences (13 pts)
G0	9/13
G1	4/13
G2	0/13
G3	0/13
G4	0/13

Haematological	Protocol 2 N+ recurrences (13 pts)
G0	9/13
G1	4/13
G2	0/13
G3	0/13
G4	0/13

Updated March 2012

Our experience. Results: outcome

Outcome	N+ recurrences (13 pts)
PSA control	11 (82%)
Imaging (PET or MRI)	12 (91%)

1 radiological persistence

Updated March 2012

Results

Cancer/Radiothérapie 16 (2012) 444–451

Disponible en ligne sur SciVerse ScienceDirect www.sciencedirect.com

Elsevier Masson France EM|consulte www.em-consulte.com

Article original

Évaluation économique prospective de la radiothérapie guidée par l'image des cancers de la prostate dans le cadre du programme national de soutien aux thérapeutiques innovantes et coûteuses

Prospective economic evaluation of image-guided radiation therapy for prostate cancer in the framework of the national programme for innovative and costly therapies assessment

P. Pommier[a,*,b], M. Morelle[b,c], L. Perrier[b,d], R. de Crevoisier[e], A. Laplanche[f], P. Dudouet[g], M.-A. Mahé[h], B. Chauvet[i], T.-D. Nguyen[j], G. Créhange[k], A. Zawadi[l], O. Chapet[m], I. Latorzeff[n], A. Bossi[o], V. Beckendorf[p], E. Touboul[q], X. Muracciole[r], J.-M. Bachaud[s], S. Supiot[h], J.-L. Lagrange[t]

Tableau 5
Durées moyennes d'occupation de la salle par séance.
Mean durations (±SD) of room immobilization per session (minutes).

Séances	Tomographie conique		Marqueurs (avec imagerie portale)[a]		Témoin (imagerie portale)
	Hebdomadaire $n=61$	Quotidien $n=67$	Hebdomadaire $n=29$	Quotidien $n=26$	$n=58$
Avec contrôle	20,9 (±3,0)	21,2 (±3,7)	18,8 (±4,6)	18,2 (±3,7)	15,8 (±3,1)
Sans contrôle	11,2 (±3,6)	NA	15,5 (±2,2)	NA	9,9 (±1,6)
Toutes	13,7 (±3,2)	21,0 (±3,9)	16,6 (±3,7)	18,3 (±3,9)	11,5 (±1,6)

Les données représentent les durées moyennes déviation standard (SR), exprimées en minutes. NA : non applicable.

[a] La modalité marqueur (avec imagerie portale) a été réalisée dans un seul centre. À titre comparatif, les durées des séances avec la modalité tomographie conique dans ce centre étaient les suivantes (en minutes) : avec contrôle 20,9 (±3,0) dans le bras hebdomadaire et 21,2 (±3,7) dans le bras quotidien ; sans contrôle 11,2 (±3,6) dans le bras hebdomadaire ; toutes séances confondues : 13,7 (±3,2) dans le bras hebdomadaire et 21,0 (±3,9) dans le bras quotidien.

Tableau 6
Durées cumulées moyenne de temps d'intervention du personnel.
Mean cumulative duration of personnel intervention (hours).

	Tomographie conique		Grains		Témoin
	Hebdomadaire	Quotidien	Hebdomadaire	Quotidien	
Manipulateur en électroradiologie	18,3 (±3,6)	28,0 (±5,2)	19,5 (±2,5)	22,2 (±2,0)	14,1 (±2,3)
Médecin	0,7 (±0,7)	2,0 (±1,6)	0,1 (±0,1)	0 (±0)	0,4 (±0,4)
Physicien	0,2 (±0,5	0,5 (±1,0)	0,1 (±0,2)	0,0 (±0,1)	0,1 (±0,1)

Les données représentent les durées moyennes (±SD) exprimées en heures.

Cancer/Radiothérapie 16 (2012) 444–451

Disponible en ligne sur SciVerse ScienceDirect www.sciencedirect.com

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Article original

Évaluation économique prospective de la radiothérapie guidée par l'image des cancers de la prostate dans le cadre du programme national de soutien aux thérapeutiques innovantes et coûteuses

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Results

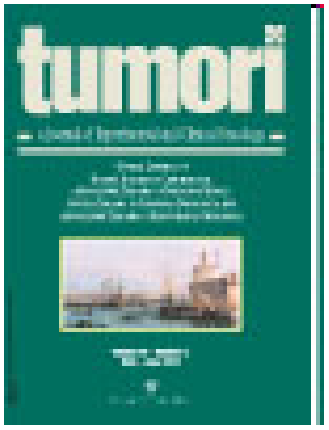
Results. – The economical analysis included a total of 241 patients enrolled between 2007 and 2011 in seven centres, 183 in the randomized study (128 with CBCT and 55 with fiducial markers) and 58 in the control group. Compared to weekly controls, the average additional cost per patient of daily controls was €847 (CBCT) and €179 (markers). Compared to PI, the average additional cost per patient was €1392 (CBCT) and €997 (fiducial markers) for daily controls; €545 (CBCT) and €818 (markers) in case of weekly controls.

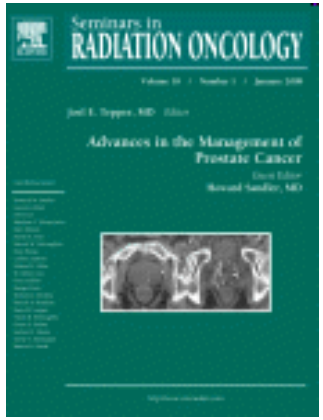
Conclusion

Conclusion. – A daily frequency for image control in IGRT and 3D images patient positioning control (IGRT) for prostate cancer lead to significant additional cost compared to weekly control and 2D imaging (PI). Long-term clinical assessment will permit to assess the medico-economical ratio of these innovative radiotherapy modalities.

Riflessioni e considerazioni conclusive

1. Nella malattia ad alto rischio la irradiazione della pelvi è basata sul corpo della letteratura: la IMRT è lo standard corrente; l'impiego di una IMRT-IGRT è raccomandata quando le dosi superano i 78 Gy
2. Nella irradiazione della malattia ad altissimo rischio (N+ pelvico / lomboartico) la IMRT-SIB-IGRT è in studio in varie Istituzioni in alternativa alla chemioterapia ed alla chirurgia (casi selezionati): i risultati sono comunque eccellenti
3. La re-irradiazione dei linfonodi è tecnica complessa che presuppone lo studio della precedente irradiazione ed un piano somma da valutare con accuratezza e senso del limite
4. Non si può prescindere da una valutazione rischio-beneficio e di costo





Fondazione del Piemonte per l'Oncologia