

# Might Adaptive Radiotherapy in NSCLC be feasible in clinical practice?

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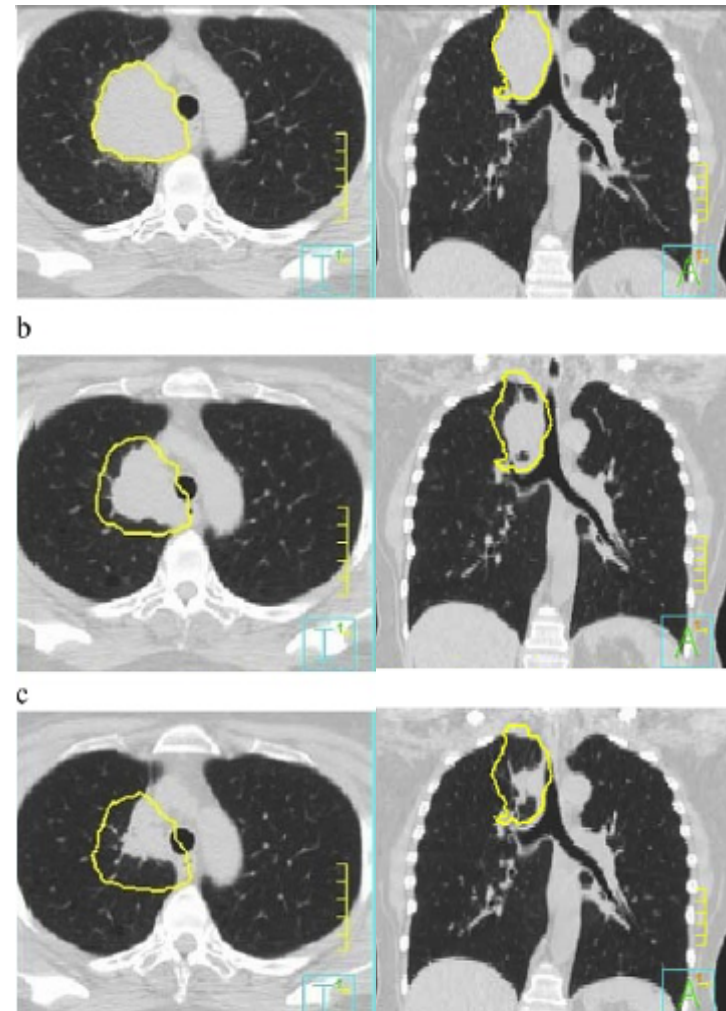


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*Background:*

Tumour motion and ANATOMIC CHANGES during radiotherapy are the major cause of target miss and/or over-treating normal tissue in lung cancer.

Some authors (Fig A) observed that while changes in tumour motion were relatively small, there was a great deal of variation in tumour size during radiotherapy.



**Fig A** Example of patient with continuous volume reduction. (a) Initial gross tumor volume. (b) First repeat scan, with initial contour in yellow, showing 41.6% volume reduction. (c) Second repeat scan, with initial contour in yellow, showing 70.8% volume reduction.



*Background:*

Several reports had quantified tumour volume changes during the course of radiotherapy but it is still unclear if target volume reductions are warranted in the scenario of GTV shrinkage.

