“CRITERI DI VALUTAZIONE DELLA RISPOSTA IN ONCOLOGIA:
La valutazione PET dopo Radioterapia"

Filippo Alongi MD

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Cancer Care Center
Negrar - Verona

Nuclear Medicine & Radiotherapy:
BACKGROUND

Pre-Treatment Staging

RT-Planning Strategy

Monitoring Response after RT

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Criteri di Valutazione della risposta in Oncologia:
Monitoring Response after RT

BRAIN

Clinical Radiology 70 (2015) 1299–1312

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Pictorial Review

Tumour progression or pseudoprogression? A review of post-treatment radiological appearances of glioblastoma

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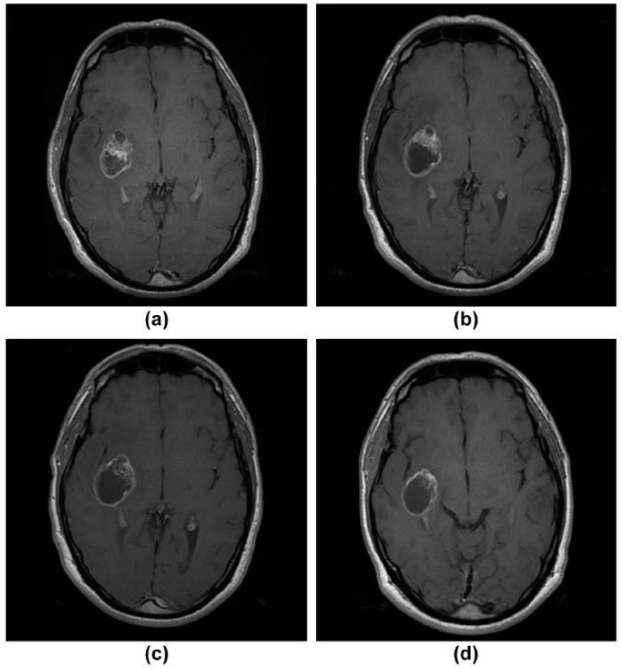

Figure 1 A patient with GBM. (a) Post-surgical MRI image showing progression on MRI at (b) 1 months and (c) 4 months post-radiotherapy; it stabilisation at (d) 7 months post-radiotherapy indicating pseudoprogression.

Glioblastoma (GBM) is a common brain tumour in adults, which, despite multimodality treatment, has a poor median survival. Efficacy of therapy is assessed by clinical examination and magnetic resonance imaging (MRI) features. There is now a recognised subset of treated patients with imaging features that indicate "progressive disease" according to Macdonald's criteria, but subsequently, show stabilisation or resolution without a change in treatment. In these cases of "pseudoprogression", it is believed that non-tumoural causes lead to increased contrast enhancement and conventional MRI is inadequate in distinguishing this from true tumour progression. Incorrect diagnosis is important, as failure to identify pseudoprogression could lead to an inappropriate change of effective therapy. The purpose of this review is to outline the current research into radiological assessment with MRI and molecular imaging of post-treatment GBMs, specifically the differentiation between pseudoprogression and tumour progression.

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Criteri di Valutazione della risposta in Oncologia:
Monitoring Response after RT

BRAIN

Amino Acid PET – An Imaging Option to Identify Treatment Response, Posttherapeutic Effects, and Tumor Recurrence?

Norbert Galldiks[1,2,3] and Karl-Josef Langen[2,4]*

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frontiers in Neurology

Routine diagnostics and treatment monitoring in patients with primary and secondary brain tumors is usually based on contrast-enhanced standard MRI. However, the capacity of standard MRI to differentiate neoplastic tissue from non-specific posttreatment effects may be limited particularly after therapeutic interventions such as radio- and/or chemotherapy or newer treatment options, e.g., immune therapy. Metabolic imaging using PET may provide relevant additional information on tumor metabolism, which allows a more accurate diagnosis especially in clinically equivocal situations, particularly when radiolabeled amino acids are used. Amino acid PET allows a sensitive monitoring of a response to various treatment options, the early detection of tumor recurrence, and an improved differentiation of tumor recurrence from posttherapeutic effects. In the past, this method had only limited availability due to the use of PET tracers with a short half-life, e.g., C-11. In recent years, however, novel amino acid PET tracers labeled with positron emitters with a longer half-life (F-18) have been developed and clinically validated, which allow a more efficient and cost-effective application. These developments and the well-documented diagnostic performance of PET using radiolabeled amino acids suggest that its application continues to spread and that this technique may be available as a routine diagnostic tool for several indications in the field of neuro-oncology.

