
# Développement et validation d'un modèle de prédiction de la réponse à l'immunothérapie en cancer du poumon non à petites cellules

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6: IBV, Université Côte d'Azur, CNRS, Inserm, Nice, France.

# Contexte

Cancer bronchique non à petites cellules (CBNPC) avancé ou métastatique sans mutation activatrice

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Expression de PD-L1 : pas un biomarqueur suffisant pour guider la prise en charge et sujet à une forte variabilité

› Ann Oncol. 2024 Oct;35(10):902-913. doi: 10.1016/j.annonc.2024.06.014. Epub 2024 Jun 29.

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Affiliations + expand

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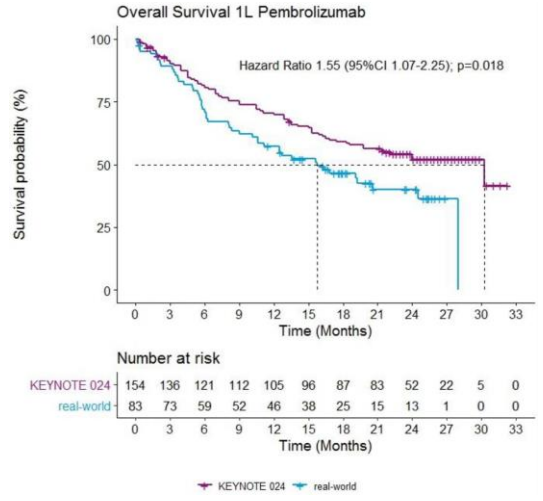


[Cramer-van der Welle et al, Sci Report 2021]


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Plusieurs scores cliniques proposés dans la littérature :

- LIPI - Lung Immune Prognostic Index [Mezquita et al, JAMA Oncol 2018]
- EPSILoN [Prelaj et al, Cancers 2019]
- LIPS-3 - Lung Immuno-oncology Prognostic Score [Banna et al, ESMO Open 2021]
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Pas ou peu contribution de l'imagerie

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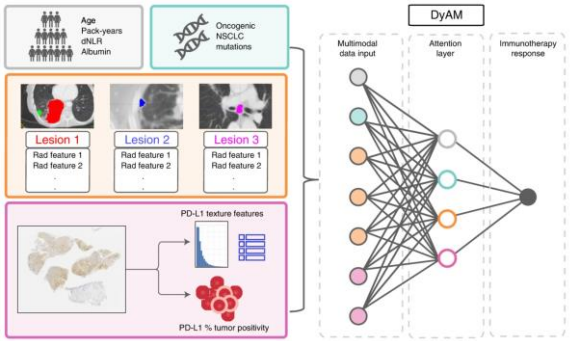
Pas ou peu contribution de l'imagerie

- [Vanguri et al, Nat Cancer 2022]



# Contexte

Place de la TEP-FDG dans la prise en charge pour le bilan d'extension

- TMTV – Total Metabolic Tumor Volume
- Dmax – distance entre les 2 lésions les plus éloignées
- SLR – Spleen-to-Liver Uptake Ratio
- …

# Objectif

**Développer et de valider sur une cohorte indépendante,**

un modèle **multivarié** combinant des caractéristiques issues de la **TEP** réalisée avant traitement par ICI avec des **biomarqueurs cliniques et/ou biologiques** déjà identifiés dans la littérature,

afin de prédire la **survie globale** des patients atteints de CBNPC avancé traités en première ligne par **ICI** (+/- chimiothérapie)

**Critères d'inclusion des patients**

1) CBNPC sans mutation activatrice EGFR/ALK
2) Patient ayant consenti à l'utilisation de ses données pour la recherche
3) Stage III ou IV, inéligible pour la chirurgie
4) TEP-FDG avant traitement par immunothérapie
5) Suivi de 12 mois minimum ou décès après initiation

# Matériel & Méthodes

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**Cohorte 1** : 197 patients – Institut Curie
→ développement du modèle

**Cohorte 2** : 86 patients – Centre Antoine Lacassagne
→ évaluation des performances

## Analyse des images TEP

- Segmentation manuelle des lésions avec SUV>4 + labellisation : lung, bone, pleural, liver, other
- Ré-échantillonnage en 2x2x2 $mm^3$

| Scanner model | Manufacturer name | Slice thickness (mm) | Pixel spacing (mm) | Reconstruction method |
|---|---|---|---|---|
| Biograph 6 | Siemens | 5 | [4.07, 4.07] | PSF 4i14s |
| Biograph 20 | Siemens | 2.03 | [4.07, 4.07] | PSF+TOF 3i21s |
| Biograph 40 | Siemens | 2.03 | [4.07, 4.07] | PSF+TOF 3i21s |
| Biograph Horizon | Siemens | 2.03 | [2.06, 2.06] | PSF+TOF 6i10s |
| Discovery 610 | General Electric | 3.27 | [2.73, 2.73] | VPHDS |
| Discovery 690 | General Electric | 3.27 | [2.73, 2.73] | VPFX |
| Discovery 710 | General Electric | 3.27 | [2.73, 2.73] | VPFXS |
| Discovery IQ | General Electric | 3.26 | [2.73, 2.73] | QCHD |
| Discovery MI | General Electric | 2.8 | [2.73, 2.73] | QCFX |
| Gemini TF 16 | Philips | 4 | [4.00, 4.00] | BLOB-OS-TF |
| Ingenuity TF | Philips | 2 | [2.00, 2.00] | BLOB-OS-TF |
| Vereos | Philips | 2 | [2.00, 2.00] | OSEM 3i5s:PSFI-Gau |

# Matériel & Méthodes

## Analyse des images TEP

- Segmentation manuelle des lésions avec SUV>4 + labellisation : lung, bone, pleural, liver, other
- Ré-échantillonnage en 2x2x2 $mm^3$
- 25 variables extraites

| Acronym | Definition |
|---|---|
| **TMTV** | Total Metabolic Tumor Volume |
| **TMTV(lung)** | Total Metabolic Tumor Volume of lung lesions |
| **TMTV(bone)** | Total Metabolic Tumor Volume of bone lesions |
| **TMTV(pleura)** | Total Metabolic Tumor Volume of pleural metastatic lesions |
| **TMTV(liver)** | Total Metabolic Tumor Volume of liver lesions |
| **TMTV(others)** | Total Metabolic Tumor Volume of other metastatic lesions |
| **SDmax** | Distance between the two most distant lesions standardized by the body surface |
| **maxSUVmax or sdSUVmax** | Maximum or standard-deviation of SUVmax over all lesions |
| **maxSUVmean or sdSUVmean** | Maximum or standard-deviation of SUVmean over all lesions |
| **maxSUVpeak or sdSUVpeak** | Maximum or standard-deviation of SUVpeak over all lesions |
| **maxMTV or sdMTV** | Maximum or standard-deviation of Metabolic Tumor Volume (MTV) over all lesions |
| **maxTLG or sdTLG** | Maximum or standard-deviation of Total Lesion Glycolysis (TLG) over all lesions |
| **TTLG** | Total Lesion Glycosis of all lesions |
| **maxNHOCmax* or sdNHOCmax*** | Maximun or standard-deviation over all lesions of the Normalized distance from the Hotspot of the radiotracer uptake (SUVmax) to the tumor Centroid |
| **maxNHOPmax* or sdNHOPmax*** | Maximun or standard-deviation over all lesions of the Normalized distance from the Hotspot of the radiotracer uptake (SUVmax) to the tumor Perimeter |
| **minSphericity or sdSphericity** | Minimum or standard-deviation of Sphericity over all lesions |
| **SLR** | Spleen-to-Liver Ratio: Ratio between SUVmean(spleen) measured in a sphere of 4 ml (diameter of 20 mm) located in healthy splenic tissue and SUVmean measured in healthy liver tissue (sphere of 14 ml, diameter of 20mm) |

