

Analyse radiomique corps-entier d'images TEP/TDM en oncologie pulmonaire

Projet **NEMO-PET** 

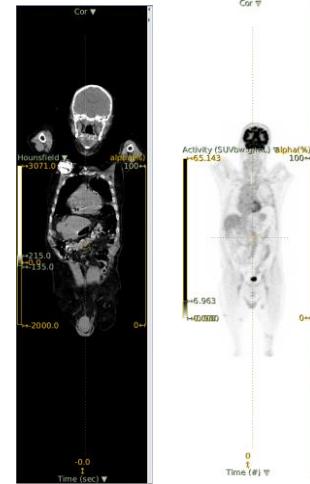
Ghada Lemoudda

Projet NEMO-PET

New prognostic metastatic phenotypes based on the analysis of whole-body PET/CT images using Artificial Intelligence



1. Analyse avancée des images TEP/TDM du corps-entier



2. Utilisation des données cliniques
- Age , sexe, statut tabagique...



- Identification des facteurs pronostiques
- Identification de différents groupes de patients métastatiques présentant un pronostic différent
- Déterminer si les mesures effectuées au niveau des organes sains contribuent à améliorer significativement la stratification des patients
- But : optimiser la prise en charge des patients.



INTRODUCTION

Contexte scientifique

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Brain glucose metabolism on [18F]-FDG PET/CT: a dynamic biomarker predicting depression and anxiety in cancer patients

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PLOS ONE

RESEARCH ARTICLE

Changes of Brain Glucose Metabolism in the Pretreatment Patients with Non-Small Cell Lung Cancer: A Retrospective PET/CT Study

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PLOS ONE

RESEARCH ARTICLE

Amygdalar activity measured using FDG-PET/CT at head and neck cancer staging independently predicts survival

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Adam Rokicki¹, Lili Zhang¹, Connor P. Mulligan¹, Michael T. Osborne^{1,4}, Azmaeen Zarif^{1,2},
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Katrina A. Armstrong¹¹, Daniel Addison^{1,12}, Tomas G. Neilan^{1,3}

Original Article

Negative Affect and Stress-Related Brain Metabolism in Patients With Metastatic Breast Cancer

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Silvia D. Almeida, MSc  ¹; Pedro Almeida, PhD  ¹; Aaron S. Heller, PhD  ⁵; Berta Sousa, MD  ²;
and Durval C. Costa, PhD  ⁴

INTRODUCTION

Contexte scientifique

- 240 patients atteints de cancer
 - Cancer mammaire : 13 %
 - Cancer pulmonaire : 41 %
 - Cancer digestif : 18 %
 - Cancer de l'estomac : 13 %
 - Cancer ORL : 16 %
 - 39 témoins
- **Les critères d'inclusion :** Les participants n'étaient pas au courant de la maladie, aucune maladie organique antérieure.
- **Les critères d'exclusion :** Métastase méningée ou cérébrale confirmée ou suspectée.

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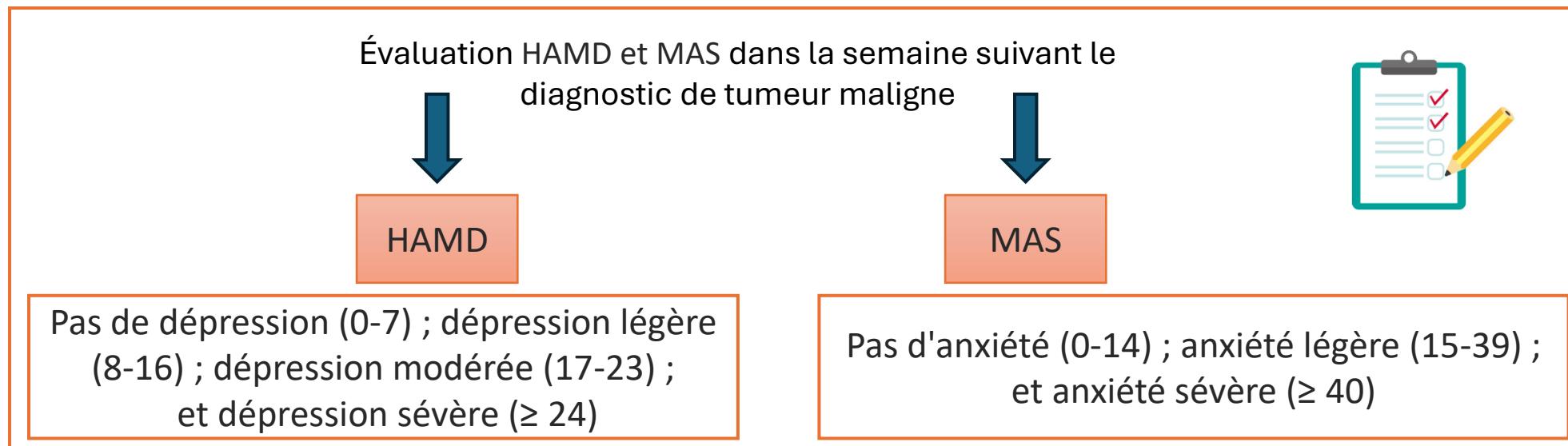


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Brain glucose metabolism on [18F]-FDG PET/CT: a dynamic biomarker predicting depression and anxiety in cancer patients

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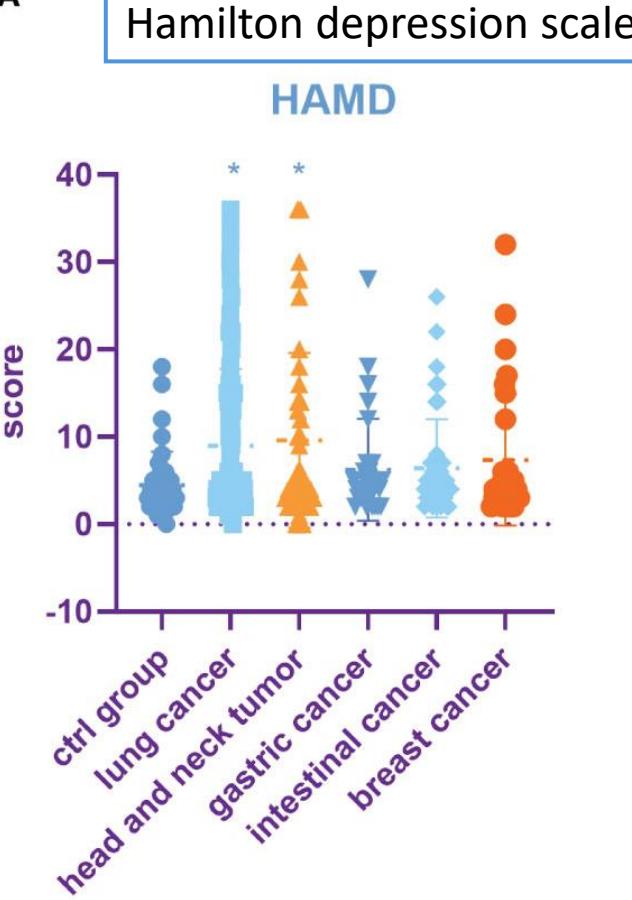
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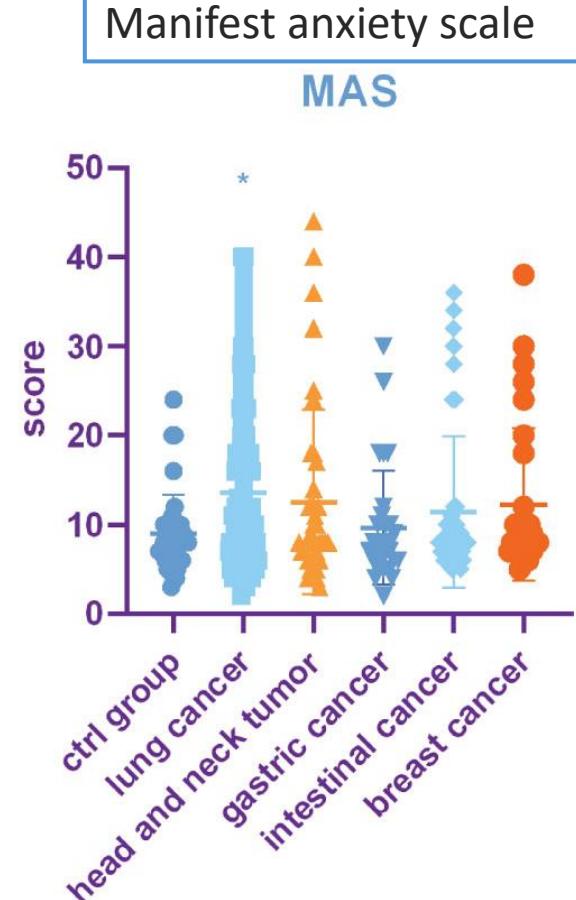
INTRODUCTION

Contexte scientifique

A



B



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Figure 1 : Taux d'incidence de la dépression et de l'anxiété pour les différents groupes de patients. (A) Score HAMD ou (B) Score MAS suivant le type de cancer.

INTRODUCTION

Contexte scientifique

Comparaison de l'absorption du glucose dans le cerveau

	Ctrl group	Lung cancer	p	Head and neck tumor	p	Gastric cancer	p	Intestinal cancer	p	Breast cancer	p
L-frontal	7.196 ± 1.007	6.284 ± 1.220	0.0002	6.335 ± 1.021	0.0052	6.661 ± 0.895	0.1987	6.996 ± 1.114	0.8909	7.079 ± 1.431	0.9919
R-frontal	7.226 ± 0.873	6.414 ± 1.231	0.0006	6.567 ± 1.052	0.0378	6.878 ± 0.764	0.5486	6.975 ± 1.080	0.7429	7.136 ± 1.263	0.9966
L-temporal	7.425 ± 0.951	6.411 ± 1.257	<0.0001	6.344 ± 1.359	0.0007	7.251 ± 1.006	0.9652	7.467 ± 1.252	0.9997	7.509 ± 1.414	0.9984
R-temporal	7.605 ± 0.888	6.704 ± 1.258	0.0003	6.657 ± 1.175	0.0020	7.429 ± 1.054	0.9550	7.507 ± 1.155	>0.9947	7.637 ± 1.247	0.9999
L-caudate	7.883 ± 0.736	7.341 ± 1.150	0.0215	7.391 ± 1.041	0.1267	7.807 ± 0.898	0.9980	7.859 ± 0.995	0.9999	7.718 ± 0.922	0.9399
R-caudate	7.963 ± 0.702	7.489 ± 1.055	0.0446	7.532 ± 1.048	0.1926	7.834 ± 0.864	0.9744	7.799 ± 1.036	0.9503	7.775 ± 0.926	0.8888
L-hippocampus	7.693 ± 0.847	6.507 ± 0.882	<0.0001	6.819 ± 1.163	0.0001	7.530 ± 0.717	0.9113	7.655 ± 0.774	0.9997	8.079 ± 0.999	0.2688
R-hippocampus	7.719 ± 0.821	6.601 ± 0.901	<0.0001	6.810 ± 1.108	<0.0001	7.468 ± 0.692	0.6504	7.650 ± 0.767	0.9962	8.104 ± 0.952	0.2574
L-cingulum	8.355 ± 0.627	7.920 ± 0.713	0.0126	7.861 ± 0.911	0.0212	8.248 ± 0.591	0.9674	8.333 ± 0.818	0.9998	8.189 ± 0.937	0.8343
L-occipital	8.097 ± 0.579	8.666 ± 0.823	0.0002	8.304 ± 0.740	0.5737	8.382 ± 0.459	0.3288	8.672 ± 0.589	0.0015	8.660 ± 0.799	0.0059
R-occipital	8.115 ± 0.496	8.609 ± 0.874	0.0026	8.267 ± 0.785	0.8378	8.318 ± 0.459	0.6858	8.726 ± 0.627	0.0013	8.636 ± 0.901	0.0194

Tableau : Valeurs SUVmean de différentes régions du cerveau chez des patients atteints de différents types de cancer.

