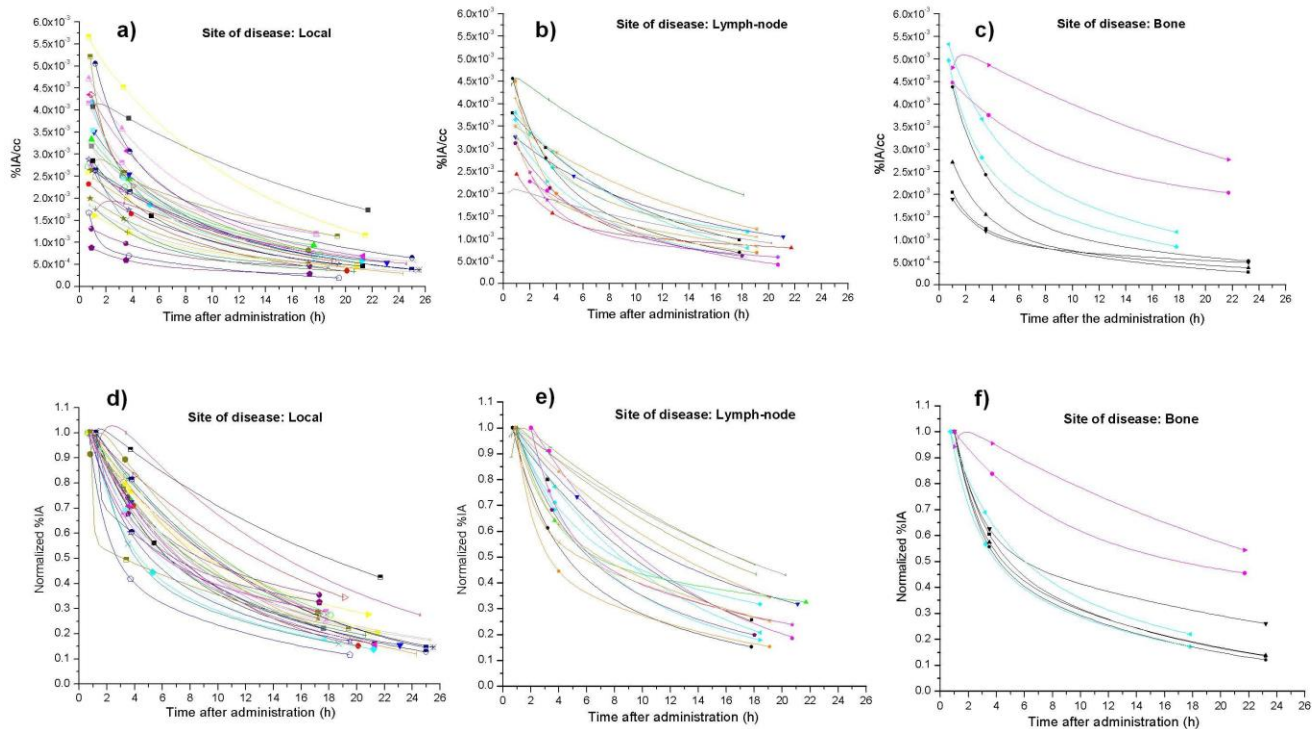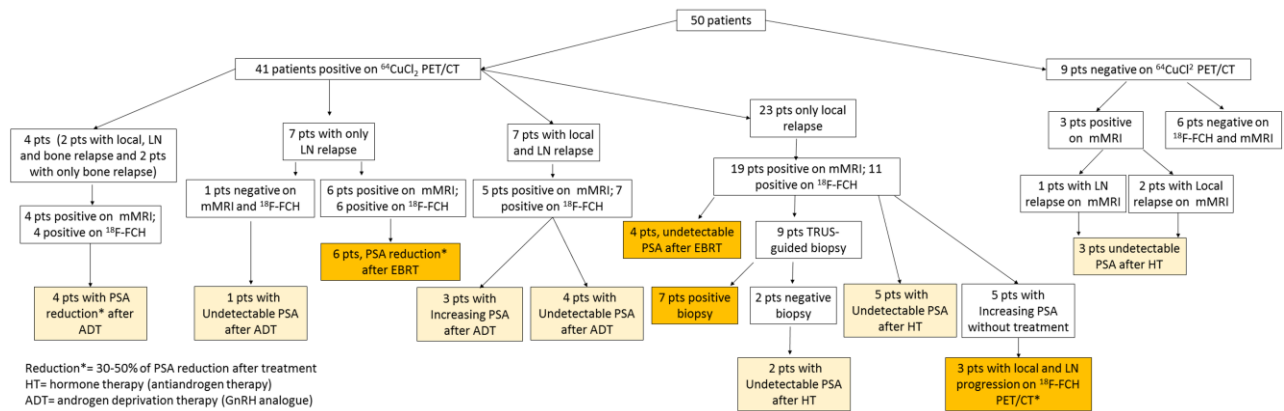Supplemental Fig. 1: Typical time-activity curves of $^{64}CuCl_2$ (as a percentage of injected activity) for source organs.
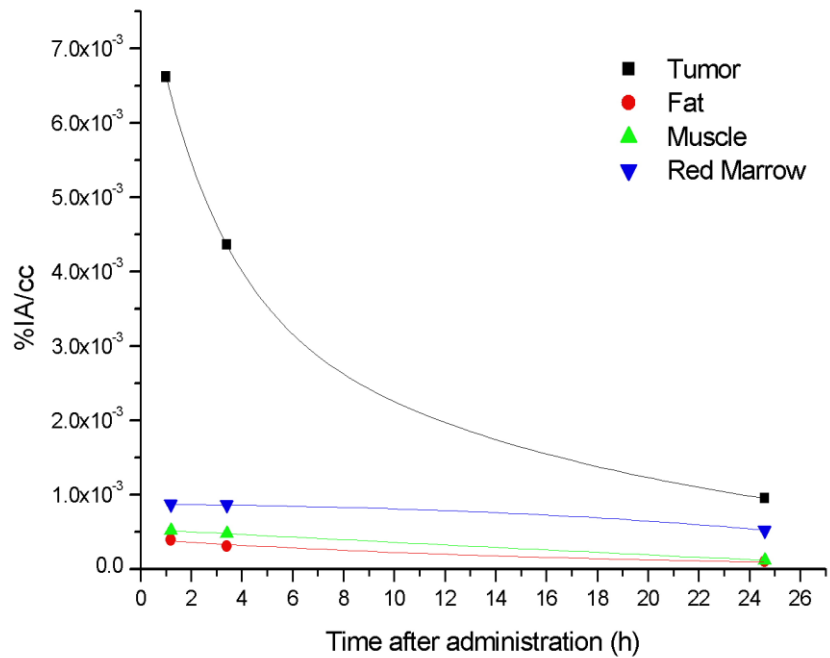
Supplemental Fig. 2: Time-activity curves of $^{64}CuCl_2$ (as a percentage of injected activity/cc) for three different site of disease: local (A), lymph-node (B) and bone (C) relapse. Figures D), E) and F) show the normalized time-activity curves.

