

16th
CONGRESS
Lung **ON**
CANCER

BARCELONA
27 / 28
NOVEMBER 2025

BRAF Mutations: Small Changes, Big Impact

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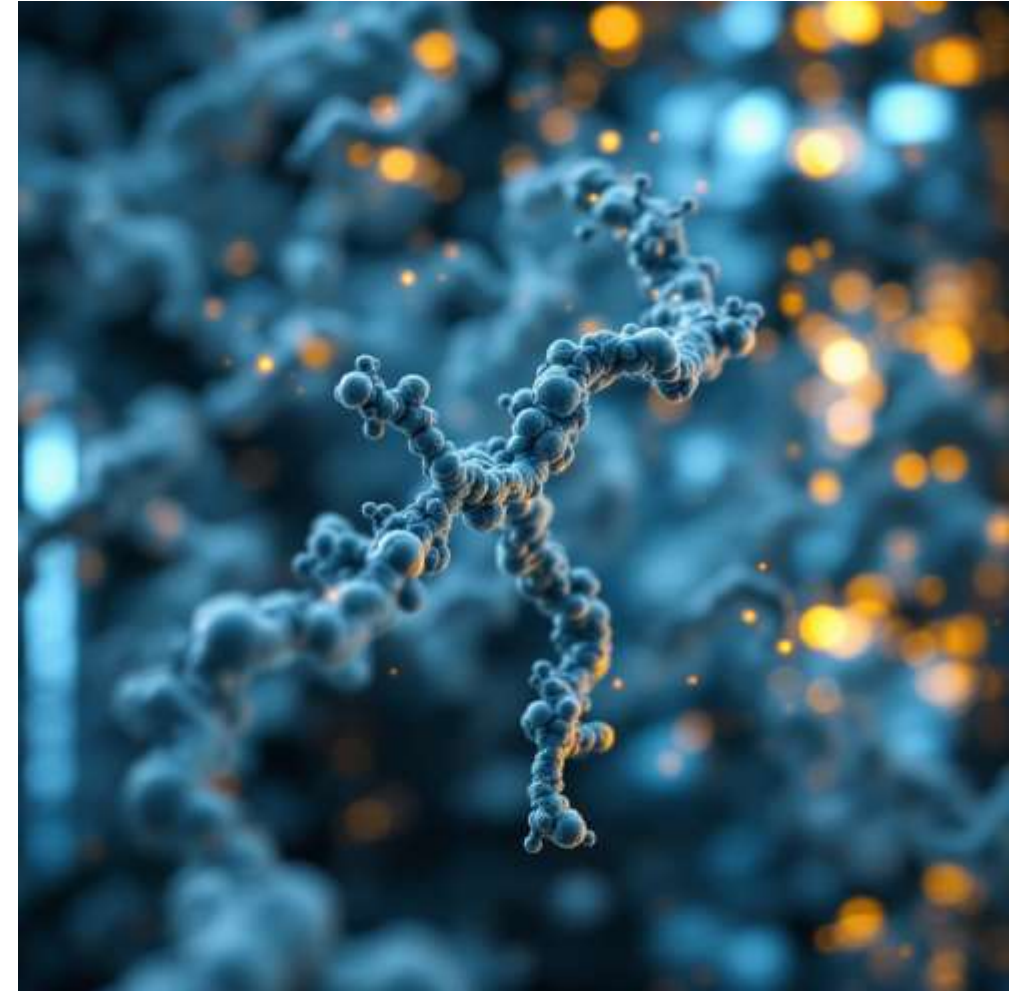
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Group Leader Onco-GIR PRO (Precision Oncology Group), IDIBGI-CERCA*

CONFLICTO DE INTERESES

- Advisory Boards: Roche, MSD, Pierre Fabre, Astrazeneca, Janssen
- Sesiones formativas: Takeda, Pfizer, Astrazeneca, BMS, Roche, Merck, Regeneron, Sanofi, Amgen, MSD
- Viajes - Congresos: Roche, MSD, Astrazeneca