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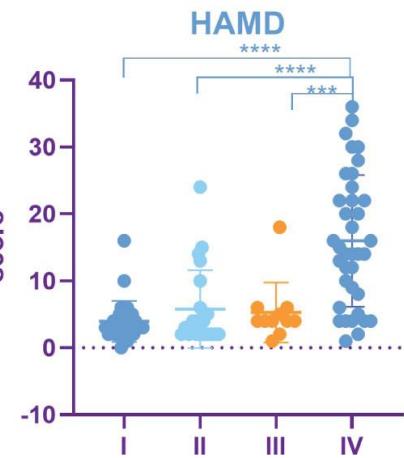
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INTRODUCTION

Contexte scientifique

Taux d'incidence de la dépression et de l'anxiété et SUV de différentes régions cérébrales chez les patients atteints d'un cancer du poumon présentant différents stades TNM

A Hamilton depression scale



B Manifest anxiety scale

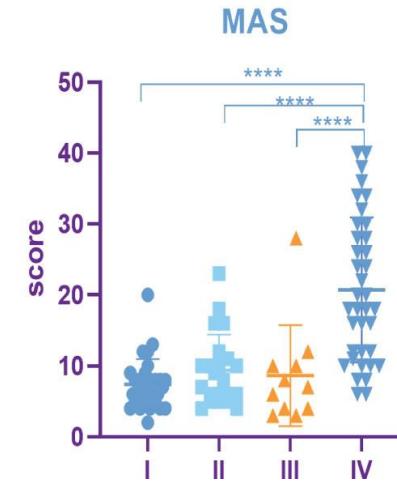


Figure: Taux d'incidence de la dépression et de l'anxiété chez les patients atteints de cancer du poumon au cours de différentes périodes TNM.
(A) Score HAMD parmi différentes périodes TNM du cancer du poumon. (B) Score MAS parmi différentes périodes TNM du cancer du poumon.

	I	II	P	III	P	IV	P
L-frontal	6.857 ± 0.733	6.735 ± 0.781	0.9563	6.875 ± 1.130	>0.9999	5.390 ± 1.268	<0.0001
R-frontal	7.035 ± 0.796	6.852 ± 0.811	0.8743	6.927 ± 1.201	0.9840	5.513 ± 1.226	<0.0001
L-temporal	6.962 ± 0.861	6.801 ± 1.127	0.9269	6.804 ± 1.054	0.9623	5.631 ± 1.291	<0.0001
R-temporal	7.281 ± 0.760	7.021 ± 1.078	0.7673	7.095 ± 0.955	0.9427	5.948 ± 1.402	<0.0001
L-caudate	7.740 ± 0.990	7.667 ± 1.074	0.9913	7.490 ± 1.003	0.8624	6.790 ± 1.173	0.0018
R-caudate	7.842 ± 0.845	7.851 ± 0.997	>0.9999	7.545 ± 0.773	0.7473	6.981 ± 1.133	0.0020
L-hippocampus	6.853 ± 0.664	6.655 ± 0.763	0.7308	6.968 ± 0.721	0.9607	6.010 ± 0.928	0.0002
R- hippocampus	6.989 ± 0.677	6.752 ± 0.819	0.6308	6.995 ± 0.675	0.9990	6.103 ± 0.952	0.0001
L-cingulum	8.103 ± 0.646	8.188 ± 0.518	0.9499	8.011 ± 0.536	0.9658	7.590 ± 0.780	0.0080

Tableau : Valeurs SUV de différentes régions du cerveau chez des patients atteints de différentes tumeurs.

INTRODUCTION

Contexte scientifique

Analyse de corrélation entre le score HAMD, le score MAS et les SUV chez les patients atteints d'un cancer du poumon

Hamilton depression scale

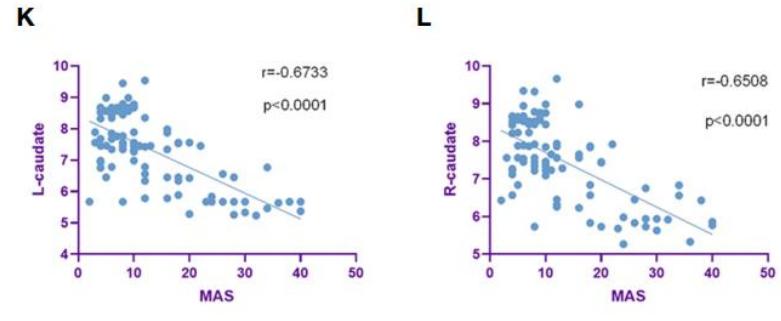
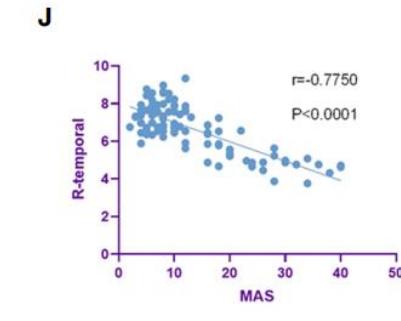
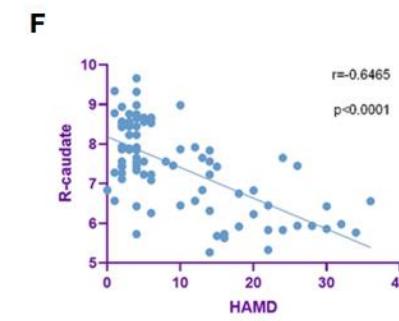
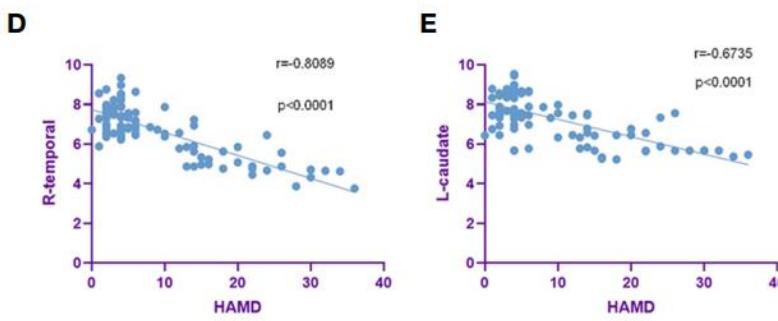
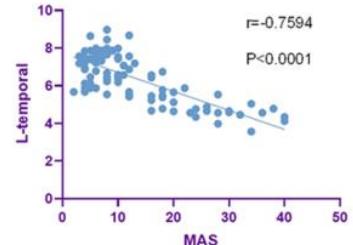
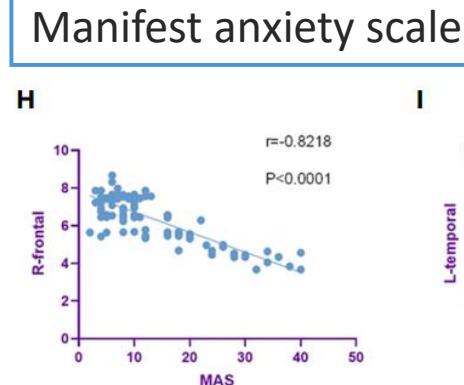
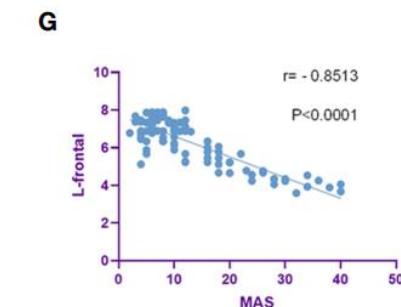
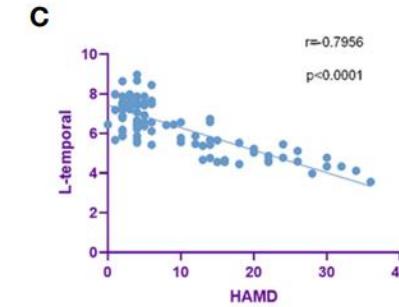
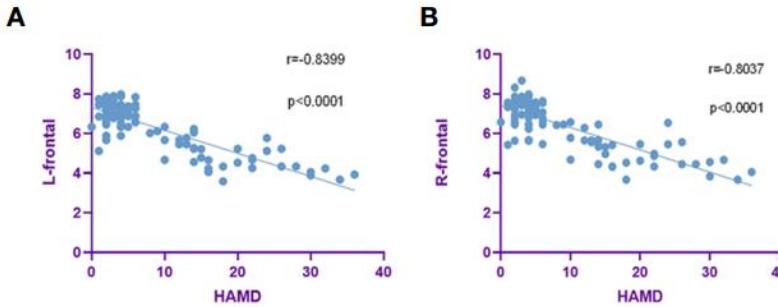


Figure : Les SUVmean étaient négativement corrélés aux scores HAMD et MAS dans la région cérébrale. (A-F) . Les SUV dans les régions frontale bilatérale, temporelle bilatérale et caudé bilatéral étaient négativement corrélés aux scores HAMD. (G-L) . Les SUV dans les régions frontale bilatérale, temporelle bilatérale et caudé bilatéral étaient négativement corrélés aux scores MAS.



- ✓ Évaluer le potentiel du SULmean cérébral comme biomarqueur pour affiner le pronostic et la prise en charge des patients CPNPC métastatiques.
- ✓ Etudier si l'ajout des informations émanant des structures cérébrales considérées individuellement améliore la stratification
- ✓ Déterminer le modèle le plus performant pour la prédition de la survie globale chez des patients atteints d'un CPNPC au stade IV

Matériel & Méthode

Bases de données rétrospectives

459 patients atteints d'un Cancer Pulmonaire Non à Petites Cellules (CPNPC)
à un stade métastatique, traités à l'Institut Curie entre 2018 et 2020