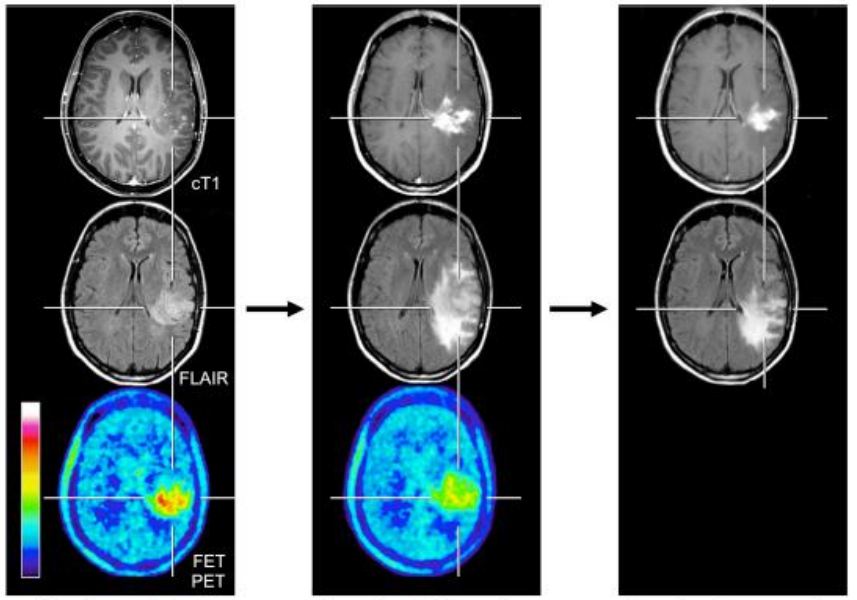

FIGURE 2 | FET PET and conventional MR imaging in a 47-year-old patient prior to histological confirmation of glioblastoma diagnosis (left column), and 8 weeks (middle column) and 3 months after completion of radiochemotherapy with temozolomide (right column). The follow-up MR images 8 weeks after completion of radiochemotherapy suggests markedly tumor progression (middle column). In contrast, the FET PET image shows decreased metabolic activity compared to initial FET PET (maximum tumor/brain ratio 3.3 vs. 4.7) indicating pseudoprogression. Correspondingly, follow-up MRI, 3 months after radiochemotherapy, shows an improvement with regressive findings without change in the treatment regimen (right column).

Criteri di Valutazione della risposta in Oncologia:
Monitoring Response after RT

HEAD AND NECK

BJR AN INTERNATIONAL JOURNAL OF RADIOLOGY, RADIATION ONCOLOGY AND ALL RELATED SCIENCES
SUBMIT SUBSCRIBE ABOUT

REVIEW ARTICLE

Role of fluorine-18 fluorodeoxyglucose PET/CT in head and neck oncology: the point of view of the radiation oncologis

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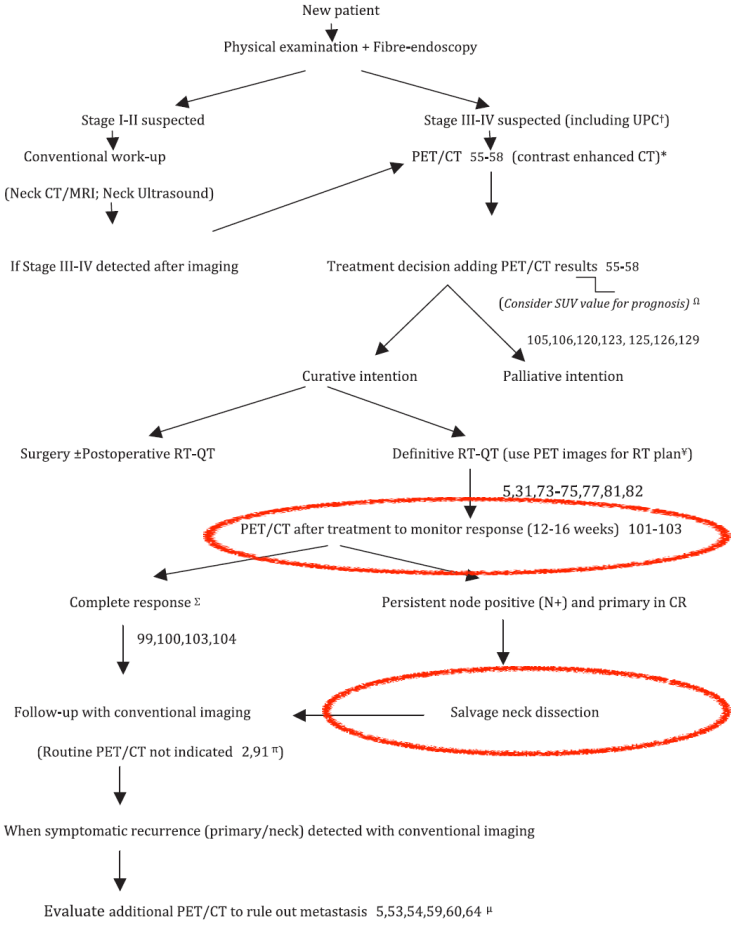
[4]FILIPPO ALONGI, MD, [2,5]JOSE A MEDINA, MD, [6]OLGUN ELICIN, MD, [7]ANDREA SKANJETI, MD, PhD,
[7]FRANCESCO GIAMMARILE, MD, PhD, [1]PEDRO BILBAO, MD, PhD, [1]FRANCISCO CASQUERO, MD, PhD,
[8]BERARDINO DE BARI, MD and [6]ALAN DAL PRA, MD