* Definition in Hovhannisyan-Baghdasarian et al. Promising candidate prognostic biomarkers in 18F-FDG PET images: evaluation in independent cohorts of NSCLC patients. *J Nucl Med* . 2024:65:635-642.

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- Ré-échantillonnage en 2x2x2 $mm^3$
- 25 variables extraites
  - **6 indices de charge tumorale**
  - **1 indice de dissémination**
  - **8 indices agrégés sur toutes les lésions soit par sd, soit par max ou min**
  - **Total - TLG**
  - **Spleen-to-Liver uptake Ratio**

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⊘ Pas d'index de texture

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- Validation croisée 5-folds x 100 fois et comparaison avec TMTV, âge et PDL1

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### Cohorte 1

Sélection des caractéristiques TEP : 1 indice par groupe de corrélation

Dichotomisation des caractéristiques par le seuil qui maximise la statistique du log-rank

Modèle multivarié en utilisant « *stepwise backward selection* » basé sur l'AIC → **NSCLC-Pro**

Seuil pour distinguer des patients « **Low-risk** » vs « **High-risk** » suivant l'OS (test du log-rank)

Validation croisée 5-folds x 100 fois et comparaison avec TMTV, âge et PDL1

### Cohorte 2

→ Evaluation de **NSCLC-Pro** model, courbe de Kaplan-Meier, test du log-rank

# Résultats – caractéristiques des patients

| Patient characteristics | Cohort 1 | | | | Cohort 2 | | | |
|---|---|---|---|---|---|---|---|---|
| | All patients | Treated by ICI | Treated by ICI-C | p-value (ICI vs ICI-C) | All patients | Treated by ICI | Treated by ICI-C | p-value (ICI vs ICI-C) |
| **Number of patients** | 197 | 71 | 126 | | 86 | 54 | 32 | |
| **Sex** | | | | 0.201 | | | | 1.000 |
| Male | 123 (62%) | 49 (69%) | 74 (59%) | | 50 (58%) | 31 (57%) | 19 (59%) | |
| Female | 74 (38%) | 22 (31%) | 52 (41%) | | 36 (42%) | 23 (43%) | 13 (41%) | |
| **Age** | | | | 0.160 | | | | 0.987 |
| < 70 y | 133 (68%) | 43 (61%) | 90 (71%) | | 55 (64%) | 34 (63%) | 21 (66%) | |
| ≥ 70 y | 64 (32%) | 28 (39%) | 36 (29%) | | 31 (36%) | 20 (37%) | 11 (34%) | |
| **Performance Status (PS)** | | | | 0.743 | | | | 0.914 |
| < 2 | 178 (90%) | 63 (89%) | 115 (91%) | | 68 (79%) | 42 (78%) | 26 (81%) | |
| ≥ 2 | 19 (10%) | 8 (11%) | 11 (9%) | | 18 (21%) | 12 (22%) | 6 (19%) | |
| **PD-L1 expression analysis** | | | | | | | | |
| < 1% | 33 (17%) | 0 (0%) | 31 (25%) | < 0.001 | 10 (12%) | 0 (0%) | 10 (32%) | < 0.001 |
| 1-49% | 97 (49%) | 2 (3%) | 60 (47%) | | 11 (13%) | 0 (0%) | 11 (34%) | |
| ≥ 50% | 67 (34%) | 69 (97%) | 35 (28%) | | 65 (75%) | 54 (100%) | 11 (34%) | |

ICI: immunotherapy alone. ICI-C: immunotherapy in comination with chemotherapy.
In parentheses: percentage relative to the total number of patients in each column.
In bold: pvalue lower than 5%

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| Patient characteristics | Cohort 1 | | | | Cohort 2 | | | | Cohort 1 vs Cohort 2 |
|---|---|---|---|---|---|---|---|---|---|
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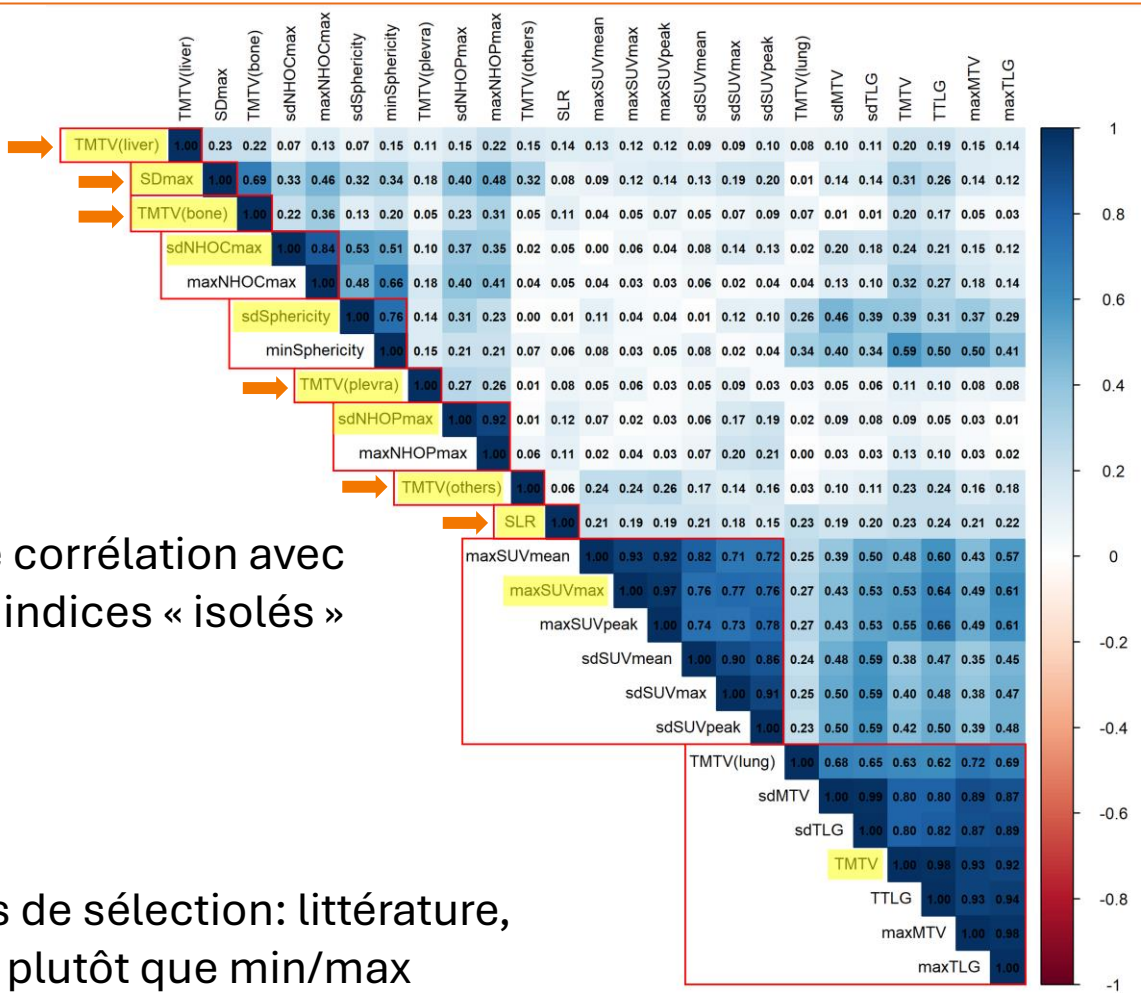
# Résultats – sélection des caractéristiques TEP