NEMO_PET(1) : 306 patients

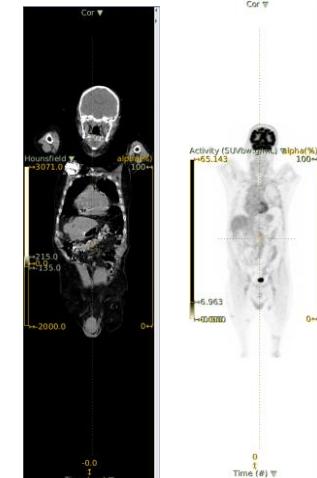
NEMO_PET(2) : 153 patients

Données cliniques

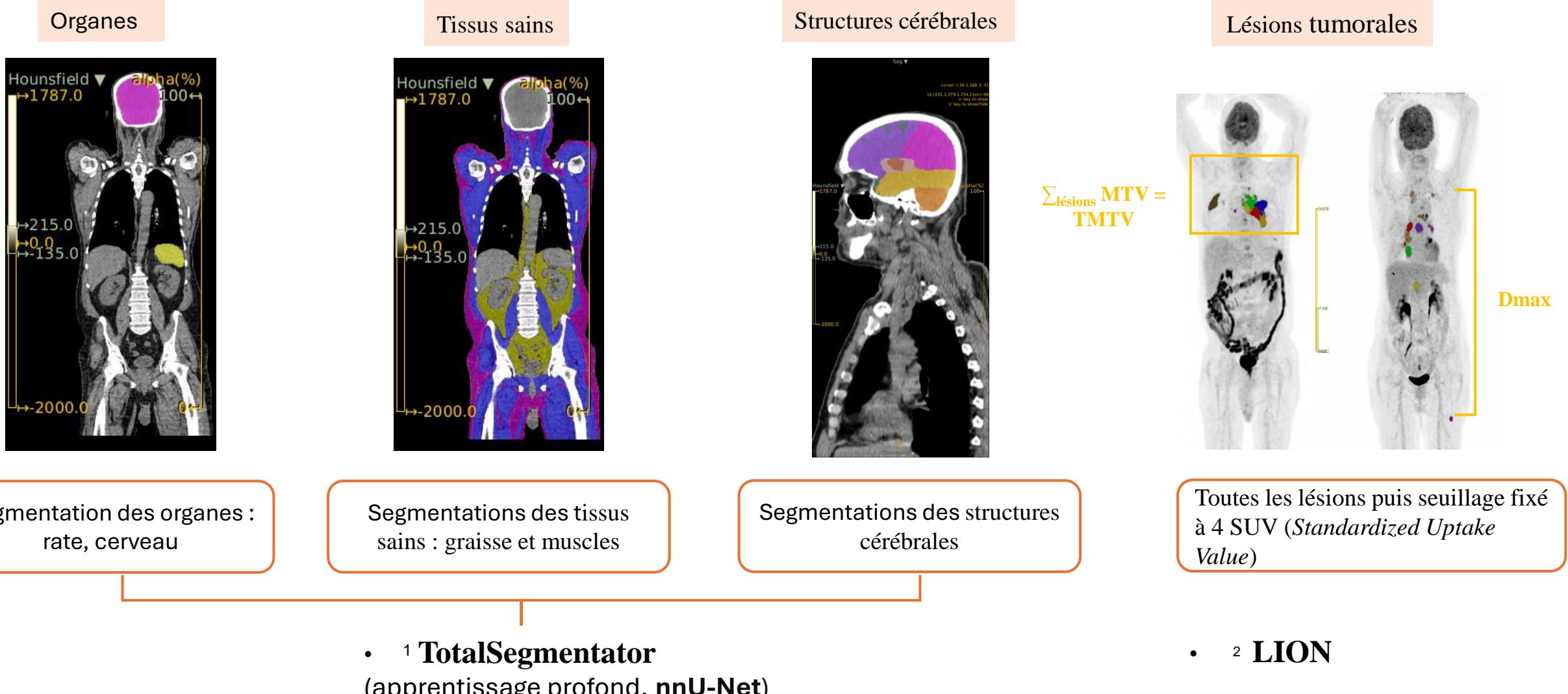
Données d'imagerie

- Données cliniques (âge, statut tabagique, Ps, sexe, IMC)

- TEP/TDM au 18F-FDG avant le traitement



Segmentations



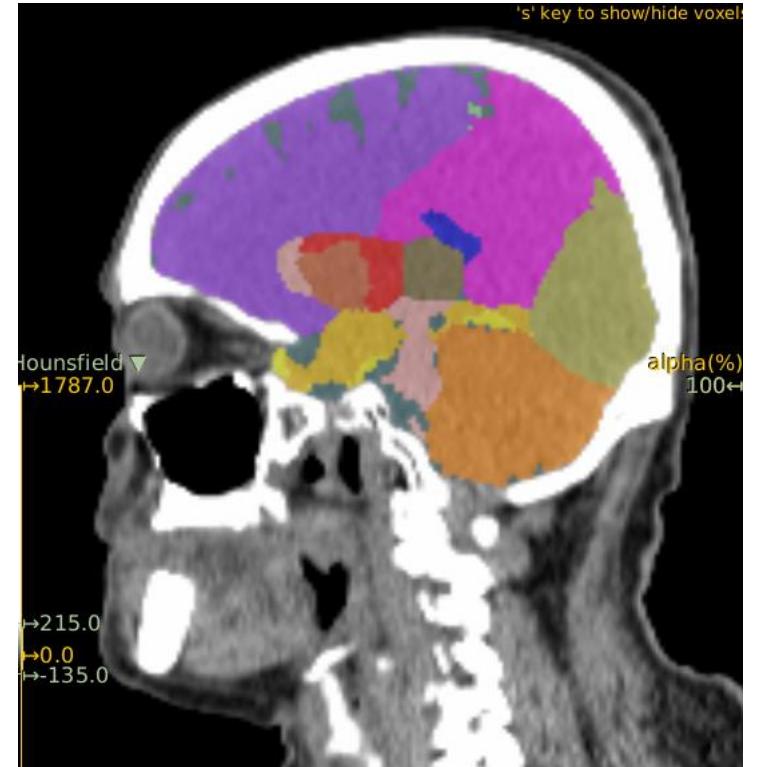
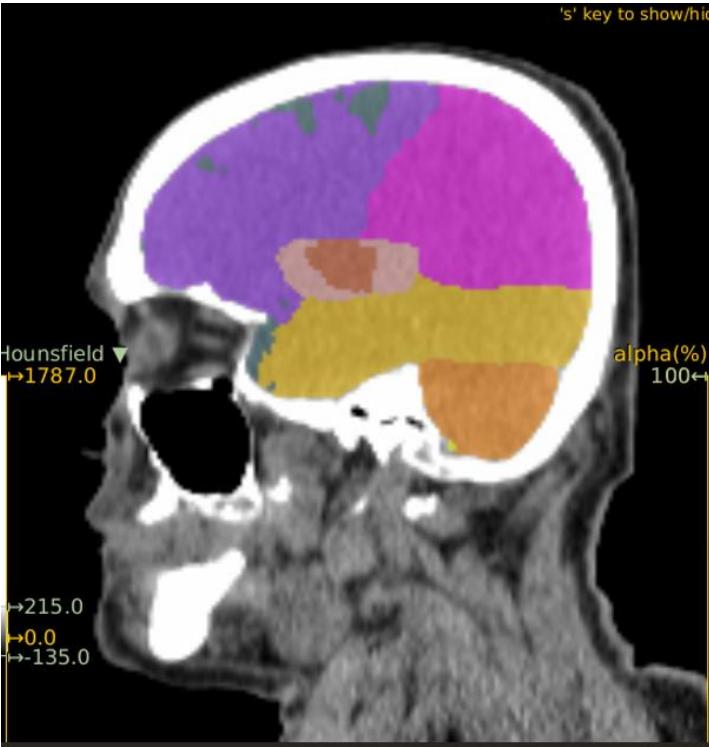
¹ Wasserthal et al. « TotalSegmentator: Robust Segmentation of 104 Anatomic Structures in CT Images » <https://github.com/wasserth/TotalSegmentator>

² <https://github.com/LalithShiyam/LION>.

Segmentations

Les structures cérébrales

- Tronc cérébral
- Noyau caudé
- Sillon central
- Cervelet
- Lobe frontal
- Lobe occipital
- Lobe pariétal
- Lobe temporal
- Cortex insulaire
- Capsule interne
- Noyau lenticulaire
- Septum pellucidum
- Espace sous-arachnoïdien
- Thalamus
- Sinus veineux
- Ventricule



- ¹**TotalSegmentator**
(apprentissage profond, **nnU-Net**)

Extraction des index radiomiques



Caractéristiques radiomiques issues des lésions tumorales = « index radiomiques »

- **TMTV** : Volume métabolique total de la tumeur = somme des volumes de toutes les lésions → charge tumorale
- **Dmax** : Distance entre les deux lésions les plus distantes → dispersion de la maladie

Caractéristiques radiomiques issues des organes/tissus sains = « index organomiques »

- **SULmean (Standardized Uptake Value normalized by Lean body mass)** : valeur moyenne de fixation du FDG en TEP , normalisée par la masse maigre
- **HUmean (Unité Hounsfield)** : densité moyenne des organes/tissus mesurée sur les images TDM
- **Volume des Régions d'Intérêt (ROI)** : volume anatomique des ROI mesuré sur les images TDM

- ✓ Binarisation des variables quantitatives selon la médiane
- ✓ Analyse univariée pour étudier l'impact de chaque variable sur la survie (HR)
- ✓ Huit modèles de Cox multivariés ont été développés, en utilisant « la régression pas à pas, minimisant AIC » pour la sélection de variables, avec **3 catégories de risque** réparties selon les quartiles (25 %, 50 %, 25 %):
 - **M1**: toutes les variables radiomiques qui caractérisent la lésion tumorale (TMTV, Dmax)
 - **M2**: toutes les variables organomiques mesurées au niveau des organes/tissus sains
 - **M2.bis** : M2 + SUL_brain
 - **M3**: cliniques
 - **M4** : M1+ M2.bis
 - **M5** : M1+ M2.bis +M3 « modèle complet »
 - **M6** : M1+ M2 +M3 + toutes les structures cérébrales
 - **M7** : M1+ M2 +M3 +quelques structures cérébrales
 - **M8** : M1 + SUL_brain

Résultats : Les caractéristiques cliniques et radiomiques des patients

CARACTÉRISTIQUES	COHORTE NEMO-PET(1)	COHORTE NEMO-PET(2)	
	n= 306 patients CPNPC	n = 153 patients CPNPC	p-value
Age (ans), moy ± sd	64.8 ± 10.3	66.82 ± 10.10	0.04
Sexe			
Homme, n	167	91	0.3
Femme, n	139	62	
Statut tabagique			-
Fumeur, n	262	-	
Non-fumeur, n	44	-	
IMC (Kg /m ²), moy ± sd	23.6 ± 4.15	24.23 ± 3.95	0.06
Statut vital			0.4
Vivant, n	64	37	
Décédé, n	242	116	
TMTV (ml)	189.78 ± 302.59	228.49 ± 342.33	0.4
Dmax (cm)	40.76 ± 21.03	44.61 ± 21.57	0.09
SUL_brain	4.14 ± 1.09	4.08 ± 1.04	0.6

Résultats

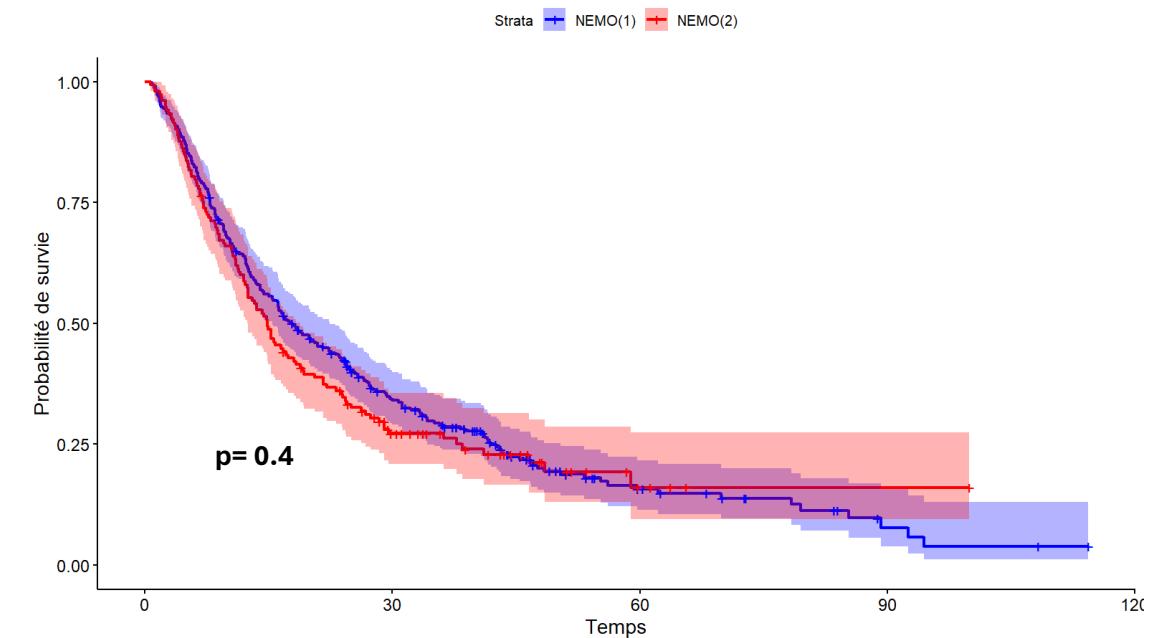
NEMO_PET(1)

Tableau de Survie

n = 306

À 1 an	À 2 ans	À 5 ans	Médiane de survie (mois)
64 %	42.5 %	15.7 %	18

Courbe de Kaplan-Meier



NEMO_PET(2)