ABSTRACT

Squamous cell carcinoma is the most common malignant tumour of the head and neck. The initial TNM staging, the evaluation of the tumour response during treatment, and the long-term surveillance are crucial moments in the approach to head and neck squamous cell carcinoma (HNSCC). Thus, at each of these moments, the choice of the best diagnostic tool providing the more precise and larger information is crucial. Positron emission tomography with fluorine-18 fludeoxyglucose integrated with CT (^{18}F-FDG-PET/CT) rapidly gained clinical acceptance, and it has become an important imaging tool in routine clinical oncology. However, controversial data are currently available, for example, on the role of ^{18}F-FDG-PET/CT imaging during radiotherapy planning, the prognostic value or its real clinical impact on treatment decisions. In this article, the role of ^{18}F-FDG-PET/CT imaging in HNSCC during pre-treatment staging, radiotherapy planning, treatment response assessment, prognosis and follow-up is reviewed focusing on current evidence and controversial issues. A proposal on how to integrate ^{18}F-FDG-PET/CT in daily clinical practice is also described.

PROPOSAL TO INCORPORATE PET/CT IN THE DECISION-MAKING PROCESS



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Criteri di Valutazione della risposta in Oncologia:
Monitoring Response after RT

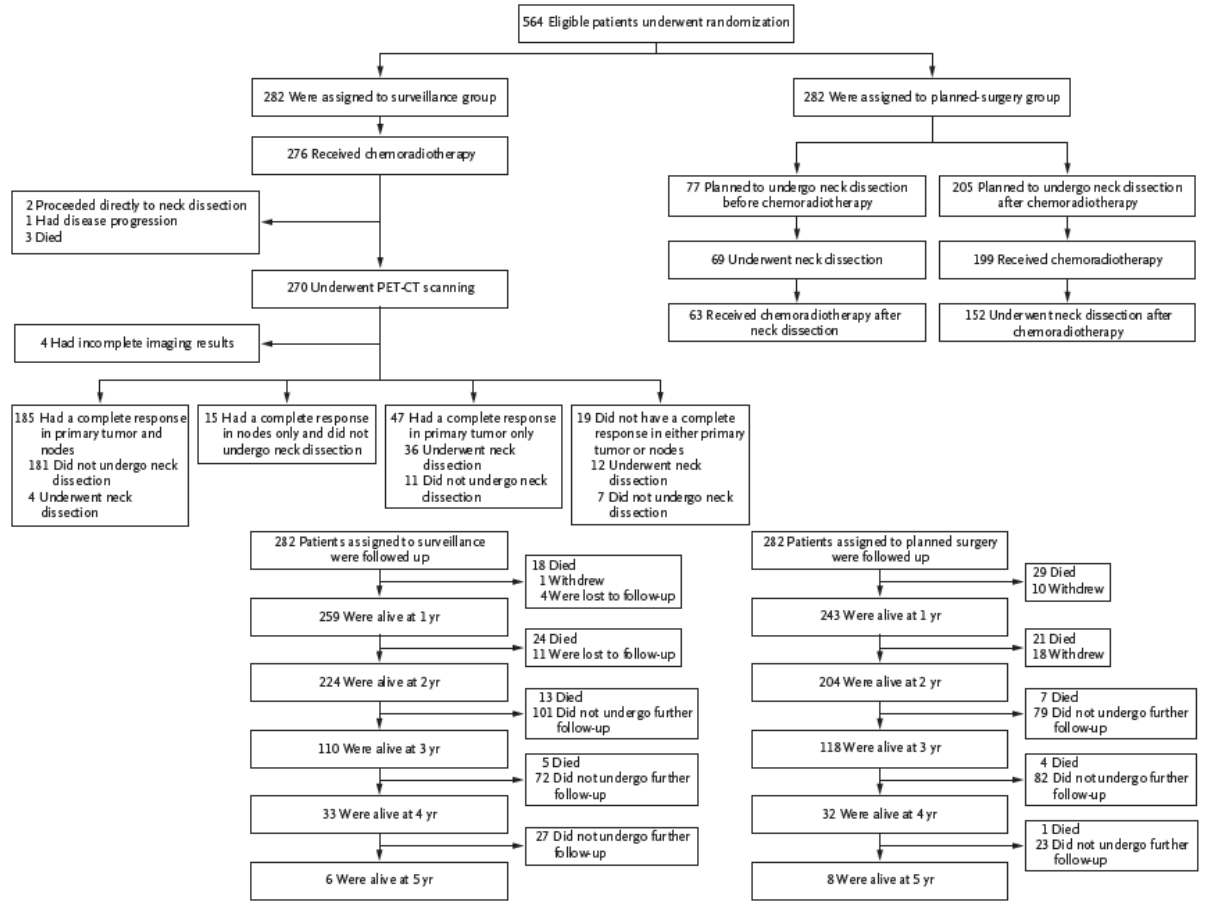
HEAD AND NECK

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

PET-CT Surveillance versus Neck Dissection in Advanced Head and Neck Cancer

Hisham Mehanna, Ph.D., Wai-Lup Wong, F.R.C.R., Christopher C. McConkey, Ph.D., Joy K. Rahman, M.Sc., Max Robinson, Ph.D., Andrew G.J. Hartley, F.R.C.R., Christopher Nutting, Ph.D., Ned Powell, Ph.D., Hoda Al-Booz, F.R.C.R., Martin Robinson, F.R.C.R., Elizabeth Junor, F.R.C.R., Mohammed Rizwanullah, F.R.C.R., Sandra V. von Zeidler, Ph.D., Hulya Wieshmann, F.R.C.R., Claire Hulme, Ph.D., Alison F. Smith, M.Sc., Peter Hall, Ph.D., Janet Dunn, Ph.D., and the PET-NECK Trial Management Group*