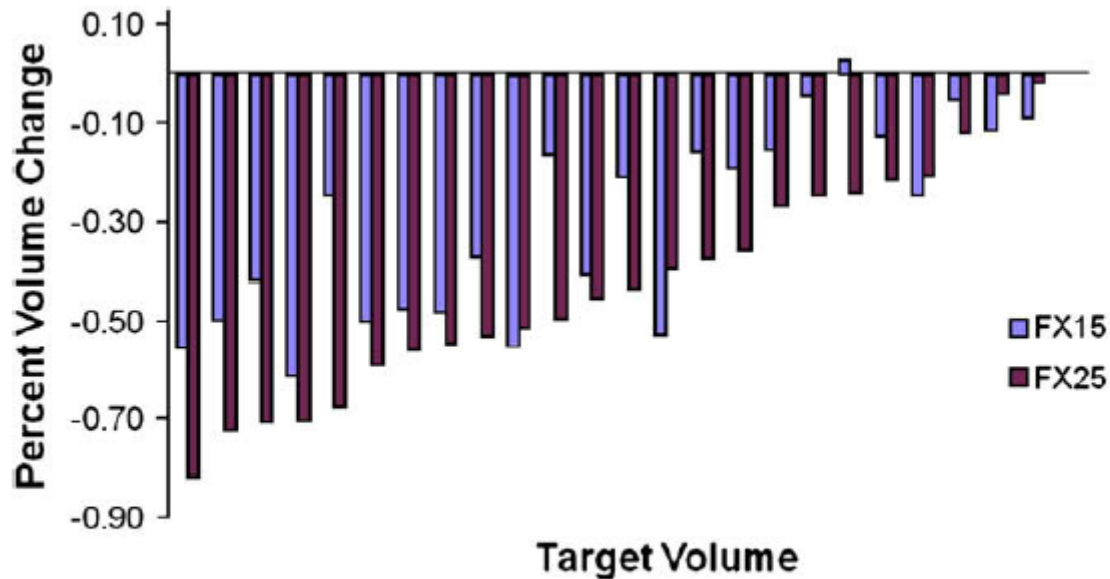


Fig. 4. Percentage of volume change from initial simulation to first repeat scan (fraction 15) and to second repeat scan (fraction 25).

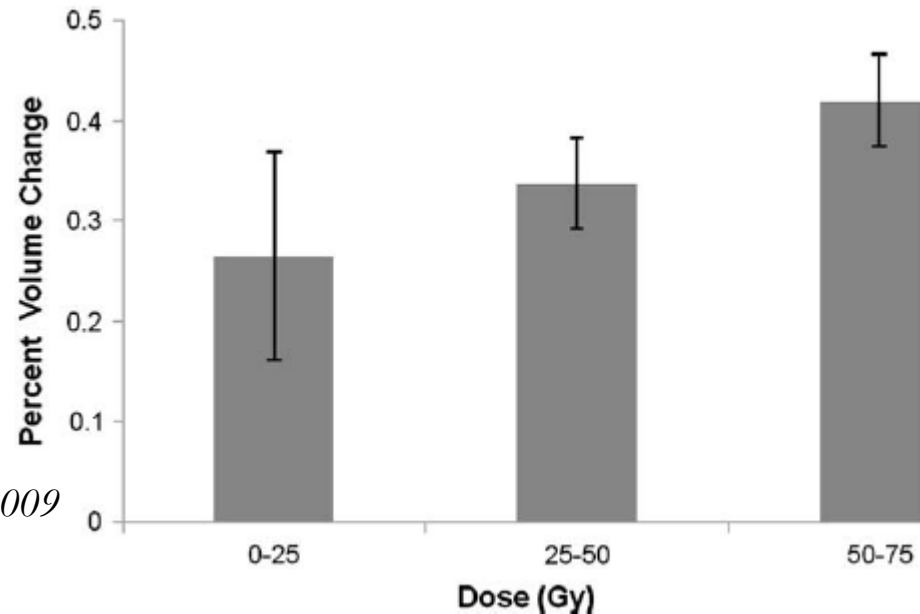


*Background:*

### *WHEN REDUCTION*

*OCCUR?:* The largest volume changes occur early in the treatment course (<30Gy) and subsequent volume changes are smaller in magnitude

*Fox J, Int. J. Rad. Oncol. Biol. Phys., 74:341–348, 2009*



*WHICH ARE THE TUMORS THAT REDUCE?:* Larger tumors had greater rates of regression (-1.67%/fraction) than smaller tumors (-1.24%/fraction) (*Lim, Kupelian*); The fractional volume reduction was not statistically different between the patients with GTV >100cc and those with GTV <100cc