Tableau de Survie

n = 153

À 1 an	À 2 ans	À 5 ans	Médiane de survie (mois)
60 %	34.7 %	16.1 %	14.9

Résultats

Résultat : analyse univariée

- Valeurs > seuil optimal mauvais pronostic
- Valeurs < seuil optimal mauvais pronostic

Variables	Cutoff (médiane)	HR	p-value(logrank)
Age	66	0.857[0.665, 1.105]	0.2
IMC	23.23462	1.206 [0.935, 1.554]	0.1
Sexe	-	1.164[0.903, 1.501]	0.2
Statut tabagique	-	0.606 [0.415, 0.884]	0.009
TMTV	114.536	0.635 [0.493, 0.818]	4e-04
Dmax	40.820	0.652[0.506, 0.841]	9e-04
SULmean spleen	1.233	0.946[0.734, 1.22]	0.7
SULmean brain	4.154	1.597[1.239, 2.06]	3e-04
HU mean muscles	32.710	1.123[0.872, 1.446]	0.4
Volume muscles	15512.93	0.893[0.694, 1.15]	0.4
HU mean subcutaneousFat	-82.120	0.731[0.567, 0.9418]	0.01
Volume subcutaneousFat	14410.07	1.226[0.9523, 1.578]	0.1

Résultats

SULmean BRAIN

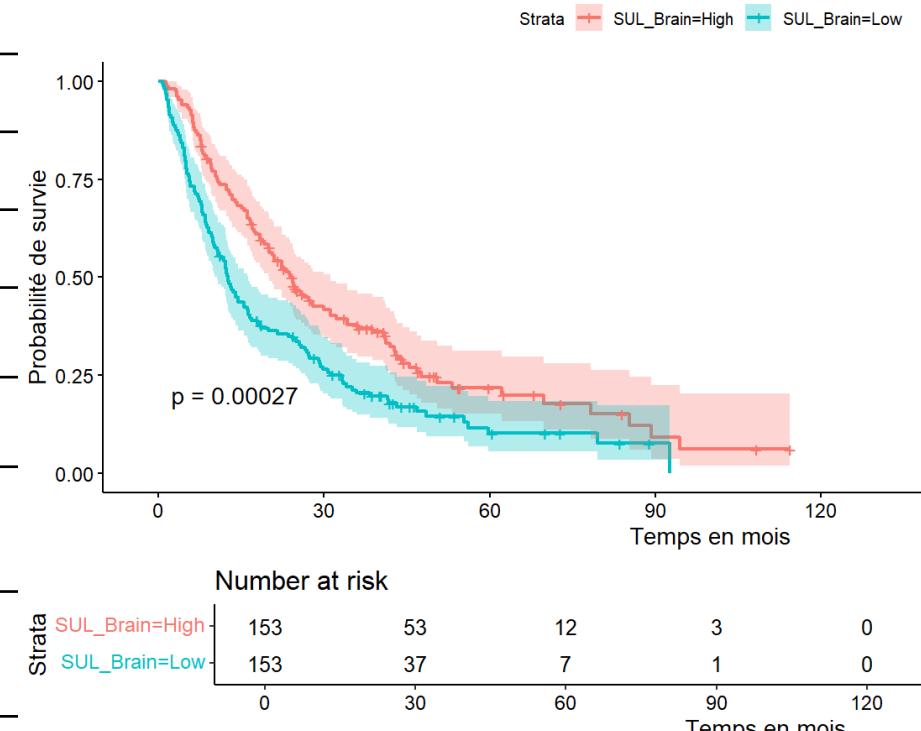
SULmean_Brain High

Pvalue (wilcoxon)

Age (mean \pm sd)	63.1 \pm 10.7	0.005	Age (mean \pm sd)	66.4 \pm 9.6
IMC (mean \pm sd)	23.836 \pm 3.9	0.2	IMC (mean \pm sd)	23.42 \pm 4.3
TMTV (mean \pm sd)	131.97 \pm 149.07	0.0009	TMTV (mean \pm sd)	247.59 \pm 393.41
Dmax (mean \pm sd)	39.37 \pm 20.42	0.4	Dmax (mean \pm sd)	42.14 \pm 21.6
Humean muscle (mean \pm sd)	33.567 \pm 7.20	0.001	Humean muscle (mean \pm sd)	27.88 \pm 33.80
Volume muscle (mean \pm sd)	16322.39 \pm 4131.71	0.06	Volume muscle (mean \pm sd)	15421.75 \pm 3910.324
Humean subcutaneousFat (mean \pm sd)	-83.333 \pm 11.50	0.002	Humean subcutaneousFat (mean \pm sd)	-82.54 \pm 40.9
Volume subcutaneousFat (mean \pm sd)	16141.3 \pm 6809.12	0.01	Volume subcutaneousFat (mean \pm sd)	14758.5 \pm 7567.4
SUL spleen (mean \pm sd)	1.27 \pm 0.2mean	0.01	SUL spleen (mean \pm sd)	1.25 \pm 0.4

SULmean_Brain Low

Courbe de Kaplan-Meier



SUL_Brain High \rightarrow bon pronostic

Résultats

SULmean BRAIN

Inflammation index

SULmean_Brain High

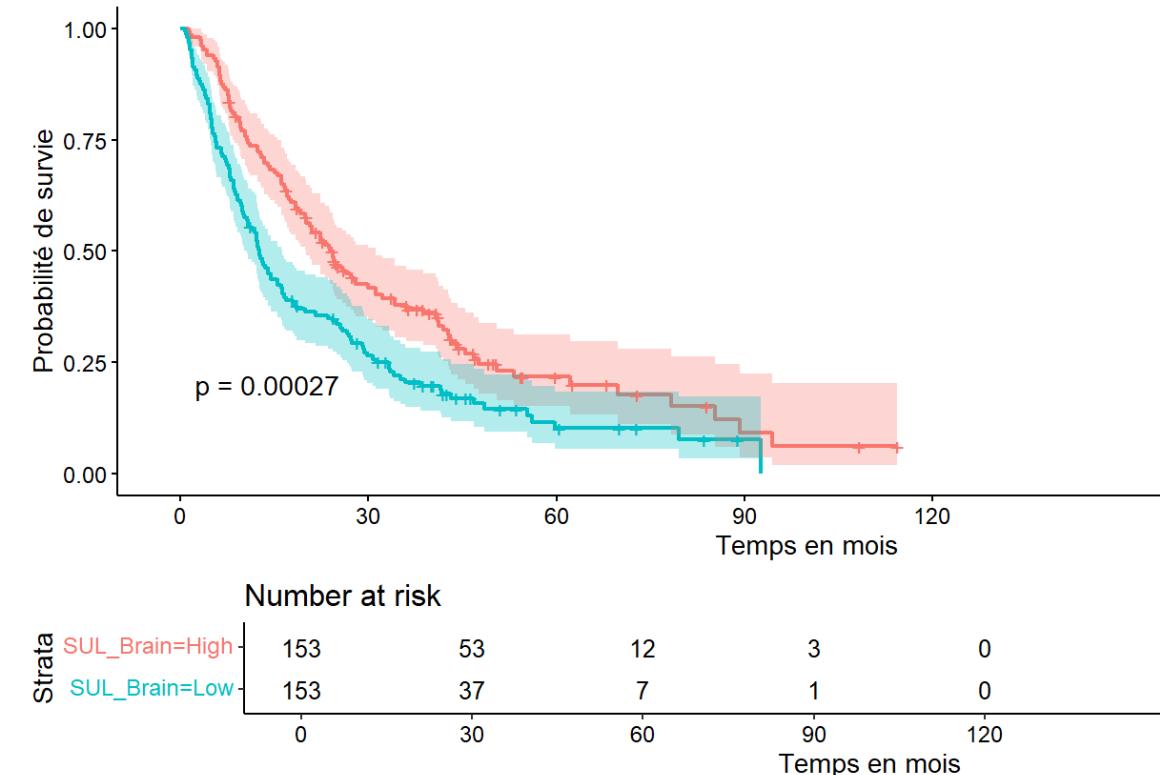
Pvalue (wilcoxon)

CRP	27.48 ± 38.12	< 0.0001	CRP	65.62 ± 71.13
ALbumine	40.05 ± 4.68	< 0.0001	ALbumine	35.57 ± 6.91
ALI	33.83 ± 20.62	< 0.0001	ALI	19.67 ± 20.40
SII	1497 ± 1864.385	< 0.0001	SII	3060 ± 3354.564
NLR	4.287 ± 3.46	< 0.0001	NLR	8.072 ± 8.64
CXI	8744.7 ± 5137.614	< 0.0001	CXI	5427.2 ± 5136.76

SULmean_Brain Low

Courbe de Kaplan-Meier

Strata SUL_Brain=High SUL_Brain=Low



ALI = Albumine * IMC / NLR → Faibles niveaux d'ALI sont associés à un mauvais pronostic

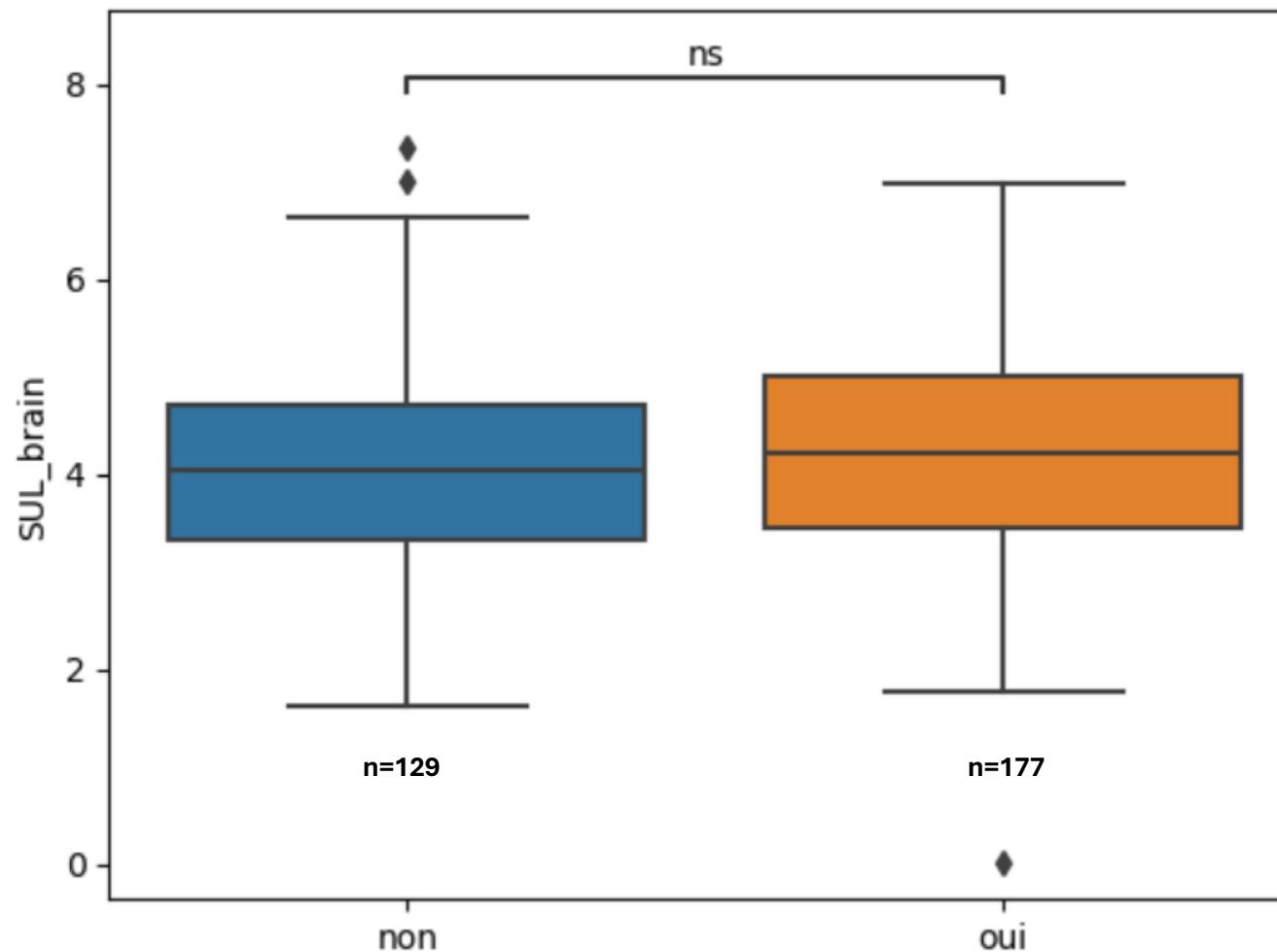
SII= NLR x Platelet count (count/mm3) → Des niveaux élevés de SII sont associés à un mauvais pronostic