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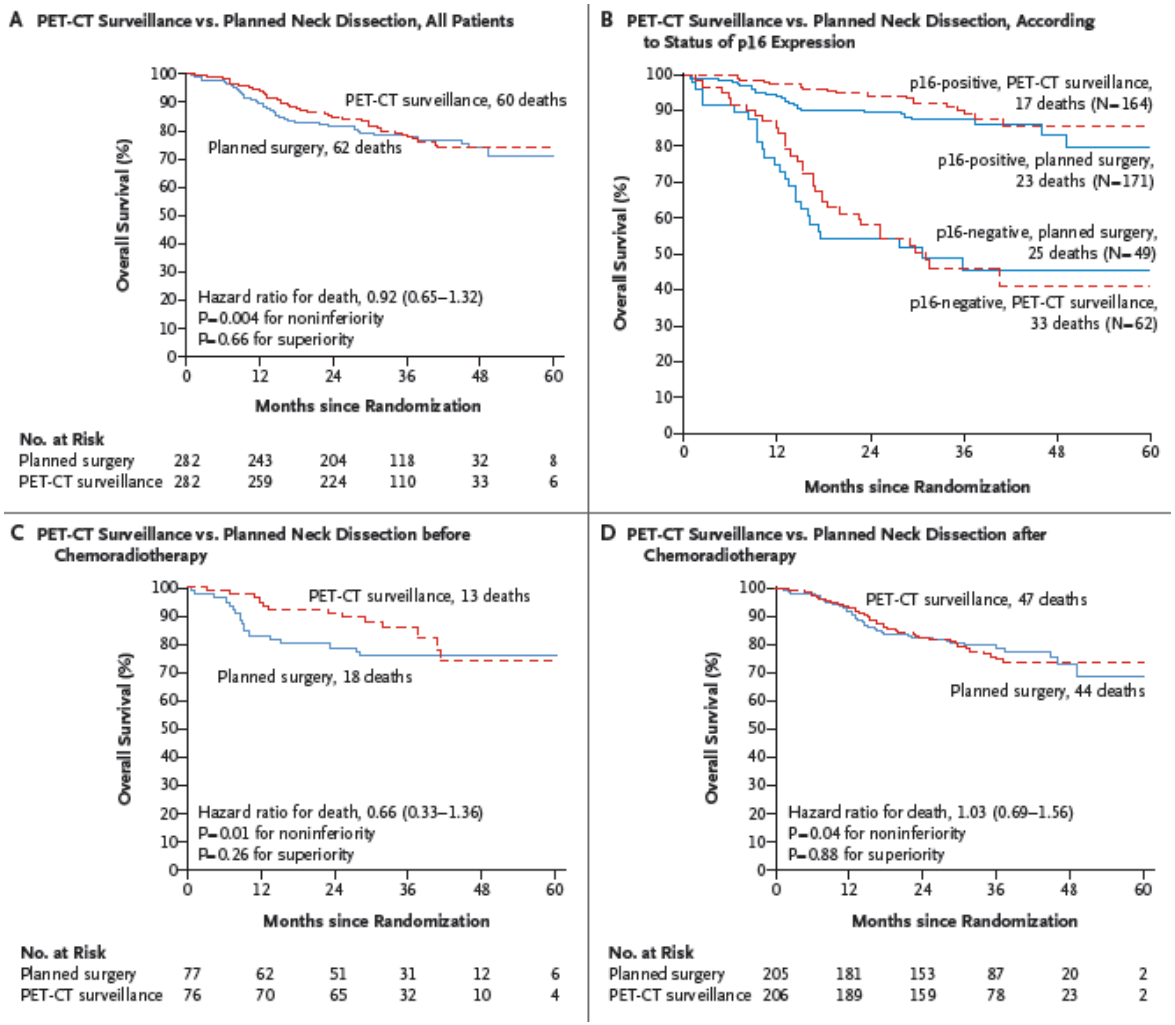

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CONCLUSIONS

Survival was similar among patients who underwent PET-CT–guided surveillance and those who underwent planned neck dissection, but surveillance resulted in considerably fewer operations and it was more cost-effective. (Funded by the National Institute for Health Research Health Technology Assessment Programme and Cancer Research UK; PET-NECK Current Controlled Trials number, ISRCTN13735240.)