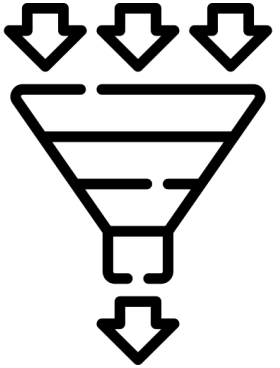
## Cohorte 1




11 groupes de corrélation avec
R ≥ 0,7 dont 6 indices « isolés »

Critères de sélection: littérature,
sd plutôt que min/max

**25 indices**



**11 indices**

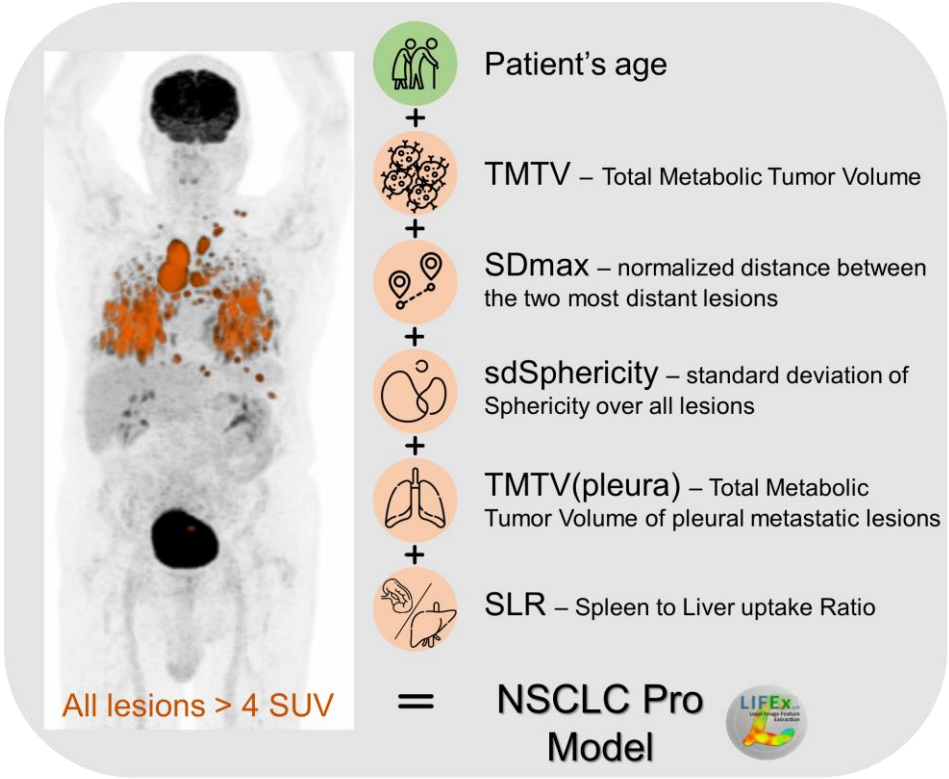
# Résultats – analyse uni-multivariée

## Cohorte 1

| Feature (cut-off) | Univariable analysis | | |
|---|---|---|---|
| | HR | 95% CI | pvalue |
| **Age** | | | |
| < 70 y | - | | |
| ≥ 70 y | 1.8 | [1.23-2.64] | 0.003 |
| **Sex** | | | |
| Female | | | |
| Male | 1.31 | [0.88-1.96] | 0.179 |
| **PD-L1 expression analysis** | | | |
| < 1% | 1.43 | [0.83-2.47] | 0.197 |
| 1-49% | - | | |
| ≥ 50% | 0.88 | [0.58-1.36] | 0.575 |
| **Treatment** | | | |
| ICI | - | | |
| ICI-C | 1.02 | [0.69-1.50] | 0.922 |
| **Performance Status (PS)** | | | |
| < 2 | - | | |
| ≥ 2 | 1.72 | [0.95-3.14] | 0.075 |
| **TMTV** | | | |
| High (> 82.6 $cm^3$) | - | | |
| Low | 0.48 | [0.33-0.70] | < 0.001 |
| **SD max** | | | |
| High (> 16.07) | - | | |
| Low | 0.49 | [0.33-0.71] | < 0.001 |
| **SLR** | | | |
| High (> 0.72) | - | | |
| Low | 0.39 | [0.17-0.88] | 0.024 |
| **maxSUVmax** | | | |
| High (> 15.7) | - | | |
| Low | 0.79 | [0.54-1.15] | 0.219 |
| **sdSphericity** | | | |
| High (> 0.09) | - | | |
| Low | 0.51 | [0.35-0.74] | < 0.001 |
| **sdNHOCmax** | | | |
| High (> 0.23) | - | | |
| Low | 0.54 | [0.35-0.83] | 0.006 |
| **sdNHOPmax** | | | |
| High (> 0.20) | - | | |
| Low | 0.64 | [0.43-0.93] | 0.019 |
| **TMTV(pleura)** | | | |
| High (> 2.16 $cm^3$) | - | | |
| Low | 0.49 | [0.29-0.83] | 0.008 |
| **TMTV(bone)** | | | |
| High (> 0.58 $cm^3$) | - | | |
| Low | 0.57 | [0.39-0.84] | 0.004 |
| **TMTV(others)** | | | |
| High (> 7.85 $cm^3$) | - | | |
| Low | 0.77 | [0.43-1.37] | 0.37 |