NLR = Absolute neutrophil count (count/mm3) / Absolute lymphocyte count (count/mm3) → Des niveaux élevés de NLR sont associés à un mauvais pronostic

CXI = [SMI,(cm²/m²) × serum albumin (g/dL)]/NLR → Faibles niveaux de CXI sont associés à un mauvais pronostic

Résultats

Les niveaux de SUL_brain en fonction de la présence de métastases cérébrales



SULmean brain

Détection meta: Moins ou égale 3mois TEP **Plus de 3mois** **Pas de métastase**

64	77	129
----	----	-----

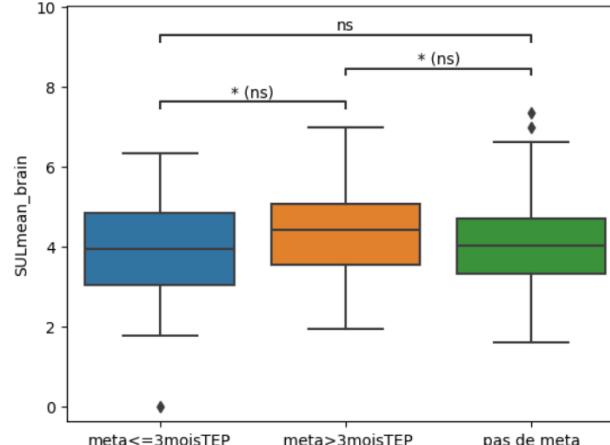
Détection meta: Moins ou égale 4mois TEP **Plus de 4mois** **Pas de métastase**

66	75	129
----	----	-----

Détection meta: Moins ou égale 6mois TEP **Plus de 6mois** **Pas de métastase**

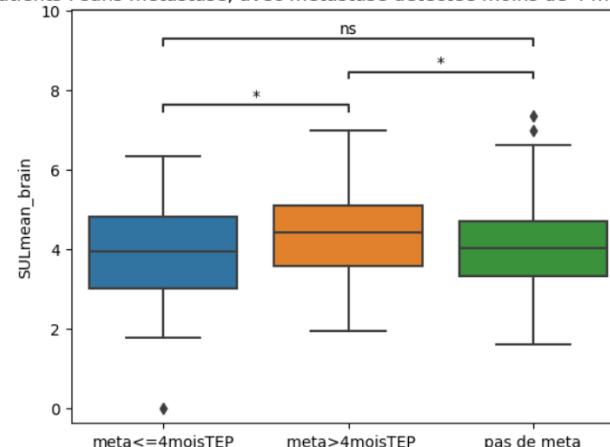
75	66	129
----	----	-----

Niveaux de SULmean_brain chez les patients : sans métastase, avec métastase détectée moins de 3 mois après la TEP, et plus de 3 mois après la TEP

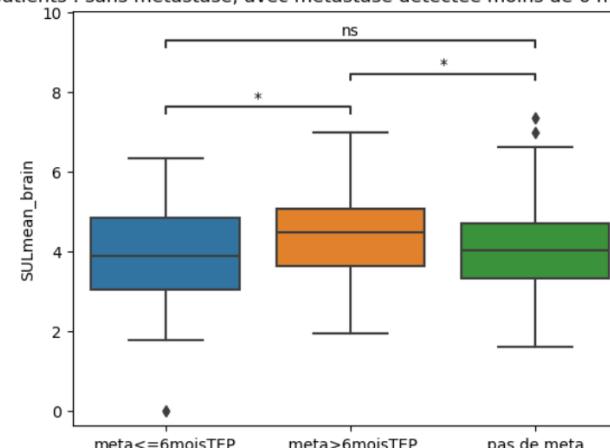


Médiane = 4.03 (pas de meta)
Médiane = 3.93 (meta <= 3mois)
Médiane = 4.42 (meta > 3mois)

Niveaux de SULmean_brain chez les patients : sans métastase, avec métastase détectée moins de 4 mois après la TEP, et plus de 4 mois après la TEP



Niveaux de SULmean_brain chez les patients : sans métastase, avec métastase détectée moins de 6 mois après la TEP, et plus de 6 mois après la TEP



Résultats

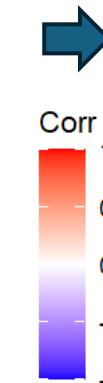
Matrice de Corrélation de Spearman

	age_diagnostic	Tmc	Dmax	SUL_brain	SUL_spleen	HU_mean_muscle	volume_muscle	volume_subcutaneous_fat	HU_mean_subcutaneous_fat	SUL_mean_parietal_lobe	SUL_mean_frontal_lobe	SUL_mean_cerebellum	SUL_mean_thalamus	SUL_mean_caudate_nucleus	SUL_mean_pallidum_space	SUL_mean_venous_sinuses	SUL_mean_lentiform_nucleus	SUL_mean_septum_pellucidum	SULmean_internal_capsule	SULmean_caudate_nucleus	SULmean_venous_sinuses	SULmean_septum_pellucidum	SULmean_subarachnoid_space	SULmean_lentiform_nucleus	SULmean_caudate_nucleus	SULmean_internal_capsule	SULmean_ventricle																					
age_diagnostic	1	-0.04	-0.03	-0.06	-0.19	0.08	-0.14	-0.41	0.03	0.05	-0.15	-0.17	-0.18	-0.12	-0.17	-0.14	-0.12	-0.04	-0.31	-0.11	-0.19	-0.08	-0.29																									
Tmc		1	-0.29	0.03	-0.1	-0.09	0.72	0.11	0.04	0.19	-0.23	0.13	0.73	0.71	0.69	0.65	0.68	0.72	0.64	0.65	0.9	0.61	0.7	0.74	1																							
Dmax			1	-0.08	0.06	-0.14	-0.07	0.94	0.16	0.05	0.17	-0.25	0.17	0.93	0.93	0.92	0.88	0.92	0.95	0.95	0.81	0.54	0.69	0.86	1	0.74																						
SUL_brain				1	-0.19	0.06	-0.19	-0.05	0.86	0.2	0.06	0.19	-0.22	0.17	0.81	0.86	0.85	0.79	0.84	0.9	0.87	0.69	0.47	0.56	1	0.86	0.7																					
SUL_spleen					1	-0.11	0.1	-0.13	-0.14	0.73	0.12	0.04	0.04	-0.27	0.11	0.71	0.73	0.73	0.68	0.7	0.67	0.64	0.82	0.5	1	0.56	0.69	0.61																				
HU_mean_muscle						1	-0.31	-0.02	-0.05	-0.1	0.52	0.05	-0.02	0.16	-0.2	0.09	0.54	0.5	0.49	0.46	0.47	0.51	0.41	0.49	1	0.5	0.47	0.54	0.9																			
volume_muscle							1	-0.04	0.02	-0.18	-0.13	0.83	0.14	-0.01	0.02	-0.26	0.1	0.81	0.81	0.82	0.79	0.8	0.79	0.77	1	0.49	0.82	0.69	0.81	0.65																		
volume_subcutaneous_fat								1	-0.12	0.06	-0.16	-0.04	0.96	0.16	0.06	0.19	-0.25	0.16	0.93	0.95	0.95	0.89	0.96	0.95	1	0.77	0.41	0.64	0.87	0.95	0.64																	
HU_mean_subcutaneous_fat									1	-0.14	0.06	-0.19	-0.06	0.95	0.16	0.04	0.19	-0.26	0.17	0.92	0.95	0.94	0.89	0.93	1	0.95	0.79	0.51	0.67	0.9	0.95	0.72																
HU_mean_muscle										1	-0.17	0.07	-0.2	-0.1	0.99	0.18	0.06	0.2	-0.27	0.16	0.96	0.98	0.98	0.93	1	0.93	0.96	0.8	0.47	0.7	0.84	0.92	0.68															
volume_cerebellum											1	-0.12	0.07	-0.15	-0.05	0.94	0.21	0.06	0.17	-0.26	0.18	0.94	0.92	0.91	1	0.93	0.89	0.89	0.79	0.46	0.68	0.79	0.88	0.65														
volume_frontal_lobe												1	-0.18	0.08	-0.2	-0.08	0.99	0.16	0.07	0.18	-0.28	0.17	0.94	0.98	1	0.91	0.98	0.94	0.95	0.82	0.49	0.73	0.85	0.92	0.69													
volume_parietal_lobe													1	-0.17	0.06	-0.19	-0.08	0.99	0.18	0.06	0.19	-0.26	0.16	0.95	1	0.98	0.92	0.98	0.95	0.95	0.81	0.5	0.73	0.86	0.93	0.71												
volume_lentiform_nucleus														1	-0.15	0.04	-0.17	-0.07	0.98	0.18	0.01	0.21	-0.28	0.15	1	0.95	0.94	0.94	0.96	0.92	0.93	0.81	0.54	0.71	0.81	0.93	0.73											
volume_subcutaneous_fat															1	0.05	0.76	-0.07	-0.04	0.16	-0.13	0.14	-0.38	-0.7	1	0.15	0.16	0.17	0.18	0.16	0.17	0.16	0.1	0.09	0.11	0.17	0.17	0.13										
HU_mean_subcutaneous_fat																1	-0.03	-0.31	0.12	0.07	-0.27	0.14	0.35	0.46	1	-0.7	-0.28	-0.26	-0.28	-0.26	-0.27	-0.26	-0.25	-0.26	-0.2	-0.27	-0.22	-0.25	-0.23									
HU_mean_muscle																	1	-0.41	-0.2	-0.08	0	0.2	0.07	0.27	1	0.46	-0.38	0.21	0.19	0.18	0.17	0.2	0.19	0.19	0.02	0.16	0.04	0.19	0.17	0.19								
volume_muscle																		1	-0.14	0.53	0.06	0.1	0.06	0.06	1	0.27	0.35	0.14	0.01	0.06	0.07	0.06	0.06	0.04	0.06	-0.01	-0.02	0.04	0.06	0.05	0.04							
SUL_spleen																			1	0.08	-0.14	0.15	0.04	0.17	1	0.06	0.07	0.14	0.06	0.13	0.14	0.18	0.16	0.21	0.18	0.16	0.16	0.14	0.05	0.12	0.2	0.16	0.11					
SUL_brain																				1	-0.19	0.06	-0.2	-0.09	1	0.17	0.06	0.2	-0.27	0.16	0.96	0.99	0.99	0.94	0.99	0.95	0.96	0.83	0.52	0.73	0.86	0.94	0.72					
Dmax																					1	-0.06	0	0.31	1	-0.09	0.04	0.1	0	0.07	-0.04	-0.07	-0.08	-0.08	-0.05	-0.1	-0.06	-0.04	-0.13	-0.1	-0.14	-0.05	-0.07	-0.09				
TMTV																						1	-0.03	-0.08	1	0.31	-0.2	0.15	0.06	-0.08	0.12	-0.07	-0.17	-0.19	-0.2	-0.15	-0.2	-0.19	-0.16	-0.18	-0.05	-0.13	-0.19	-0.14	-0.1			
imc																							1	-0.04	1	-0.08	0	0.06	-0.14	0.53	-0.2	-0.31	0.76	0.04	0.06	0.08	0.07	0.07	0.06	0.06	0.02	-0.02	0.1	0.06	0.06	0.03		
age_diagnostic																								1	0.04	-0.03	-0.06	-0.19	0.08	-0.14	-0.41	0.03	0.05	-0.15	-0.17	-0.18	-0.12	-0.17	-0.14	-0.12	-0.04	-0.31	-0.11	-0.19	-0.08	-0.29		