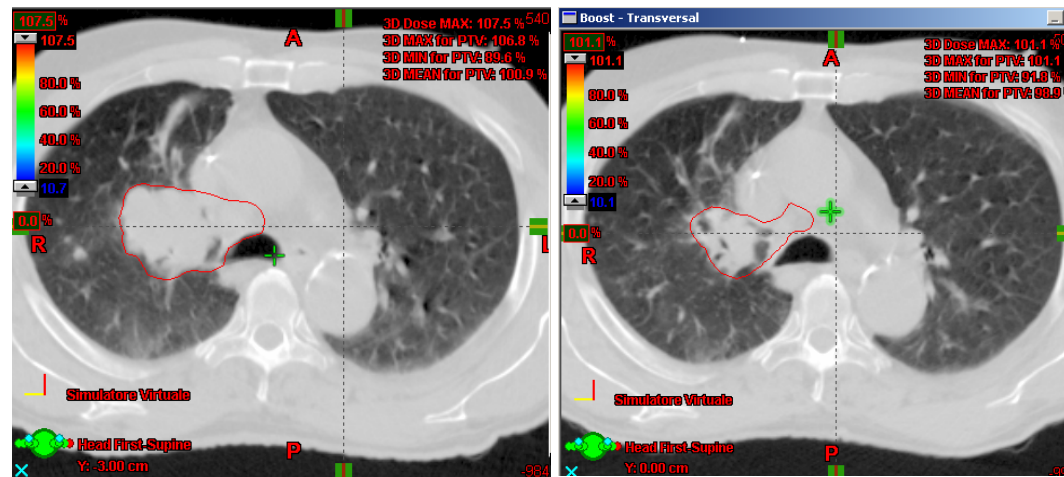
*Fox J, Int. J. Rad. Oncol. Biol. Phys., 74: 341–348, 2009*

*Kupelian P, Int. J. Radiation Oncology Biol. Phys., 63,1024–1028, 2005*



## *Purpose:*

The purpose of this trial is to analyze the *PATTERN OF FAILURE* in locally advanced NSCLC patients treated with concurrent chemoradiation with an adaptive approach.



### *Methods and Materials:*

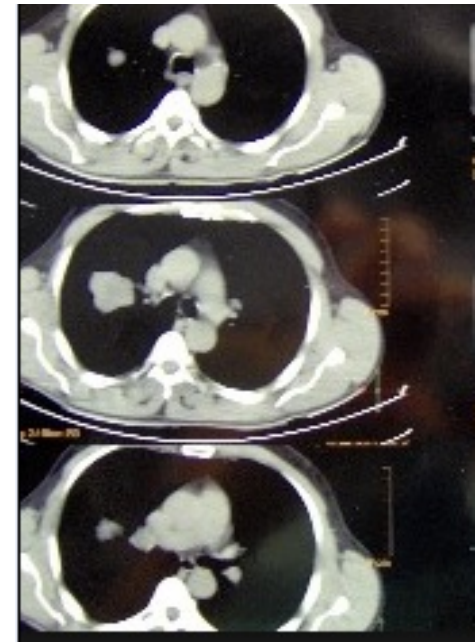
From 2009 to 2013, patients with locally advanced lung cancer were treated at our institution undergoing to weekly thorax CT.



In case of tumor reduction a CT with contrast was performed and a new simulation-based treatment planning was run up to the total prescribed dose.

*At the end of treatment, the first evaluation was:*

- after one month in order to consider **response to treatment**;
- during follow-up in order to consider **local relapse**.



**TABLE 1. Patient Characteristics**

	TOTAL
	38
Age (yr), median (range)	71 (38-92)
Sex, N (%)	30
Male	8
Female	
Stage, N (%)	
IIIA	21
IIIB	16
Relapse (mediastinal)	1
Histology, N (%)	
Squamous cell	22
Adenocarcinoma	10
NSCLC NOS	6