# Résultats – analyse uni-multivariée

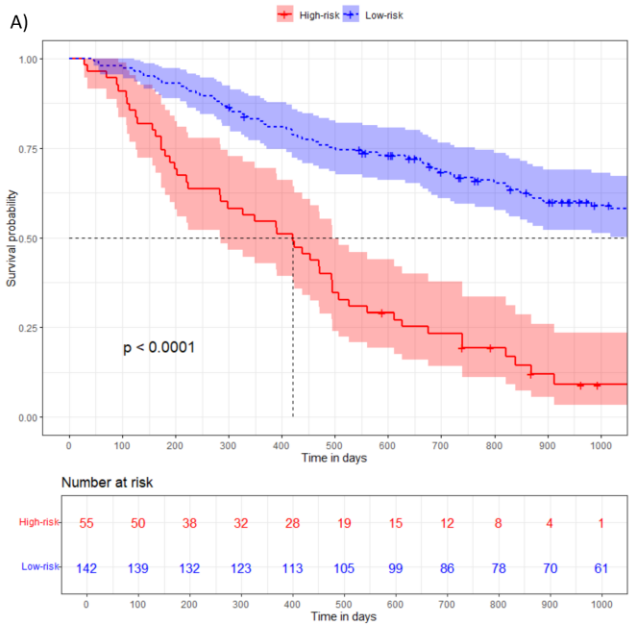
## Cohorte 1




| Feature (cut-off) | Univariable analysis | | | Multivariable analysis | | |
|---|---|---|---|---|---|---|
| | HR | 95% CI | pvalue | HR | 95% CI | pvalue |
| **Age** | | | | | | |
| < 70 y | - | | | - | | |
| ≥ 70 y | 1.8 | [1.23-2.64] | 0.003 | 2.27 | [1.52-3.39] | < 0.001 |
| **Sex** | | | | | | |
| Female | | | | | | |
| Male | 1.31 | [0.88-1.96] | 0.179 | | | |
| **PD-L1 expression analysis** | | | | | | |
| < 1% | 1.43 | [0.83-2.47] | 0.197 | | | |
| 1-49% | - | | | | | |
| ≥ 50% | 0.88 | [0.58-1.36] | 0.575 | | | |
| **Treatment** | | | | | | |
| ICI | - | | | | | |
| ICI-C | 1.02 | [0.69-1.50] | 0.922 | | | |
| **Performance Status (PS)** | | | | | | |
| < 2 | - | | | | | |
| ≥ 2 | 1.72 | [0.95-3.14] | 0.075 | | | |
| **TMTV** | | | | | | |
| High (> 82.6 $cm^3$) | - | | | - | | |
| Low | 0.48 | [0.33-0.70] | < 0.001 | 0.6 | [0.40-0.91] | 0.016 |
| **SD max** | | | | | | |
| High (> 16.07) | - | | | - | | |
| Low | 0.49 | [0.33-0.71] | < 0.001 | 0.51 | [0.34-0.75] | < 0.001 |
| **SLR** | | | | | | |
| High (> 0.72) | - | | | - | | |
| Low | 0.39 | [0.17-0.88] | 0.024 | 0.48 | [0.21-1.11] | 0.087 |
| **maxSUVmax** | | | | | | |
| High (> 15.7) | - | | | | | |
| Low | 0.79 | [0.54-1.15] | 0.219 | | | |
| **sdSphericity** | | | | | | |
| High (> 0.09) | - | | | - | | |
| Low | 0.51 | [0.35-0.74] | < 0.001 | 0.64 | [0.42-0.98] | 0.04 |
| **sdNHOCmax** | | | | | | |
| High (> 0.23) | - | | | | | |
| Low | 0.54 | [0.35-0.83] | 0.006 | | | |
| **sdNHOPmax** | | | | | | |
| High (> 0.20) | - | | | | | |
| Low | 0.64 | [0.43-0.93] | 0.019 | | | |
| **TMTV(pleura)** | | | | | | |
| High (> 2.16 $cm^3$) | - | | | - | | |
| Low | 0.49 | [0.29-0.83] | 0.008 | 0.49 | [0.29-0.84] | 0.009 |
| **TMTV(bone)** | | | | | | |
| High (> 0.58 $cm^3$) | - | | | | | |
| Low | 0.57 | [0.39-0.84] | 0.004 | | | |
| **TMTV(others)** | | | | | | |
| High (> 7.85 $cm^3$) | - | | | | | |
| Low | 0.77 | [0.43-1.37] | 0.37 | | | |