Analyse de Corrélation de Spearman

Corrélation SULmean_brain avec :



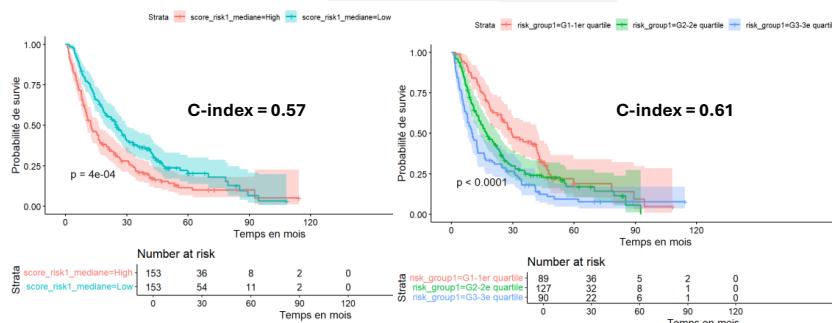
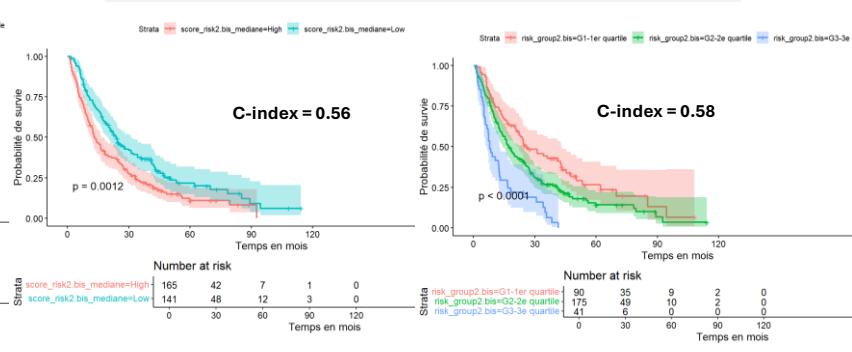
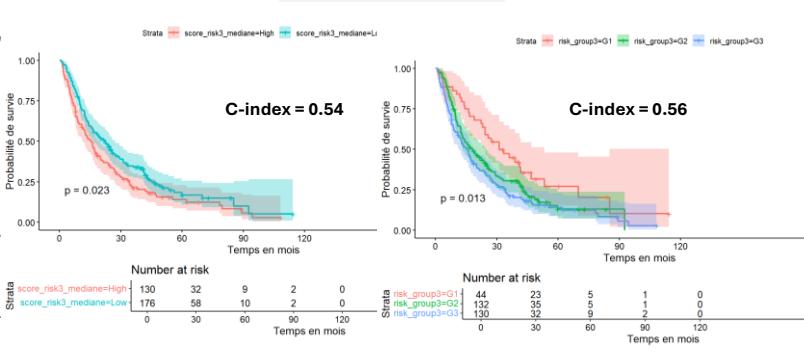
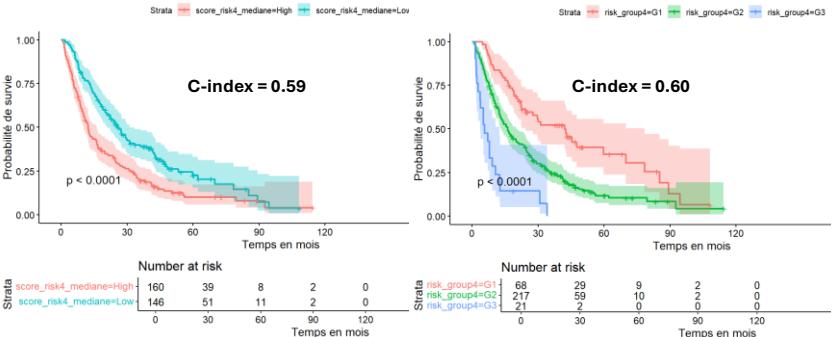
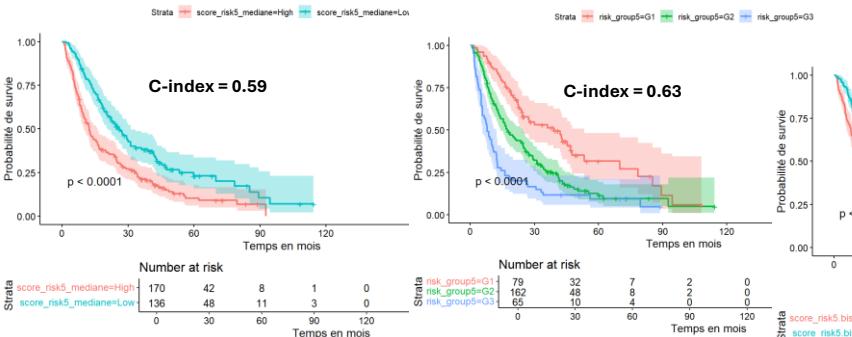
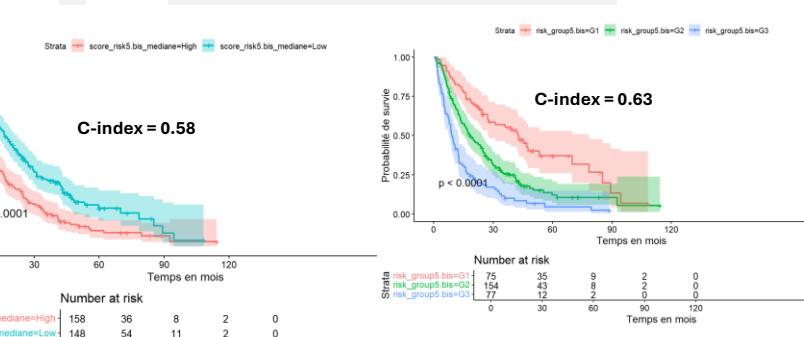
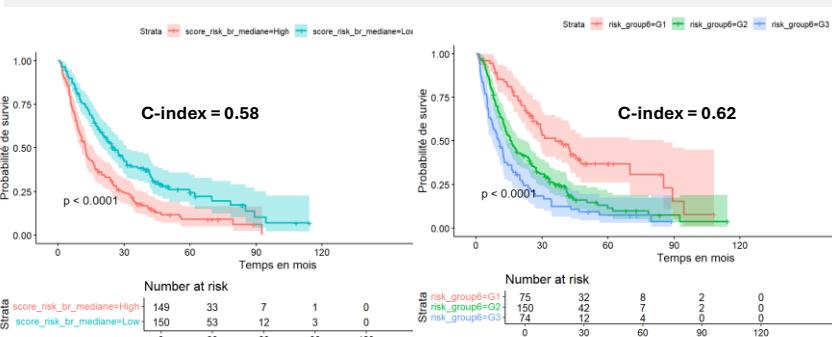
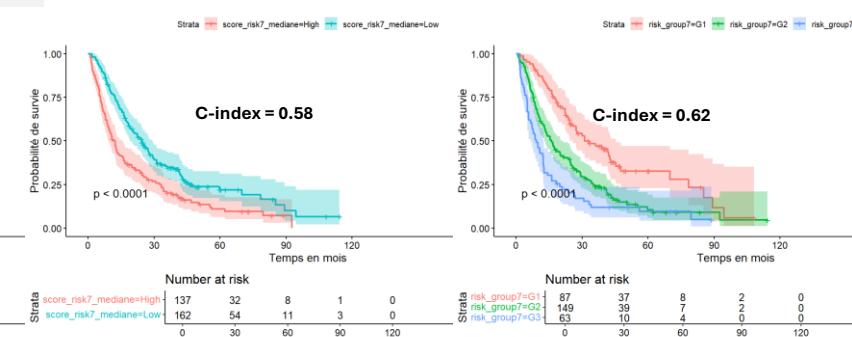
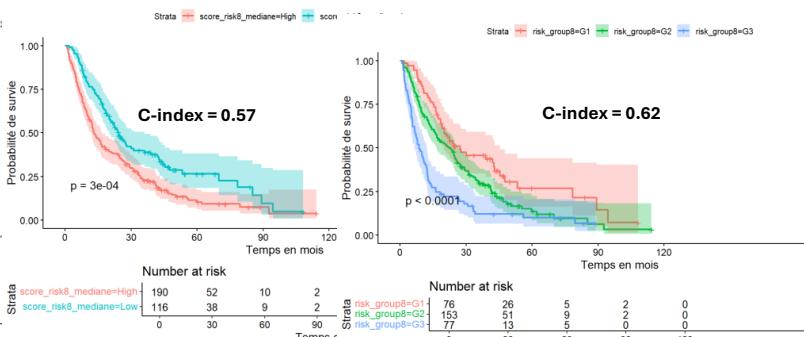
- rho = - 0.19 (âge)
- rho = 0.06 (IMC)
- rho = - 0.2 (TMTV)
- rho = - 0.09 (Dmax)
- rho = 0.17 (SULmean_spleen)
- rho = 0.06 (volume muscle)
- rho = 0.2 (Humean_muscle)
- rho = - 0.27 (Humean_subcutaneous_fat)
- rho = 0.16 (volume subcutaneous_fat)

cliniques

radiomiques

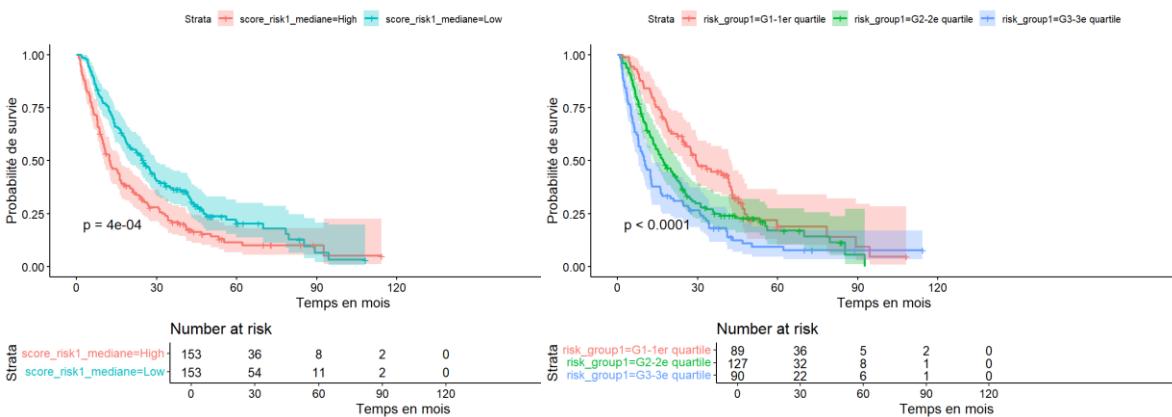
organomiques

age_diagnostic Tmc Dmax SUL_brain SUL_spleen HU_mean_muscle volume_muscle fat HU_mean_subcutaneous_fat volume_subcutaneous_fat SULmean_parietal_lobe SULmean_frontal_lobe SULmean_cerebellum SULmean_thalamus SULmean_caudate_nucleus SULmean_pallidum_space SULmean_venous_sinuses SULmean_lentiform_nucleus SULmean_septum_pellucidum SULmean_subarachnoid_space SULmean_lentiform_nucleus SULmean_caudate_nucleus SULmean_internal_capsule SULmean_ventricle