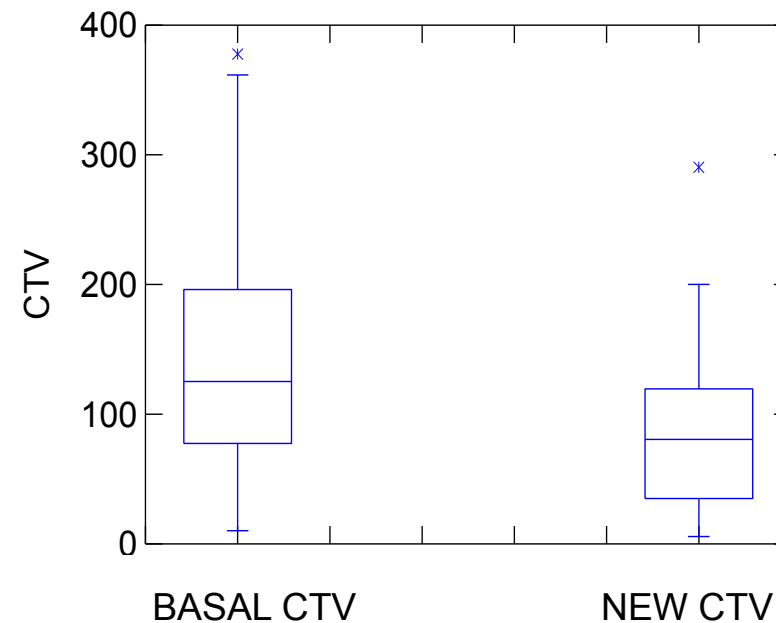
Median total dose was *62Gy with standard fractionation (1.8Gy/die)*. Concomitant chemotherapy schedules were gemcitabine-based (25 patients) or not gemcitabine-based (13 patients).



## Results: CTV and PTV

Mean *CLINICAL TARGET VOLUME* at the first simulation-CT (*basal-CTV*) and at re-planning study (*new-CTV*) were 159.99 cc and 92.5cc, respectively with a mean reduction of 67.4 cc.

Mean *PLANNING TARGET VOLUME* at the first simulation-CT (*basal-PTV*) and at re-planning study (*new-PTV*) were 269.7 cc and 172.4cc, respectively with a mean reduction of 97.3 cc.

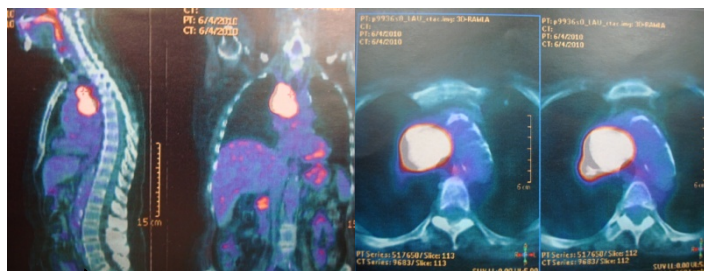




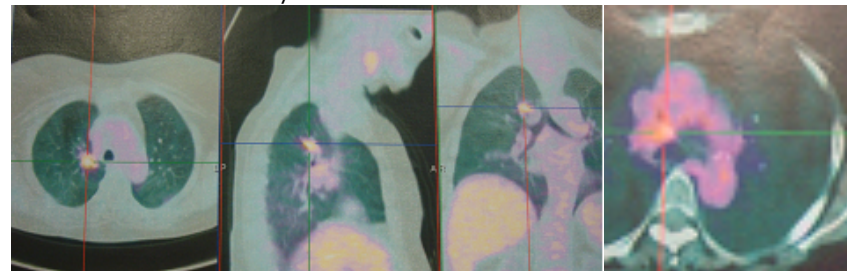
# Results: RESPONSE EVALUATION

- LOCAL FAILURE were **out field** in five cases;
- LOCAL FAILURE were **in field** in five cases:

PET/CT AT DIAGNOSIS



PET/CT AT RELAPSE



TREATMENT PLANNING

RE-PLANNING

LAURI, GIULIA (CC10017211), 0 - External Beam Planning - Eclipse

Plan Sum DEF - Transversal

Plan Sum DEF - Frontal

Plan Sum DEF - Sagittal

Group	Plan ID	Field ID	Technique	MachineEnergy	Weight	Scale	Gantry Rtn [deg]	Coll Rtn [deg]	Couch Rtn [deg]	Wedge	Field X [cm]	X1 [cm]	X2 [cm]	Field Y [cm]	Y1 [cm]	Y2 [cm]	X [cm]	Y [cm]	Z [cm]	SSD [cm]	MU	Ref. D [Gy]
PLAN DEF	Field 1	STATIC-I	2100CD_A-15X	1.00	VAR_IEC	16.0	0.0	0.0	0.0	W15L20	8.8	+4.3	+4.5	8.5	+3.8	+4.7	1.3	-7.8	-2.7	87.7	107	1.100
PLAN DEF	Field 2	STATIC-I	2100CD_A-15X	0.80	VAR_IEC	168.0	0.0	0.0	0.0	W15R20	10.2	+4.4	+5.8	8.5	+3.8	+4.7	1.3	-7.8	-2.7	88.7	84	0.843
PLAN DEF	Field 3	STATIC-I	2100CD_A-15X	0.60	VAR_IEC	257.0	0.0	0.0	0.0	W15IN20	7.9	+4.3	+3.8	8.5	+3.8	+4.7	1.3	-7.8	-2.7	83.7	67	0.746
NO PLAN DEF	Field 1	STATIC-I	2100CD_A-15X	1.00	VAR_IEC	51.0	346.0	0.0	0.0	W15IN20	7.8	+3.8	+4.0	8.9	+4.2	+4.7	1.3	-7.8	-2.7	82.8	97	1.106
NO PLAN DEF	Field 2	STATIC-I	2100CD_A-15X	0.50	VAR_IEC	223.5	346.0	340.0	0.0	W30R20	8.0	+4.0	+4.0	9.1	+4.2	+4.9	1.3	-7.8	-2.7	86.0	53	0.469
NO PLAN DEF	Field 4	STATIC-I	2100CD_A-15X	0.70	VAR_IEC	89.5	0.0	346.5	0.0	W15L20	8.5	+3.7	+4.8	9.0	+4.1	+4.9	1.3	-7.8	-2.7	80.3	67	0.821

External Beam Planning - Eclipse

REPLANNING - Transversal

REPLANNING - Frontal

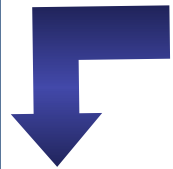
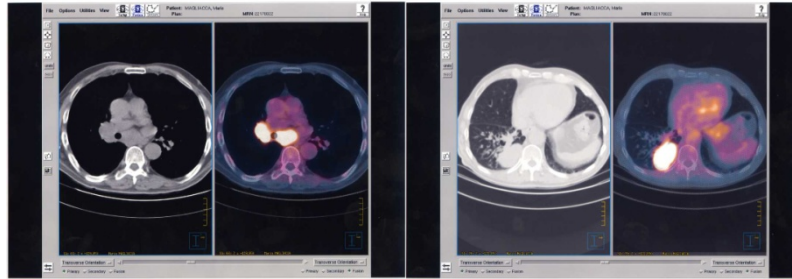
REPLANNING - Sagittal

Technique	MachineEnergy	Weight	Scale	Gantry Rtn [deg]	Coll Rtn [deg]	Couch Rtn [deg]	Wedge	Field X [cm]	X1 [cm]	X2 [cm]	Field Y [cm]	Y1 [cm]	Y2 [cm]	X [cm]	Y [cm]	Z [cm]	SSD [cm]	MU	Ref. D [Gy]
STATIC-I	2100CD_A-15X	1.00	VAR_IEC	51.0	346.0	21.5	W30R20	7.2	+3.4	+3.8	8.6	+4.1	+4.5	1.0	0.6	-3.8	82.3	86	0.817
STATIC-I	2100CD_A-15X	1.00	VAR_IEC	233.5	346.0	340.0	W15L20	7.4	+3.8	+3.5	8.7	+4.8	+3.8	1.0	0.6	-3.8	86.1	66	0.686
STATIC-I	2100CD_A-15X	1.00	VAR_IEC	89.5	0.0	346.5	W45IN20	8.2	+3.7	+4.4	8.4	+4.7	+3.7	1.0	0.6	-3.8	80.2	112	0.862
STATIC-I	2100CD_A-15X	1.00	VAR_IEC	309.5	341.5	28.0	W45R20	9.5	+5.8	+3.7	8.9	+4.7	+4.2	1.0	0.6	-3.8	82.3	105	0.771