# Résultats – analyse uni-multivariée

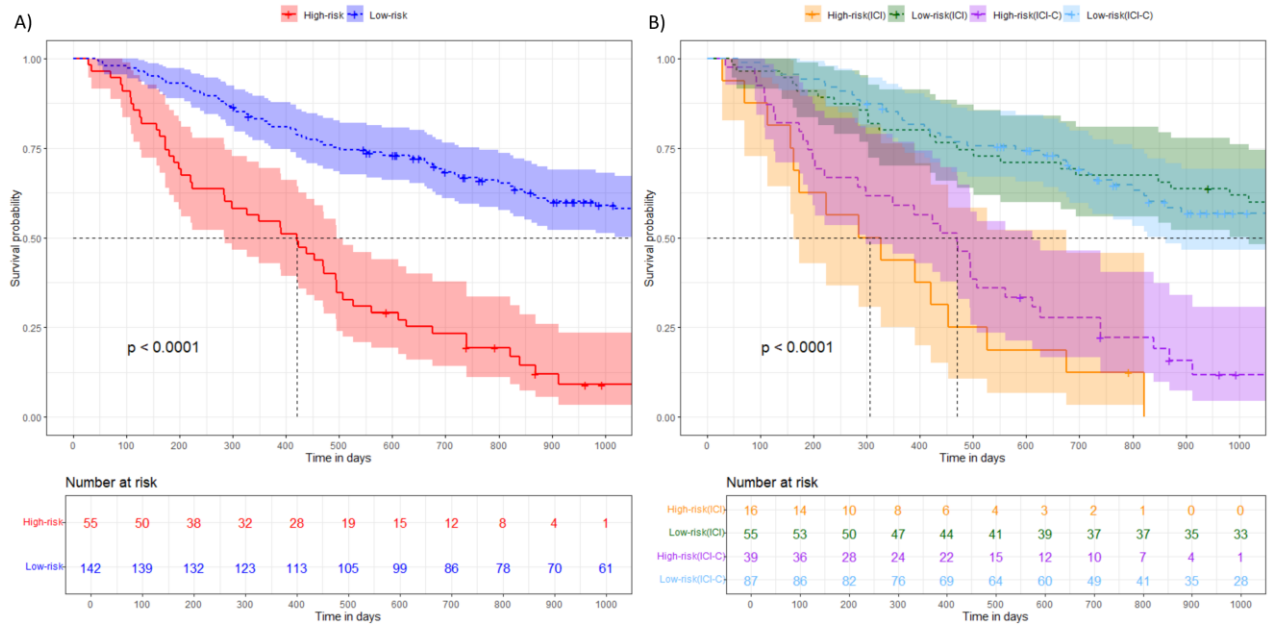
## Cohorte 1




| Feature (cut-off) | Univariable analysis | | | Multivariable analysis | | |
|---|---|---|---|---|---|---|
| | HR | 95% CI | pvalue | HR | 95% CI | pvalue |
| **Age** | | | | | | |
| < 70 y | - | | | - | | |
| ≥ 70 y | 1.8 | [1.23-2.64] | 0.003 | 2.27 | [1.52-3.39] | < 0.001 |
| **Sex** | | | | | | |
| Female | | | | | | |
| Male | 1.31 | [0.88-1.96] | 0.179 | | | |
| **PD-L1 expression analysis** | | | | | | |
| < 1% | 1.43 | [0.83-2.47] | 0.197 | | | |
| 1-49% | - | | | | | |
| ≥ 50% | 0.88 | [0.58-1.36] | 0.575 | | | |
| **Treatment** | | | | | | |
| ICI | - | | | | | |
| ICI-C | 1.02 | [0.69-1.50] | 0.922 | | | |
| **Performance Status (PS)** | | | | | | |
| < 2 | - | | | | | |
| ≥ 2 | 1.72 | [0.95-3.14] | 0.075 | | | |
| **TMTV** | | | | | | |
| High (> 82.6 $cm^3$) | - | | | - | | |
| Low | 0.48 | [0.33-0.70] | < 0.001 | 0.6 | [0.40-0.91] | 0.016 |
| **SD max** | | | | | | |
| High (> 16.07) | - | | | - | | |
| Low | 0.49 | [0.33-0.71] | < 0.001 | 0.51 | [0.34-0.75] | < 0.001 |
| **SLR** | | | | | | |
| High (> 0.72) | - | | | - | | |
| Low | 0.39 | [0.17-0.88] | 0.024 | 0.48 | [0.21-1.11] | 0.087 |
| **maxSUVmax** | | | | | | |
| High (> 15.7) | - | | | | | |
| Low | 0.79 | [0.54-1.15] | 0.219 | | | |
| **sdSphericity** | | | | | | |
| High (> 0.09) | - | | | - | | |
| Low | 0.51 | [0.35-0.74] | < 0.001 | 0.64 | [0.42-0.98] | 0.04 |
| **sdNHOCmax** | | | | | | |
| High (> 0.23) | - | | | | | |
| Low | 0.54 | [0.35-0.83] | 0.006 | | | |
| **sdNHOPmax** | | | | | | |
| High (> 0.20) | - | | | | | |
| Low | 0.64 | [0.43-0.93] | 0.019 | | | |
| **TMTV(pleura)** | | | | | | |
| High (> 2.16 $cm^3$) | - | | | - | | |
| Low | 0.49 | [0.29-0.83] | 0.008 | 0.49 | [0.29-0.84] | 0.009 |
| **TMTV(bone)** | | | | | | |
| High (> 0.58 $cm^3$) | - | | | | | |
| Low | 0.57 | [0.39-0.84] | 0.004 | | | |
| **TMTV(others)** | | | | | | |
| High (> 7.85 $cm^3$) | - | | | | | |
| Low | 0.77 | [0.43-1.37] | 0.37 | | | |

# Résultats – analyse uni-multivariée

## Cohorte 1




| Feature (cut-off) | Univariable analysis | | | Multivariable analysis | | |
|---|---|---|---|---|---|---|
| | HR | 95% CI | pvalue | HR | 95% CI | pvalue |
| **Age** | | | | | | |
| < 70 y | - | | | - | | |
| ≥ 70 y | 1.8 | [1.23-2.64] | 0.003 | 2.27 | [1.52-3.39] | < 0.001 |
| **Sex** | | | | | | |
| Female | | | | | | |
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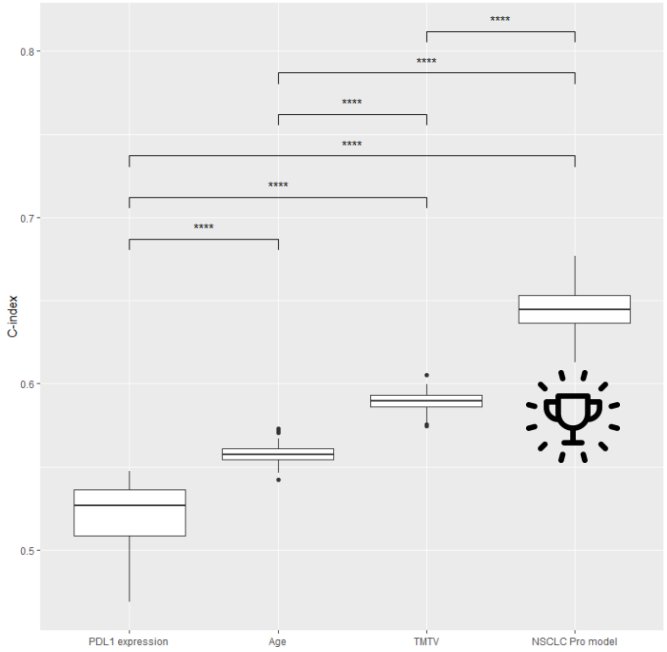
| **Treatment** | | | | | | |
| ICI | - | | | | | |
| ICI-C | 1.02 | [0.69-1.50] | 0.922 | | | |
| **Performance Status (PS)** | | | | | | |
| < 2 | - | | | | | |
| ≥ 2 | 1.72 | [0.95-3.14] | 0.075 | | | |
| **TMTV** | | | | | | |
| High (> 82.6 $cm^3$) | - | | | - | | |
| Low | 0.48 | [0.33-0.70] | < 0.001 | 0.6 | [0.40-0.91] | 0.016 |
| **SD max** | | | | | | |
| High (> 16.07) | - | | | - | | |
| Low | 0.49 | [0.33-0.71] | < 0.001 | 0.51 | [0.34-0.75] | < 0.001 |
| **SLR** | | | | | | |
| High (> 0.72) | - | | | - | | |
| Low | 0.39 | [0.17-0.88] | 0.024 | 0.48 | [0.21-1.11] | 0.087 |
| **maxSUVmax** | | | | | | |
| High (> 15.7) | - | | | | | |
| Low | 0.79 | [0.54-1.15] | 0.219 | | | |
| **sdSphericity** | | | | | | |
| High (> 0.09) | - | | | - | | |
| Low | 0.51 | [0.35-0.74] | < 0.001 | 0.64 | [0.42-0.98] | 0.04 |
| **sdNHOCmax** | | | | | | |
| High (> 0.23) | - | | | | | |
| Low | 0.54 | [0.35-0.83] | 0.006 | | | |
| **sdNHOPmax** | | | | | | |
| High (> 0.20) | - | | | | | |
| Low | 0.64 | [0.43-0.93] | 0.019 | | | |
| **TMTV(pleura)** | | | | | | |
| High (> 2.16 $cm^3$) | - | | | - | | |
| Low | 0.49 | [0.29-0.83] | 0.008 | 0.49 | [0.29-0.84] | 0.009 |
| **TMTV(bone)** | | | | | | |
| High (> 0.58 $cm^3$) | - | | | | | |
| Low | 0.57 | [0.39-0.84] | 0.004 | | | |
| **TMTV(others)** | | | | | | |
| High (> 7.85 $cm^3$) | - | | | | | |
| Low | 0.77 | [0.43-1.37] | 0.37 | | | |