M1 : TMTV + Dmax**M2.bis :Données organomique****M3 : Clinique****M4 : TMTV + Dmax + SUL_brain + organomique****M5: TMTV + Dmax + SUL_brain+ données cliniques + données organomiques****M5.bis: M5+ méta_cérébrale****M6: TMTV + Dmax + données cliniques + données organomiques + toutes les structures du cerveau****M7: M6+ quelques structures du cerveau****M8 : TMTV + Dmax + SULmean_brain**

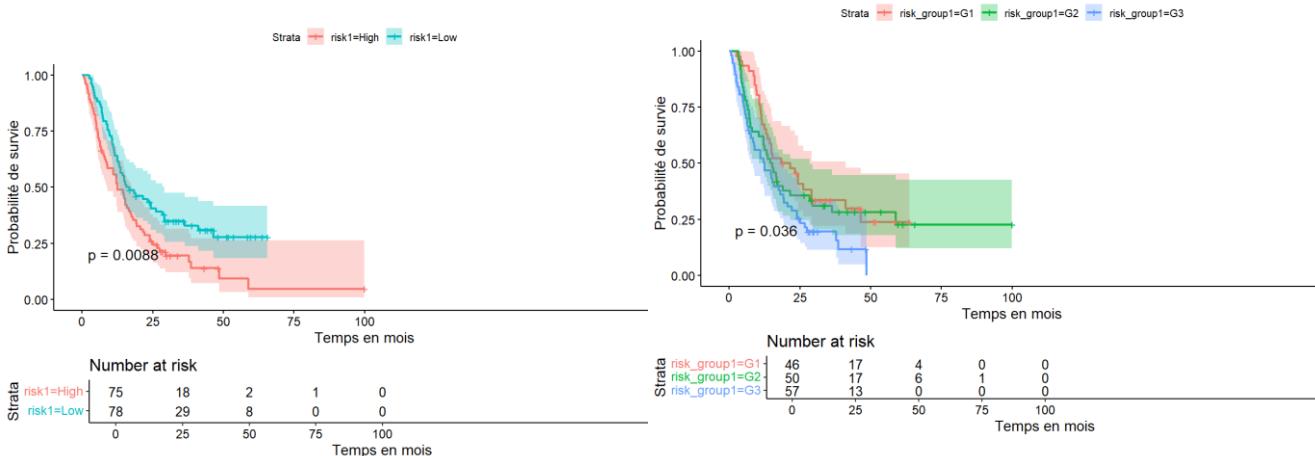
NEMO-PET(1)

M1 : TMTV + Dmax

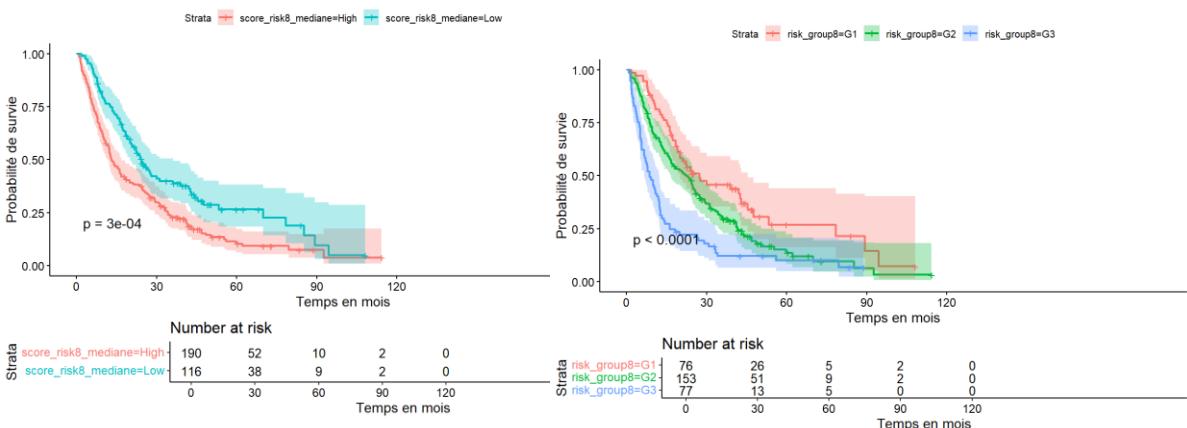


NEMO-PET(2)

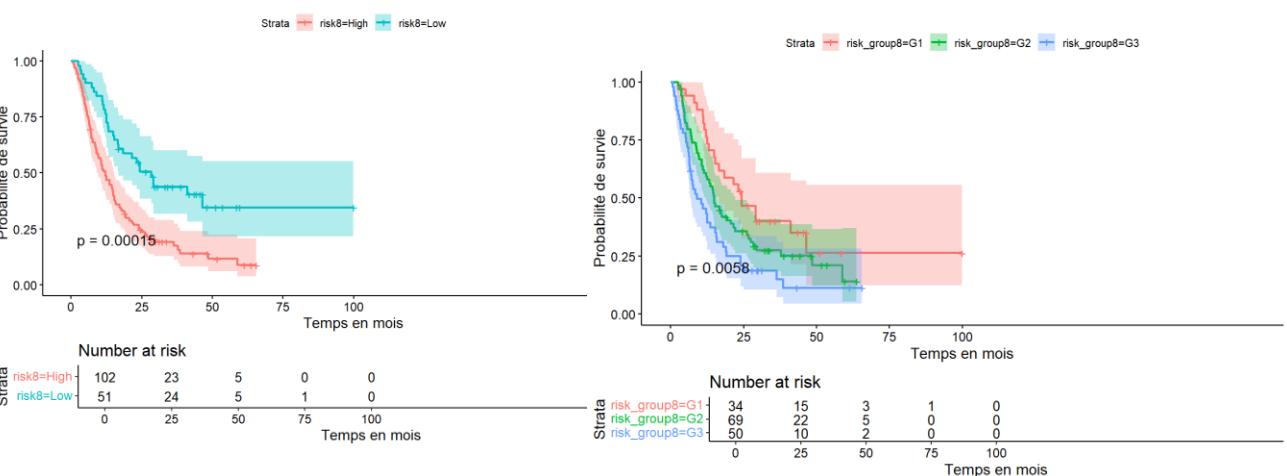
M1 : TMTV + Dmax



M8 : TMTV + Dmax + SULmean_brain



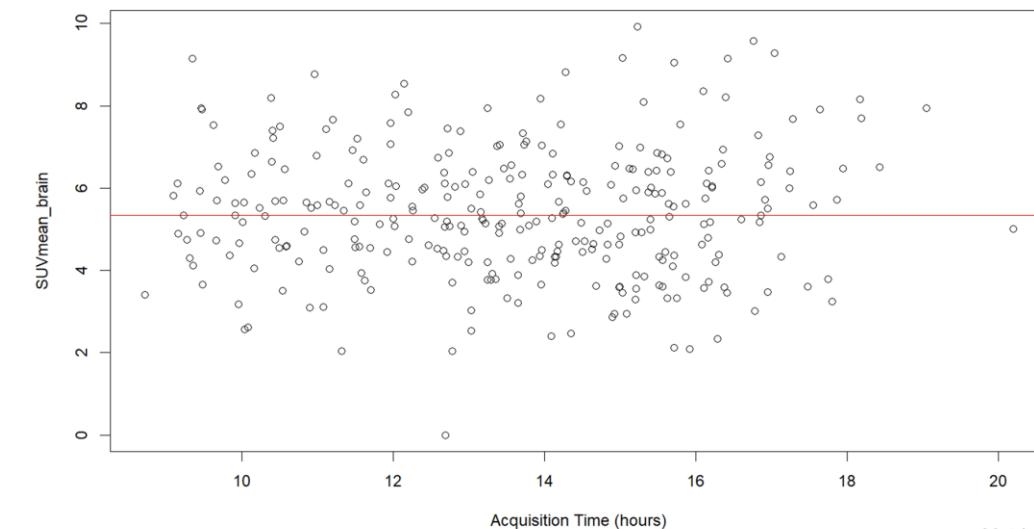
M8 : TMTV + Dmax + SULmean_brain



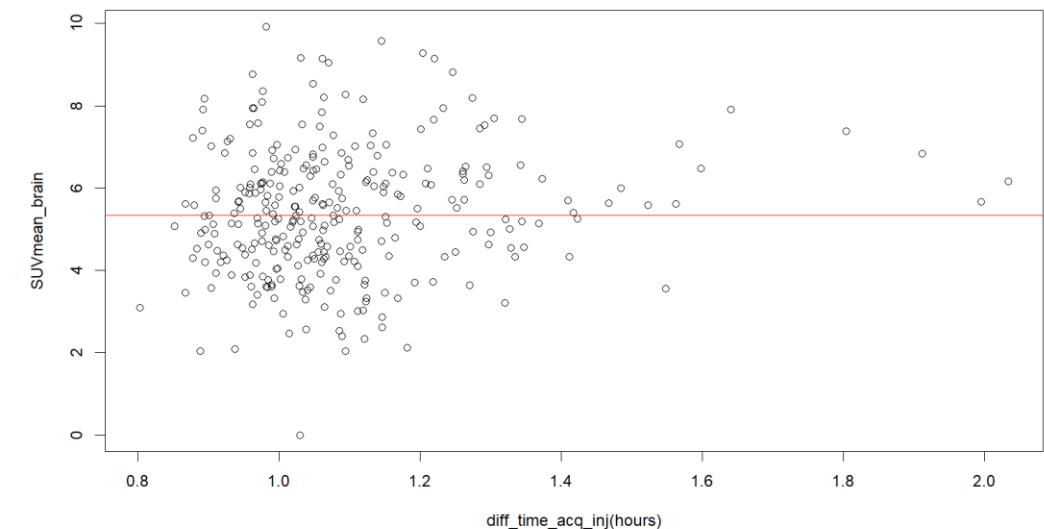
Y a-t-il un lien entre l'heure d'acquisition des images TEP et le SUVmean_Brain ?

Y a-t-il un lien entre le temps entre l'injection et l'acquisition des images, et le SUVmean_brain ?

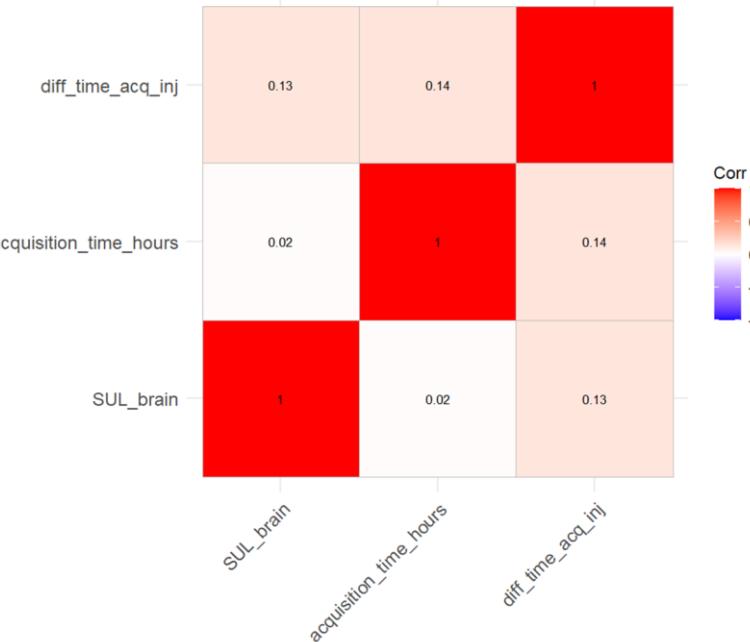
Scatter Plot of Acquisition Time vs SUVmean_brain