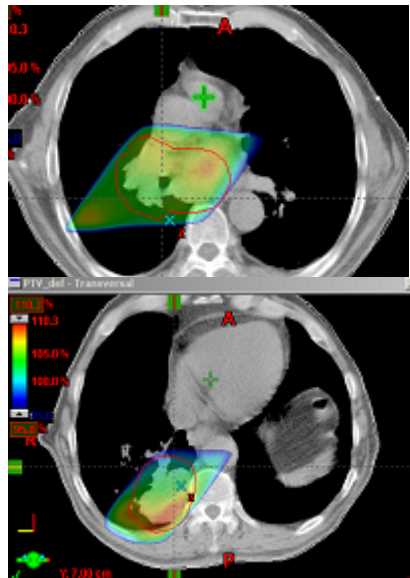
# Results: RESPONSE EVALUATION

B- One patients had a MARGINAL RELAPSE which could be related to the shrinking method:

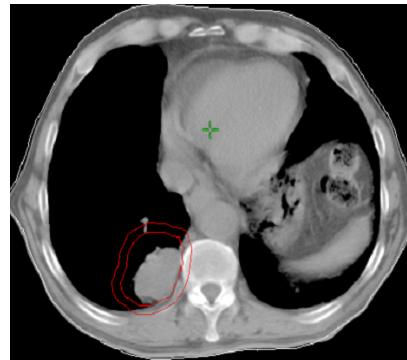
## PET/CT AT DIAGNOSIS



## TREATMENT PLANNING



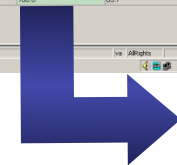
## VOLUME REDUCTION



## RE-PLANNING

Screenshot of the Pinnacle3 treatment planning software interface. The interface shows the target volume (red outline) and OARs (green and blue outlines) in axial, coronal, and sagittal views. The software also displays a list of OARs and a table of dose prescriptions.

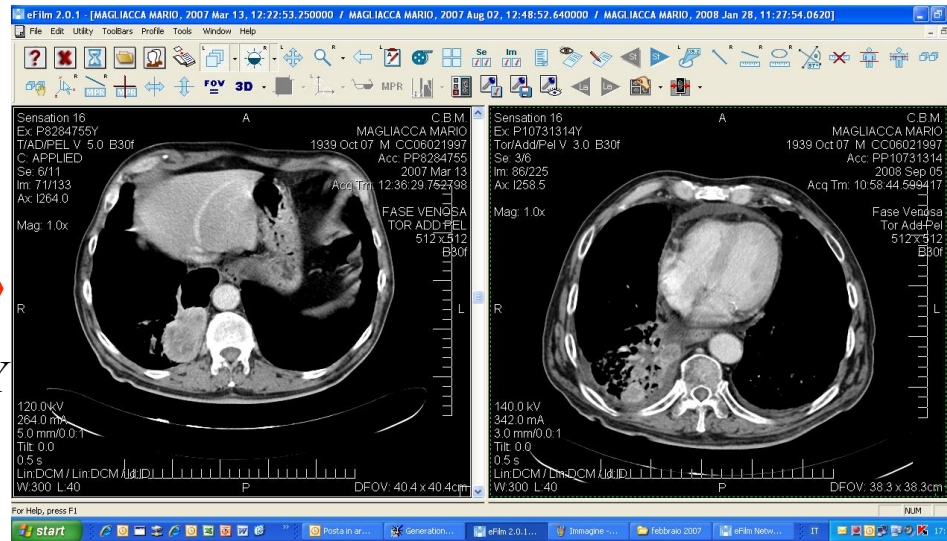
Fields	Dose Prescription	Calculation Options
PlanID	Fractionation	Number of Fractions
Field 1	1.800	12
Field 2	1.800	21
Field 3	1.800	21



## Results: RESPONSE EVALUATION

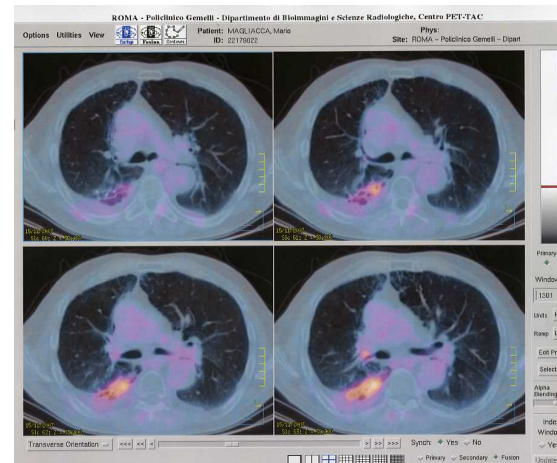
B- The marginal relapse in this patient occurred twelve months after the end of the treatment, but also after a bone metastases, occurred after ten months from the end of RT.