# Résultats – validation croisée 5 folds x 100 fois

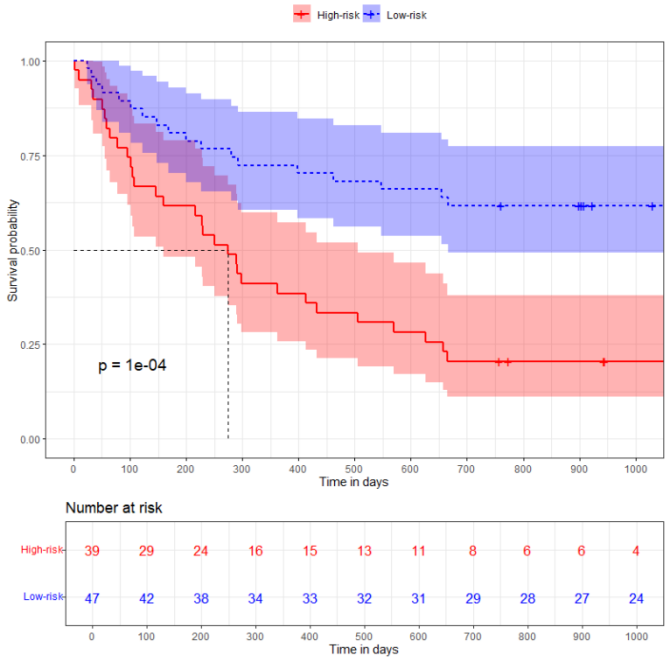
## Cohorte 1




| OS rate | | Age cut-off = 70 y | PD-L1 expression cut-off = 1% | TMTV cut-off = 82.6 $cm^3$ | NSCLC-Pro model |
|---|---|---|---|---|---|
| **1y-OS** | | | | | |
| | Low-risk | 78% | 77% | 80% | 82% |
| | High-risk | 67% | 65% | 67% | 55% |
| **2y-OS** | | | | | |
| | Low-risk | 61% | 56% | 65% | 67% |
| | High-risk | 42% | 45% | 40% | 23% |

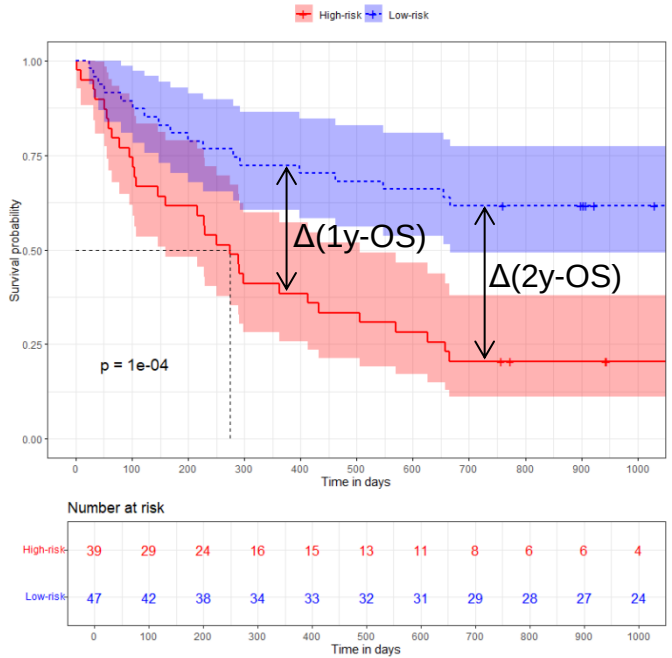
# Résultats – validation externe

## Cohorte 2



# Résultats – validation externe

## Cohorte 2

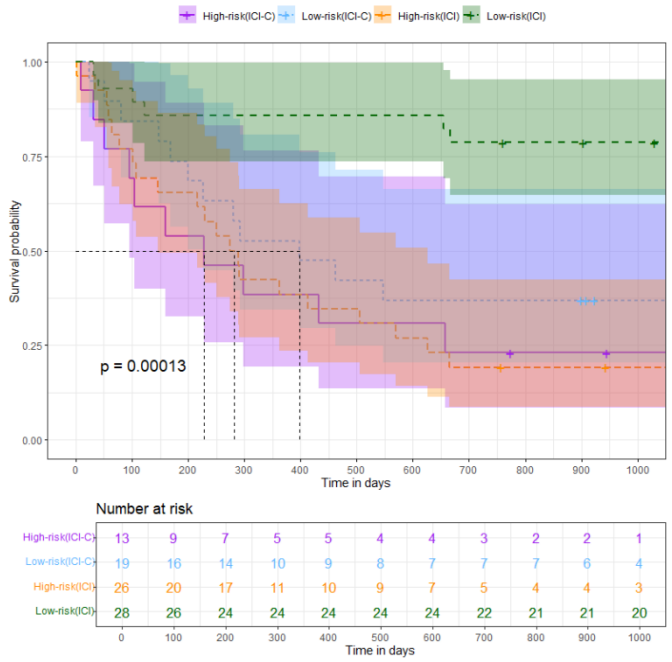



| | 1y-OS | 2y-OS |
|---|---|---|
| Low-risk | 82% | 67% |
| High-risk | 55% | 23% |
| Δ | 27% | 44% |

| | | |
|---|---|---|
| Low-risk | 72% | 62% |
| High-risk | 39% | 21% |
| Δ | **33%** | **41%** |