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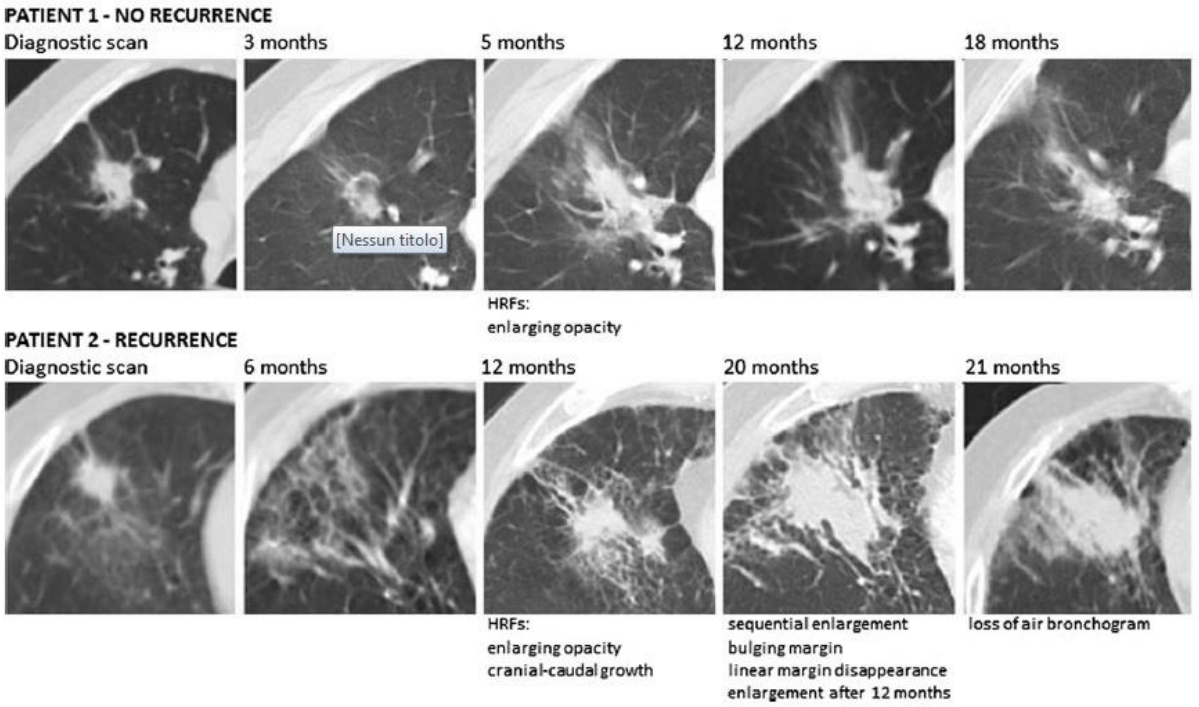
Criteri di Valutazione della risposta in Oncologia:
Monitoring Response after SABR

LUNG LESIONS



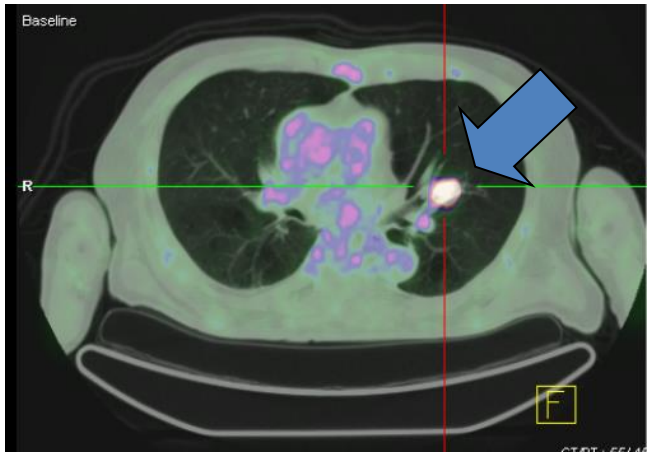
With the increasing using of lung SABR**, distinguishing fibrosis from recurrence is a research priority** for survivorship, as salvage treatment by surgery or repeat SABR while feasible, are not without toxicity

Louie et al. Radiotherapy and Oncology. *2015*

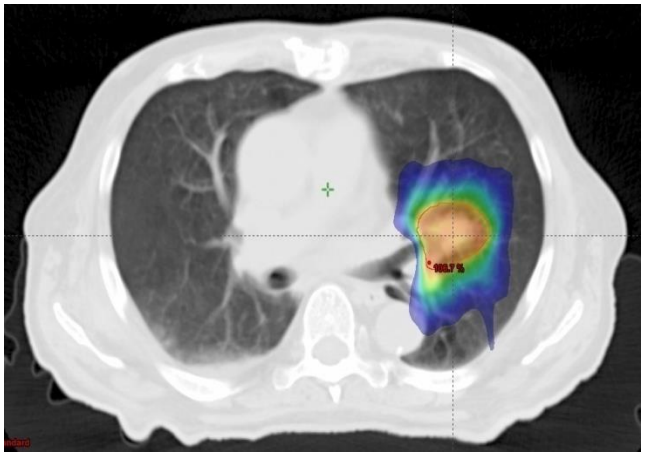
LUNG OLIGOMETASTASES:

UNRESOLVED ISSUES: PREDICTIVE FACTORS OF RESPONSE

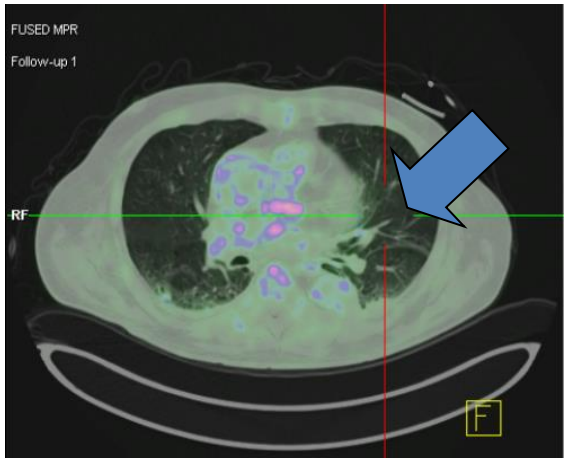
Male 73 y. Ultra-Central oligometastasis



CT-PET before SABR



Planning CT



CT-PET 60 days after SABR

CR @ CT-PET after **70 Gy/10** fr. **(BED > 100)** with FFF beams

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Criteri di Valutazione della risposta in Oncologia:
Monitoring Response after SABR

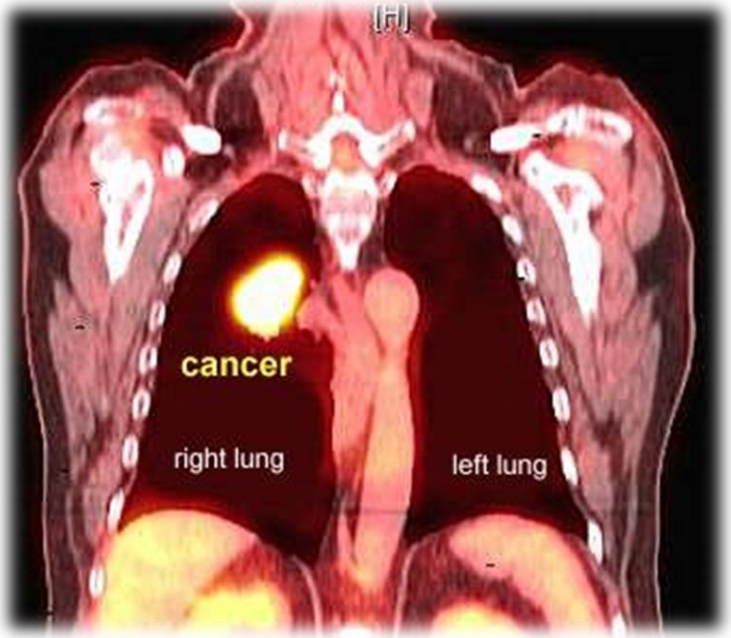
LUNG LESIONS

✓***SUV-max*** as measured by the highest pixels within the ROI

✓***SUV-mean*** as measured by the mean 18-FDG uptake value within the ROI

✓ **Metabolic Tumor Volume (MTV)** defined as total tumor volume with a SUV of 2.5 or greater

✓ ***Total Lesion Glycolysis (TLG)*** represented the metabolic rate of the tumor, calculated by multiplying SUV-mean by MTV



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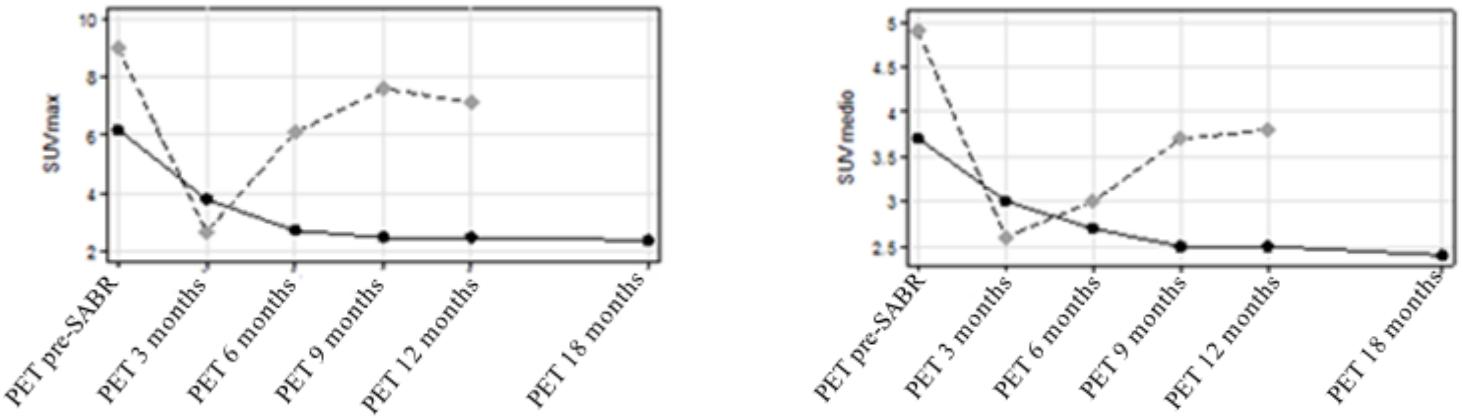
PET after SABR for lung oligometastases: Our Experience



Patients with local failure (Dashed Line) - Patients without local failure (Solid Line)

✓***Pre-SABR SUV-max < 5 related to complete response at 6 months***
(p-value < 0.001) (Sensitivity = 88%, Specificity = 94%)

✓***Pre-SABR SUV-mean < 3.5 related to complete response at 6 months***
(p-value < 0.03)