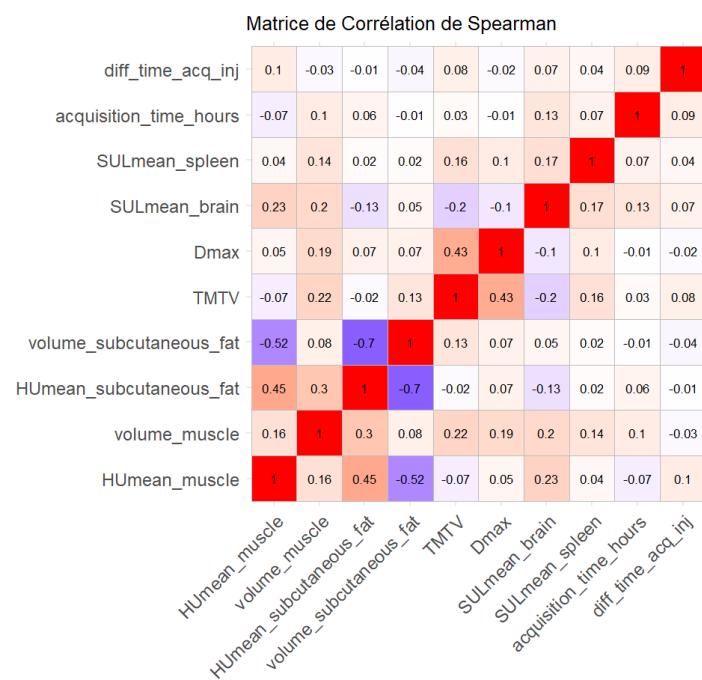
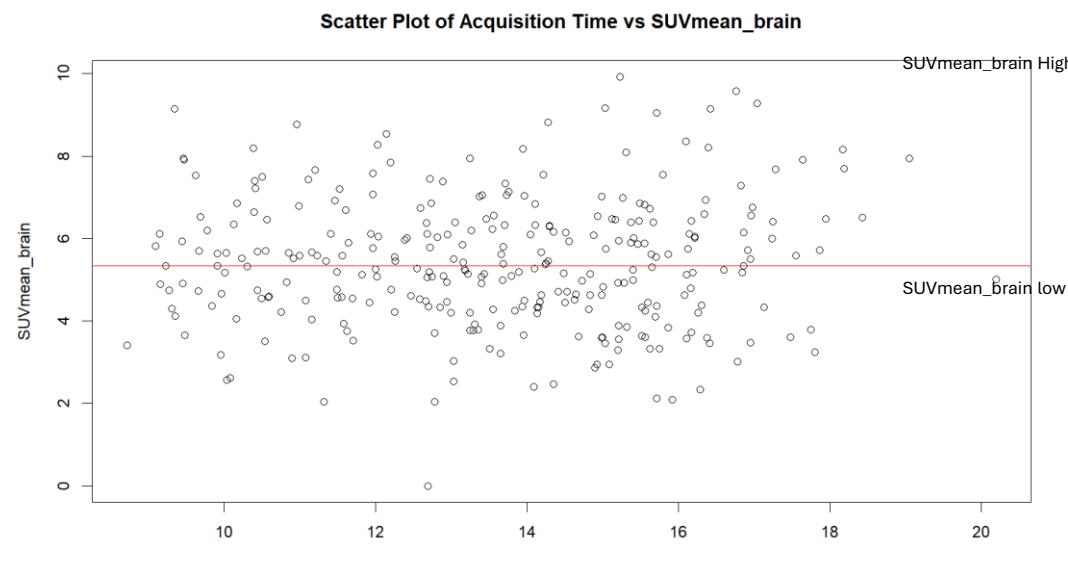
Difference entre le temps d'acquisition des images et injection du FDG



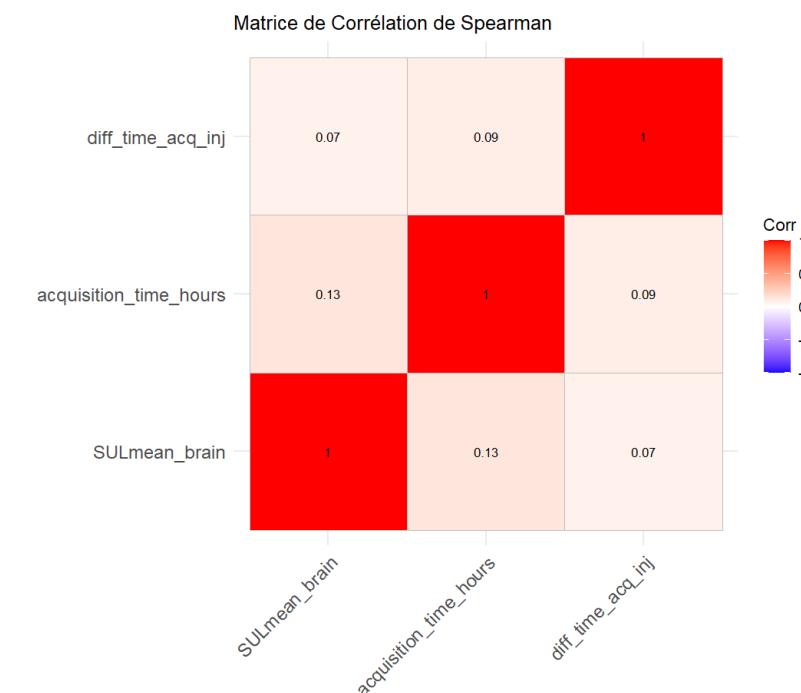
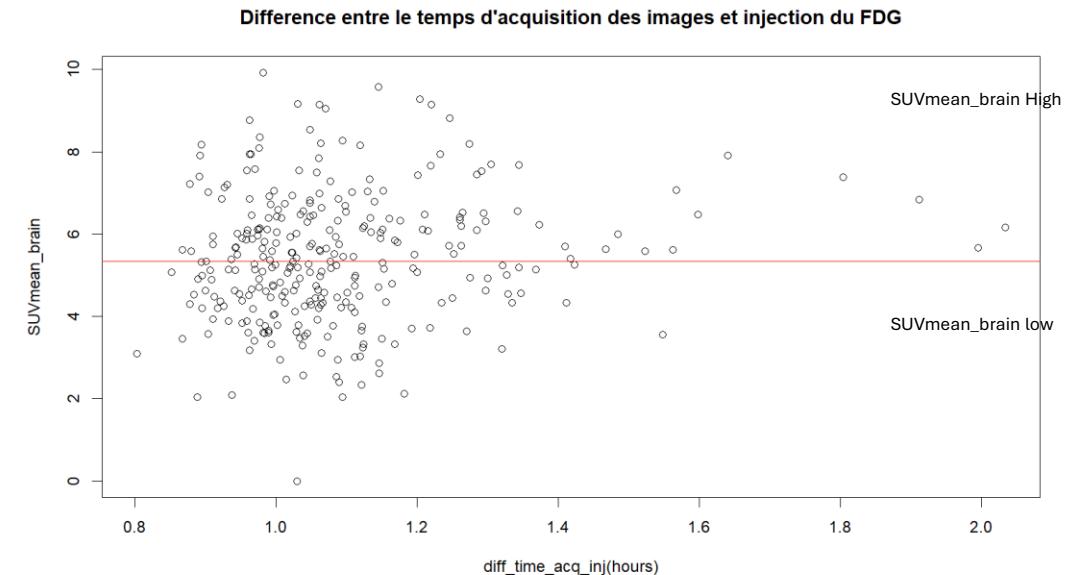
Matrice de Corrélation de Spearman



Y a-t-il un lien entre l'heure d'acquisition des images TEP et le SUVmean_Brain ?



Y a-t-il un lien entre le temps entre l'injection et l'acquisition des images, et le SUVmean_brain ?

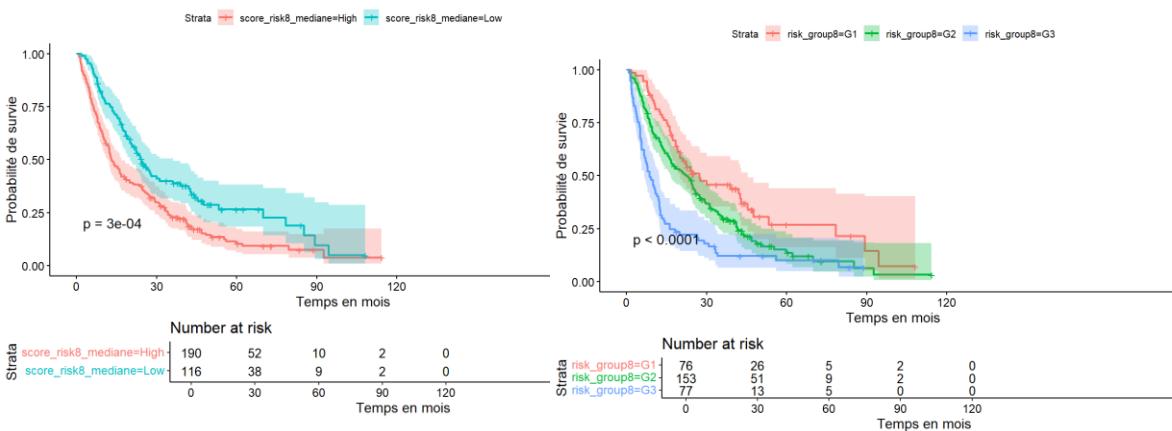


Conclusion

- Les variations du SULmean cérébral semblent offrir une nouvelle perspective pour la stratification pronostique des patients CPNPC.
- Le modèle le plus performant dans la prediction de la survie globale chez des patients atteints d'un CPNPC au stade IV → TMTV + Dmax + SULmean_brain
- Validation sur une autre cohorte

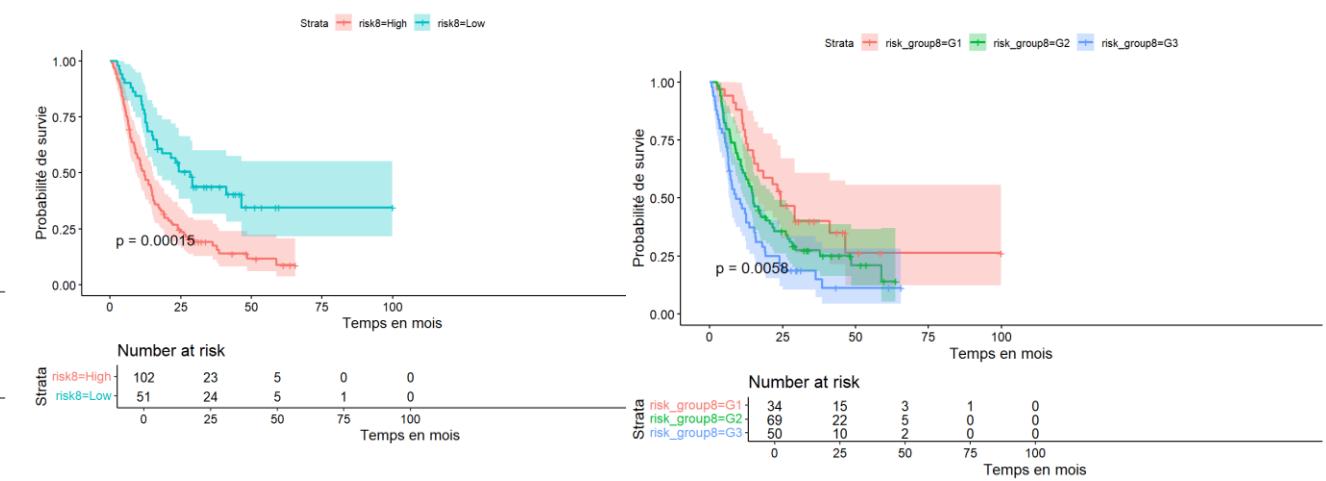
NEMO-PET(1)

M8 : TMTV + Dmax + SULmean_brain



NEMO-PET(2)

M8 : TMTV + Dmax + SULmean_brain



Perspectives

- ❑ Tester SULmean_brain sur d'autres cohortes CPNPC et pour d'autres types de cancer
- ❑ Comprendre la signification de SULmean_brain : corrélation avec des scores cliniques ?
(questionnaire patients)