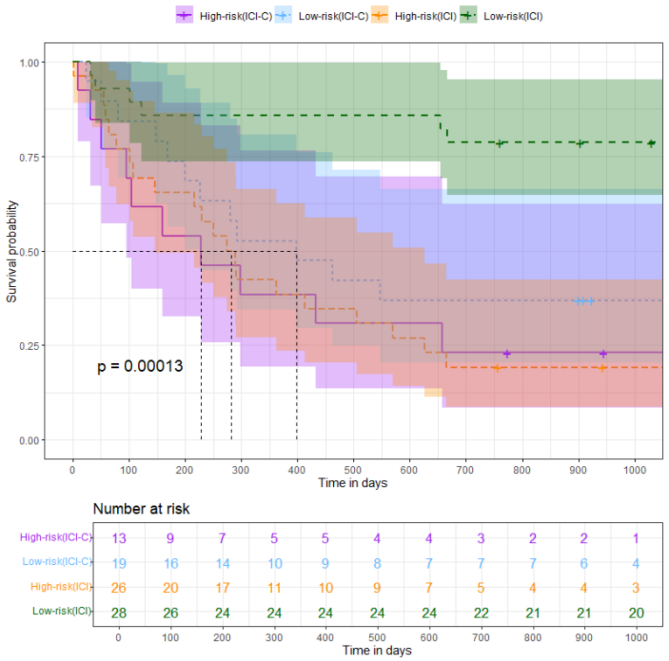
# Résultats – validation externe

## Cohorte 2

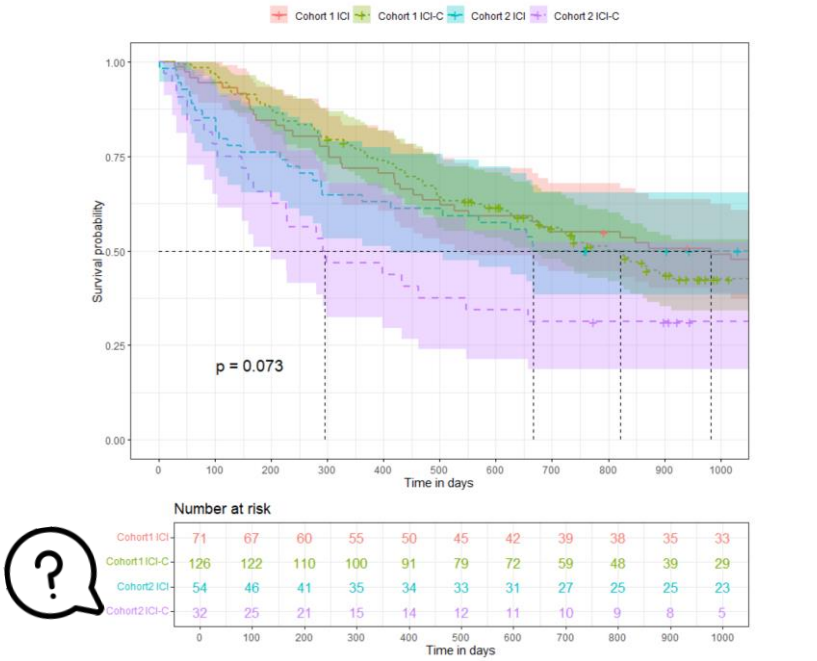


# Résultats – validation externe

## Cohorte 2




## Cohorte 1 Cohorte 2



# Résultats – score METRICS

## METRICS Tool v1.0

**Please fill out all conditions first for relevant sections and then all active items to calculate METRICS score.**

**Please note that default option is "No".**

? Stands for explanation of items and conditions.

C Stands for conditional items or sections.

| Items/Conditions | Definitions | Weights | Options |
|---|---|---|---|
| **Study Design** | | | |
| Item#1 | ? Adherence to radiomics and/or machine learning-specific checklists or guidelines | 0,0368 | Yes / No |
| Item#2 | ? Eligibility criteria that describe a representative study population | 0,0735 | Yes / No |
| Item#3 | ? High-quality reference standard with a clear definition | 0,0919 | Yes / No |
| **Imaging Data** | | | |
| Item#4 | ? Multi-center | 0,0438 | Yes / No |
| Item#5 | ? Clinical translatability of the imaging data source for radiomics analysis | 0,0292 | Yes / No |
| Item#6 | ? Imaging protocol with acquisition parameters | 0,0438 | Yes / No |
| Item#7 | ? The interval between imaging used and reference standard | 0,0292 | Yes / No |
| **Segmentation** C | | | |
| Condition#1 | ? Does the study include segmentation? | | Yes / No |
| Condition#2 | ? Does the study include fully automated segmentation? | | Yes / No |
| Item#8 | ? Transparent description of segmentation methodology | 0,0337 | Yes / No |
| Item#9 | ? Formal evaluation of fully automated segmentation C | 0,0225 | Yes / No |
| Item#10 | ? Test set segmentation masks produced by a single reader or automated tool | 0,0112 | Yes / No |
| **Image Processing and Feature Extraction** | | | |
| Condition#3 | ? Does the study include hand-crafted feature extraction? | | Yes / No |
| Item#11 | ? Appropriate use of image preprocessing techniques with transparent description | 0,0622 | Yes / No |
| Item#12 | ? Use of standardized feature extraction software C | 0,0311 | Yes / No |
| Item#13 | ? Transparent reporting of feature extraction parameters, otherwise providing a default configuration statement | 0,0415 | Yes / No |
| **Feature Processing** | | | |
| Condition#4 | ? Does the study include tabular data? | | Yes / No |
| Condition#5 | ? Does the study include end-to-end deep learning? | | Yes / No |
| Item#14 | ? Removal of non-robust features C | 0,0200 | Yes / No |
| Item#15 | ? Removal of redundant features C | 0,0200 | Yes / No |
| Item#16 | ? Appropriateness of dimensionality compared to data size C | 0,0300 | Yes / No |
| Item#17 | ? Robustness assessment of end-to-end deep learning pipelines C | 0,0200 | Yes / No |
| **Preparation for Modeling** | | | |
| Item#18 | ? Proper data partitioning process | 0,0599 | Yes / No |
| Item#19 | ? Handling of confounding factors | 0,0300 | Yes / No |
| **Metrics and Comparison** | | | |
| Item#20 | ? Use of appropriate performance evaluation metrics for task | 0,0352 | Yes / No |
| Item#21 | ? Consideration of uncertainty | 0,0234 | Yes / No |
| Item#22 | ? Calibration assessment | 0,0176 | Yes / No |
| Item#23 | ? Use of uni-parametric imaging or proof of its inferiority | 0,0117 | Yes / No |
| Item#24 | ? Comparison with a non-radiomic approach or proof of added clinical value | 0,0293 | Yes / No |
| Item#25 | ? Comparison with simple or classical statistical models | 0,0176 | Yes / No |
| **Testing** | | | |
| Item#26 | ? Internal testing | 0,0375 | Yes / No |
| Item#27 | ? External testing | 0,0749 | Yes / No |
| **Open Science** | | | |
| Item#28 | ? Data availability | 0,0075 | Yes / No |
| Item#29 | ? Code availability | 0,0075 | Yes / No |
| Item#30 | ? Model availability | 0,0075 | Yes / No |
| | | **Total METRICS score:** | **89.4%** |
| | | ? **Quality category:** | **Excellent** |
| | | ? **Publication ID:** | |