PRE-  
RADIOTHERAPY



MARGINAL  
RELAPSE

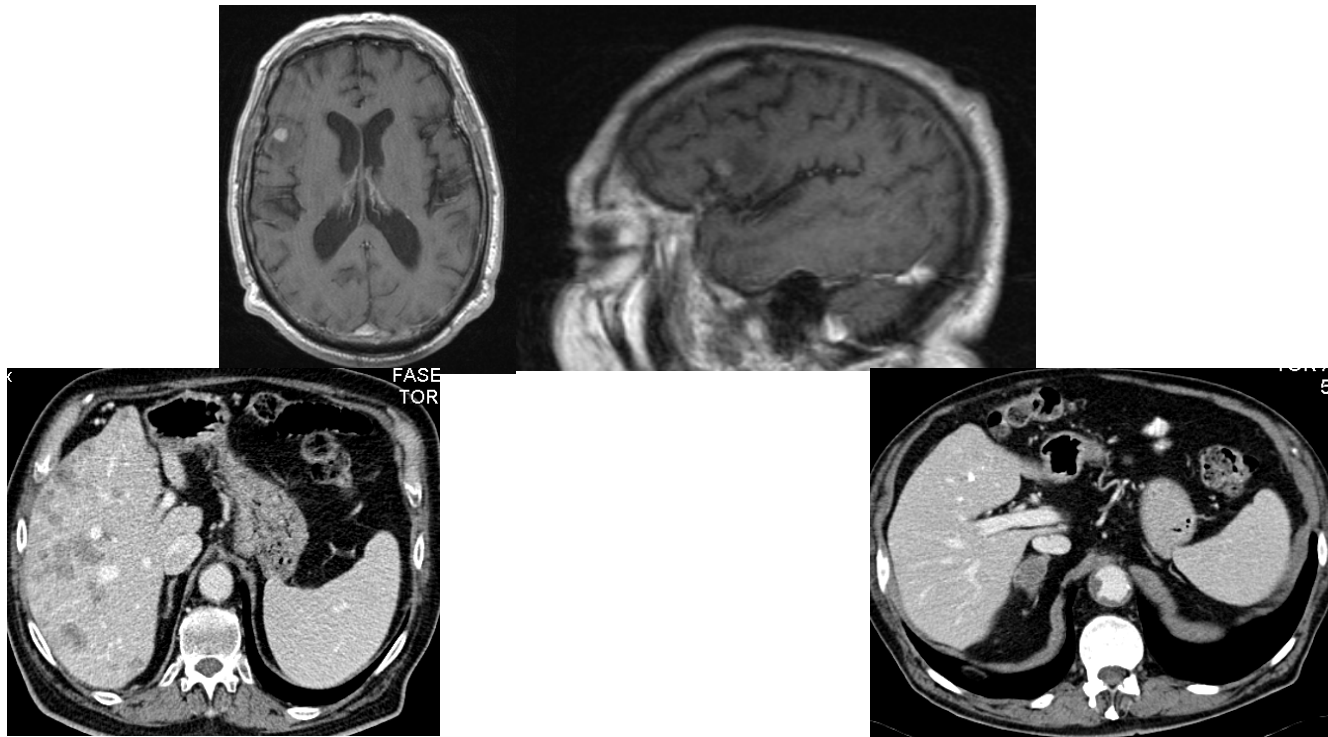
PET-CT AT RELAPSE





*Results:*

Distant metastasis were reported in 11/25 patients. The most frequent site was brain (45%) followed by liver (18%), adrenal glands (18%) and bone (18.5%). Mean time to distant metastasis was 7.5 months.



## *Conclusions:*

Our experience is one of the first evaluating the **clinical outcome** of an adaptive strategy during concurrent chemoradiation in LA lung cancer.

The number of enrolled patients is limited, but this approach seems feasible and the rate of marginal local recurrence (N°: 1; 3%) is low.