Supplemental Fig. 3: concordance between the different diagnostic modalities and detailed description of the multidisciplinary standard of reference for each patients. In particular, a robust standard of reference (orange "*boxes*") was available in 11 of the 23 patients with evidence of local relapse on^{64}CuCl$_2$-PET/CT.

Supplemental Fig 4: typical time-activity curves of $^{64}CuCl_2$ (as a percentage of injected activity/cc) of fat, marrow and muscles compared with that of one site of disease.

Supplemental table 1. Patients based analysis by Radical Prostatectomy (yes/no). DR (%) & [95%CI] were calculated for each single diagnostic modality in each site of disease.

Site of disease	RP	$^{64}CuCl_2$ PET/CT	^{18}F-Choline PET/CT	p*	mpMRI	p*
All positive patients	yes	24/33 (73%) [54 ÷ 87]	13/33 (39%) [23 ÷ 58]	0.001	22/33 (67%) [48 ÷ 82]	0.7
	no	17/17 (100%) [80 ÷ 100]†	15/17 (88%) [64 ÷ 99]	0.5	15/17 (88%) [64 ÷ 99]	0.5
	p-value‡	0.02	0.001		0.2	
Local	yes	16/33 (48%) [31 ÷ 66]	3/33 (9%) [2 ÷ 24]	<0.001	13/33 (39%) [23 ÷ 58]	0.5
	no	16/17 (94%) [71 ÷ 100]	12/17 (71%) [44 ÷ 90]	0.1	12/17 (71%) [44 ÷ 90]	0.1
	p-value‡	0.002	<0.001		0.07	
Lymph-node	yes	11/33 (33%) [18 ÷ 52]	10/33 (30%) [16 ÷ 49]	1.0	10/33 (30%) [16 ÷ 49]	1.0
	no	5/17 (29%) [10 ÷ 56]	5/17 (29%) [10 ÷ 56]	1.0	4/17 (24%) [7 ÷ 50]	1.0
	p-value‡	1.0	1.0		0.7	
Bone	yes	4/33 (12%) [3 ÷ 28]	4/33 (12%) [3 ÷ 28]	1.0	5/33 (15%) [5 ÷ 32]	1.0
	no	0/17 (0%) [0 ÷ 20]†	0/17 (0%) [0 ÷ 20]†	1.0	0/17 (0%) [0 ÷ 20]†	1.0
	p-value‡	0.3	0.3		0.2	

Abbr.: 95%CI: 95% exact confidence interval; RP=Radical Prostatectomy. *McNemar test vs. $^{64}CuCl_2$ PET/CT; † One-sided, 97.5% confidence interval; ‡ Fisher-exact test for difference in detection rates between RP yes and RP no.