**If you publish any work which uses this tool, please cite the following publication:**

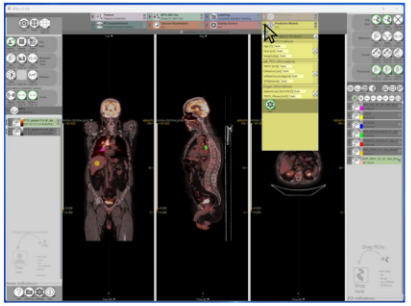
Kocak B, Akinci D'Antonoli T, Mercaldo N, et al. METhodological RadiomICs Score (METRICS): a quality scoring tool for radiomics research endorsed by EuSoMII. Insights Imaging. 2024;15(1):8. Published 2024 Jan 17. doi:10.1186/s13244-023-01572-w

https://metricsscore.github.io/metrics/METRICS.html

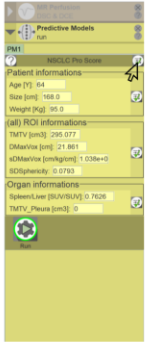
# Module NSCLC-Pro Score dans LIFEx

## Step 3: Calculate the *NSCLC-Pro Score**

Open Predictive Models toolbox.



Update model parameters by clicking on 



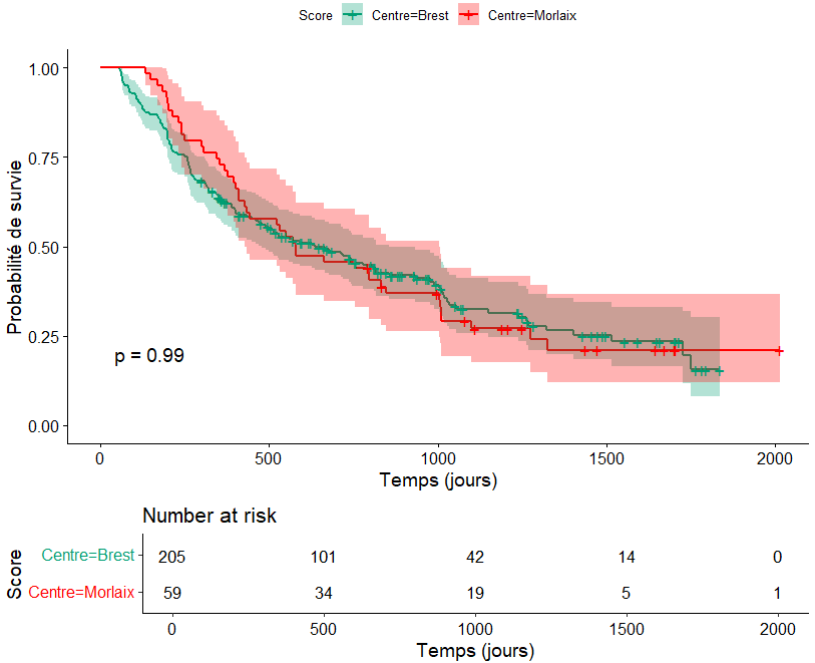

Run the model  ,
the prediction result is displayed.


⚠ Age, size and weight are filled in automatically from the Dicoms header fields. If these data are missing, you can complete them manually, as they are required for the score calculation.

*: *NSCLC-Pro Score* is the subject of a declaration of invention. Please contact contact@lifexsoft.org for further information.

# Résultats – 2ème validation externe et indépendante !

## Cohorte 3





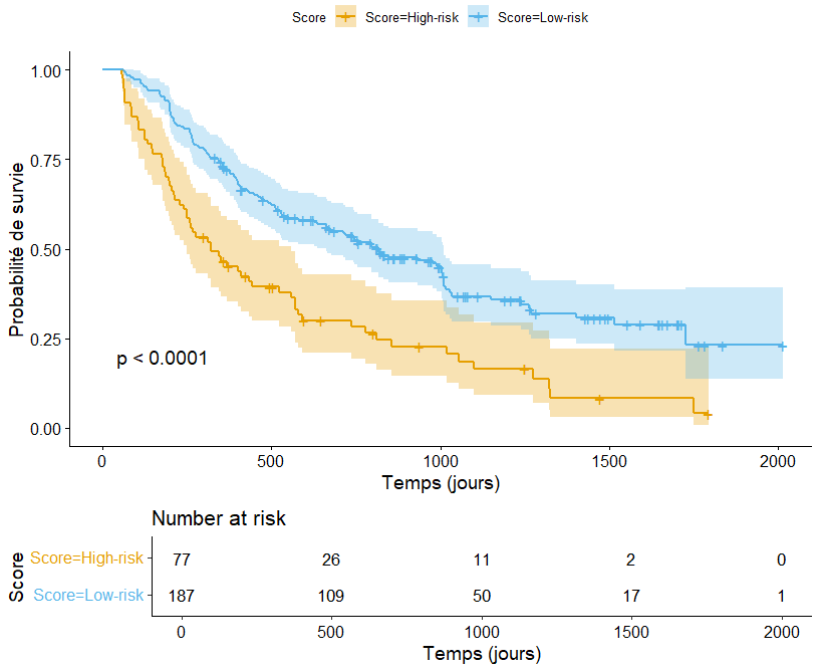
R. Abgral[1,2], D. Bourhis[1,2], V. Bourbonne[3], K. Amrane[4], C. Le Meur[3], M. Geier[5,2], R. Floch[1], K. Kerleguer[1], P. Salaün[1,2]

1: Molecular Imaging and Radiotheranostic Department, University Hospital of Brest, Brest, France
2: UMR 1304 Inserm GETBO, Brest, France
3: Radiotherapy Department, University Hospital of Brest, Brest, France
4: Oncology Department, Regional Hospital of Morlaix, Morlaix, France
5: Thoracic Oncology Department, University Hospital of Brest, Brest, France


264 patients avec CBNPC traités par ICI+chimio en 1ère et 2ème ligne

# Résultats – 2ème validation externe et indépendante !

## Cohorte 3




| | 1y-OS | 2y-OS |
|---|---|---|
| Low-risk | 82% | 67% |
| High-risk | 55% | 23% |
| Δ | 27% | 44% |
| Low-risk | 72% | 62% |
| High-risk | 39% | 21% |
| Δ | 33% | 41% |
| Low-risk | 72% | 54% |
| High-risk | 47% | 30% |
| Δ | 25% | 24% |

# Conclusion

- Développement sur une cohorte rétrospective de 197 patients
- Signature simple et interprétable
  = âge + 5 indices TEP avant traitement
- Performances prognostiques confirmées sur <u>2 cohortes indépendantes</u>
  - ✓ Total = 350 patients de 3 centres
  - ✓ ICI ou ICI+C – 1ère ou 2ème ligne
- Module **NSCLC-Pro model** disponible dans LIFEx pour validation externe