✓***For In-Field Progression***
Delta SUV max and mean 3-6 months post-SABR increased comparing to Delta SUVs 0-3 months
(p 0.008, two-sample Wilcoxon rank-sum test)

Journal of Thoracic Oncology: Under Review

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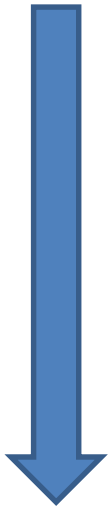
Criteri di Valutazione della risposta in Oncologia:
Monitoring Response after SABR

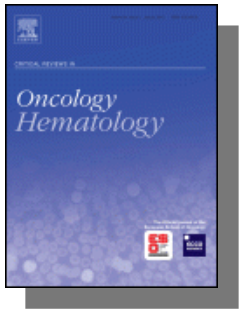
PROSTATE CANCER

PSA RELAPSE AFTER PRIMARY TREATMENT AND ANDROGEN THERAPY



CASTRATION-RESISTANCE

Criteri di Valutazione della risposta in Oncologia:
Monitoring Response after SABR



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Critical Reviews in Oncology/Hematology 91 (2014) 234–247

CRITICAL REVIEWS IN
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Choline-PET in prostate cancer management: The point of view of the radiation oncologist

Berardino De Bari [a,*], Filippo Alongi [b], Laëtitia Lestrade [c], Francesco Giammarile [d]

[a] *Radiation Oncology Department, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne, Switzerland*
[b] *Radiation Oncology Department, Sacro Cuore Hospital, Negrar-Verona, Italy*
[c] *Radiation Oncology Department, Hôpitaux Universitaires de Genève (HUG), Geneva, Switzerland*
[d] *Médecine Nucléaire, Hospices Civils de Lyon and EA 3738, Université Claude Bernard Lyon 1, Lyon, France*

- Choline-PET/CT could change the therapeutic approach in almost 15–20% of the patients.

- New Tracers (PSMA) are promising also for lower PSA values.

De Bari et al. Critical Review in Oncology/Hematology 2014

Criteri di Valutazione della risposta in Oncologia:
Monitoring Response after SABR

Q J NUCL MED MOL IMAGING 2015;59:411-9

Lymph-node relapsed prostate cancer management and PET-driven external beam radiotherapy: salvage or palliative treatment?

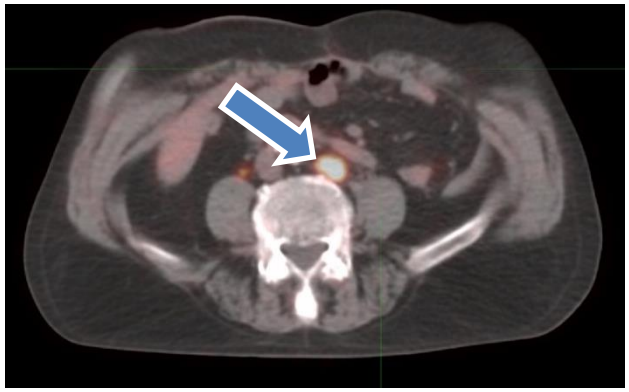
V. VAVASSORI [1], F. ALONGI [2], G. A D'AGOSTINO [3], E. DELLA BOSCA [1], M. SCORSETTI [3]

SBRT AND NEW DRUGS?

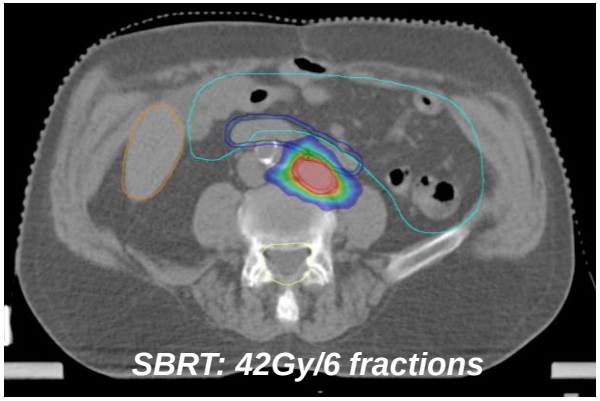
Vavassori et al. QJ Nucl Med Mol Imaging 2015

Criteri di Valutazione della risposta in Oncologia:
Monitoring Response after SABR

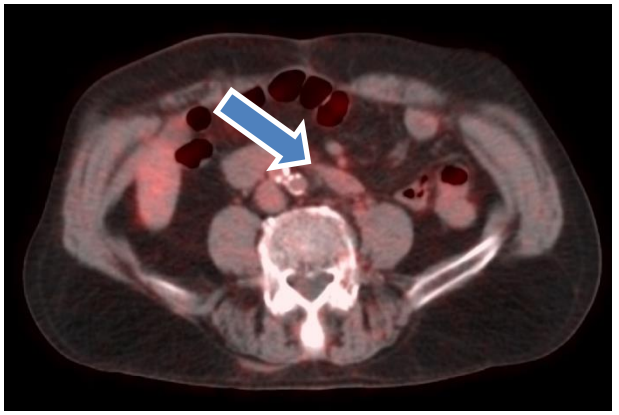
Isolated Lymph node metastasis from prostate cancer during ADT



CHOLINE PET-CT
before SBRT
PSA value: 2 ng/mL



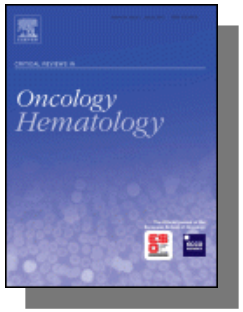
PLANNING CT



CHOLINE PET-CT
6 months post- SBRT
PSA value: 0.6 ng/mL

Immagini Archivio Clinico RT Negrar

Criteri di Valutazione della risposta in Oncologia:
Monitoring Response after SABR



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Choline-PET in prostate cancer management: The point of view of the radiation oncologist

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[b] *Radiation Oncology Department, Sacro Cuore Hospital, Negrar-Verona, Italy*
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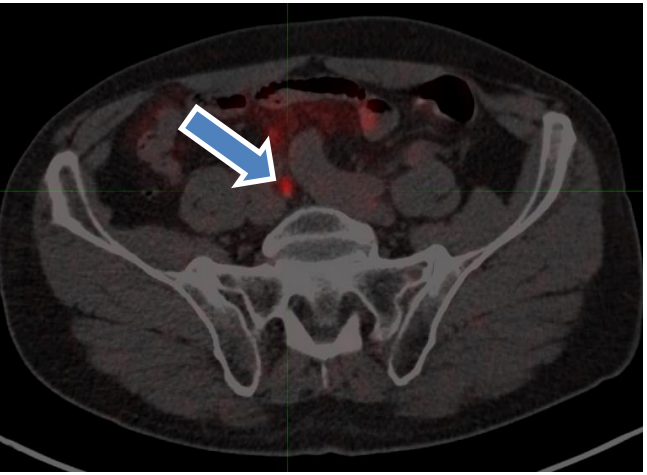
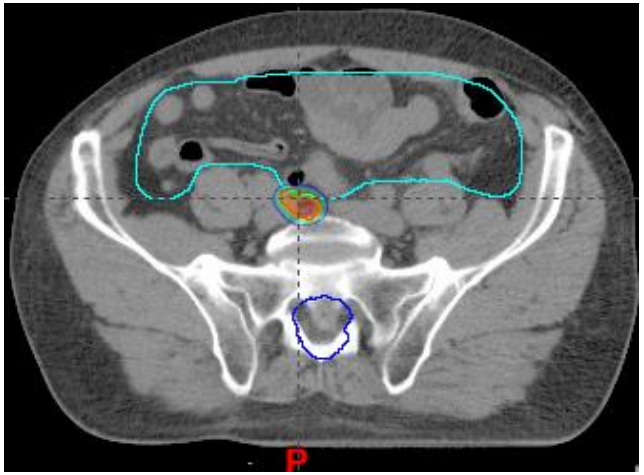
[d] *Médecine Nucléaire, Hospices Civils de Lyon and EA 3738, Université Claude Bernard Lyon 1, Lyon, France*

In the perspective of an extensive adoption of Choline-PET as a guide for personalized treatment planning in various phases of PC, more efforts in technology development, such as hybrid PET/MRI scans, will surely improve its accuracy and subsequently its extensive clinical use. Another interesting issue could be the development of new radiopharmaceuticals. In particular, prostate-specific membrane antigen (PSMA), labeled by 68 Gallium (^{68}Ga-PSMA) seems more sensitive and specific than Choline [88].

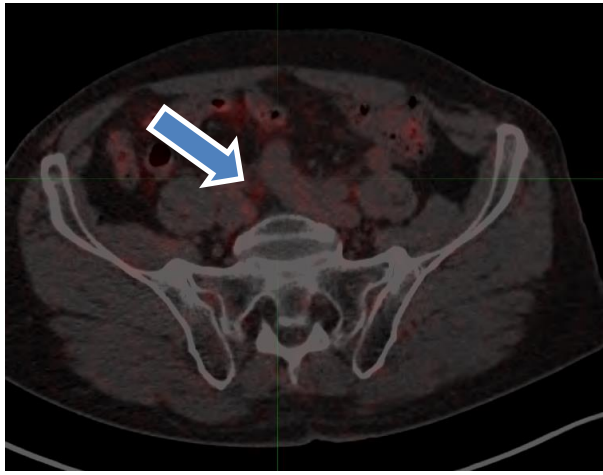
Criteri di Valutazione della risposta in Oncologia:
Monitoring Response after SABR



PET/CT PSMA
before SBRT
PSA value: 0.14 ng/mL



SBRT PET/CT PSMA
Guided
30 Gy in 5 Fr



PET/CT PSMA
Post-SBRT
PSA value: 0.04 ng/mL

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CONCLUSIONS:

La valutazione PET dopo Radioterapia

La PET è cruciale nella valutazione della Risposta dopo trattamento RT in diversi distretti anatomici e per diversi tipi istologici

Nuovi parametri semi-quantitativi potrebbero essere utili a scopo prognostico e predittivo di risposta

Il Timing post-RT rimane oggetto di discussione

Nuovi traccianti sono promettenti per una valutazione di specifiche caratteristiche metabolico-funzionali