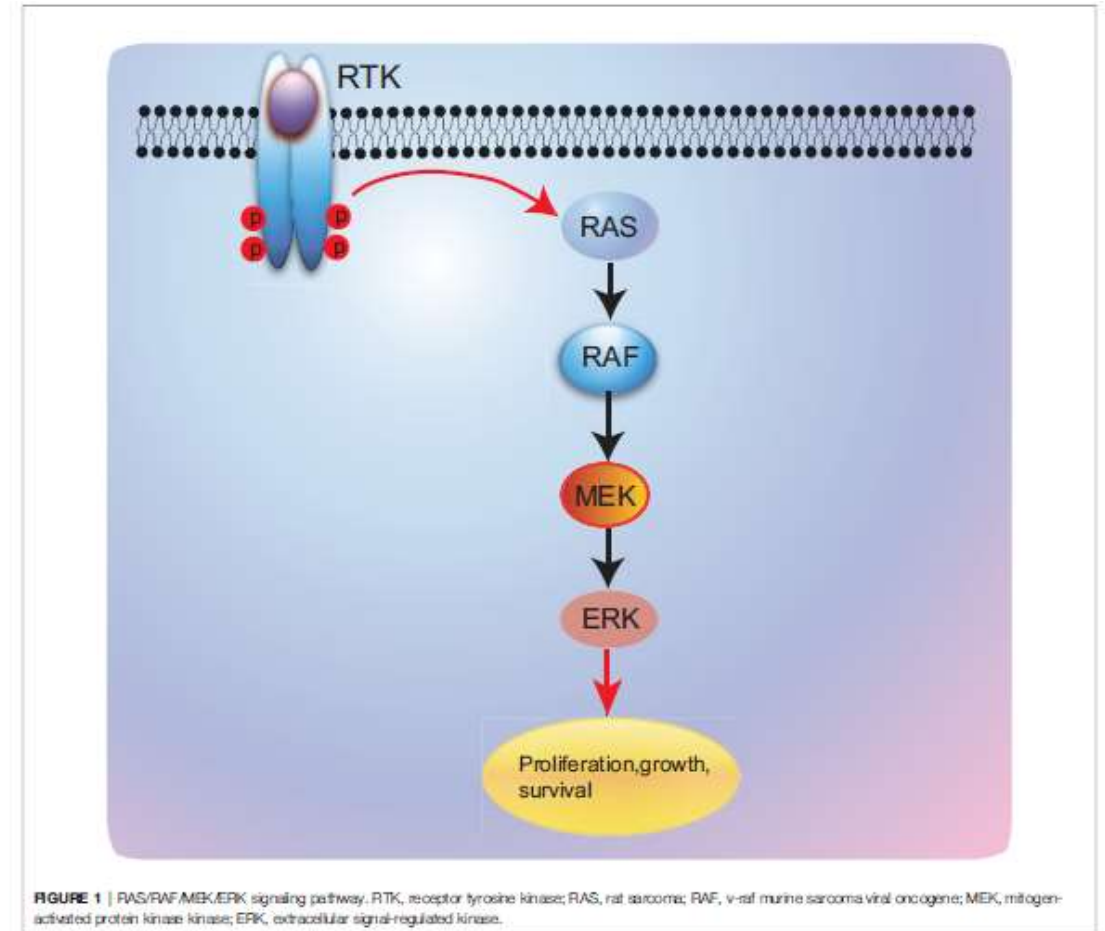
Outline

- Biology and spectrum of BRAF mutations
- Clinical phenotype and thromboembolic risk
- Treatment:
 - Targeted therapies
 - Immunotherapy
 - Sequencing



BRAF in the MAPK Pathway

- BRAF is a **serine/threonine kinase** of the RAF family
- Key component of the RAS–RAF–MEK–ERK (**MAPK**) cascade.
- Transduces signals from activated receptor tyrosine kinases
- Regulates **proliferation, differentiation and cell survival**



Classes of BRAF Mutations

- *BRAF* mutations can be classified as Class I, II or III based on the point mutation(s) and effects on the MAPK pathway^{1,2}
- Class I mutations include V600E/K/D/R/M/G³
- Class II and III encompass non-V600 *BRAF* mutations¹
- Approximately 50% of *BRAF* mutations involve the V600 point mutation^{1,4}

<i>BRAF</i> Mutation Class	Class I	Class II	Class III
Incidence, % ¹	~50%	~50%	
<i>BRAF</i> mutations ³	V600 (including V600E)	<ul style="list-style-type: none"> • G496 • G464 • R4621 • I463 • E586 • L485 	<ul style="list-style-type: none"> • L597 • A598 • T599 • K601 • A727 • P367
Effect on the MAPK pathway ^{1,4}	Promotes constitutive activity of the MAPK pathway, which causes strong activation of the <i>BRAF</i> kinase gene	Signals as RAS-independent dimers	Amplifies ERK signalling in the presence of activated upstream RTKs or coalterations that increase the RAS activity
	<u>Micropapilar, mujeres no fumadoras</u> mejor pronóstico (menos <u>Mtx SNC</u>)	<u>Mucinoso, hombres fumadores</u>	

Different classes → different biology and drug sensitivity

BRAF V600E, the only targetable mutation with approved therapies

1. Yan N, et al. Front Oncol. 2022;12:863043; 2. Dagogo-Jack I, et al. Clin Cancer Res. 2019;25(1):158-165; 3. Riudavets M, et al. Lung Cancer. 2022;169:102-114; 4. Šutić M, et al. J Pers Med. 2021;11(11):1102.

Incidence of BRAF mutations in cancer

- **BRAF mutations are present in several tumor types**

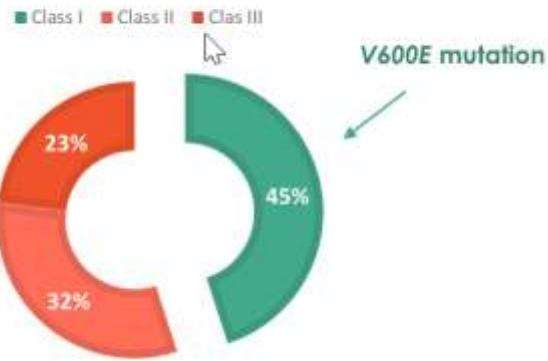
Tumor type	%	Class 1	Class 2	Class 3
Melanoma	39,6%	30,8%	5%	3,1%
NSCLC	4,1%	1,3%	1,4%	1,3%
Thyroid Carcinoma	33,3%	32,4%	0,9%	0%
Colorectal Cancer	8,7%	6,9%	0,5%	1,2%

- **Common in melanoma (up to ~40 %)**
- **Relevant subset in colorectal, thyroid and others**
- **Less frequent in NSCLC (~1–5 % of cases)**
- **Despite low prevalence, major therapeutic implications**

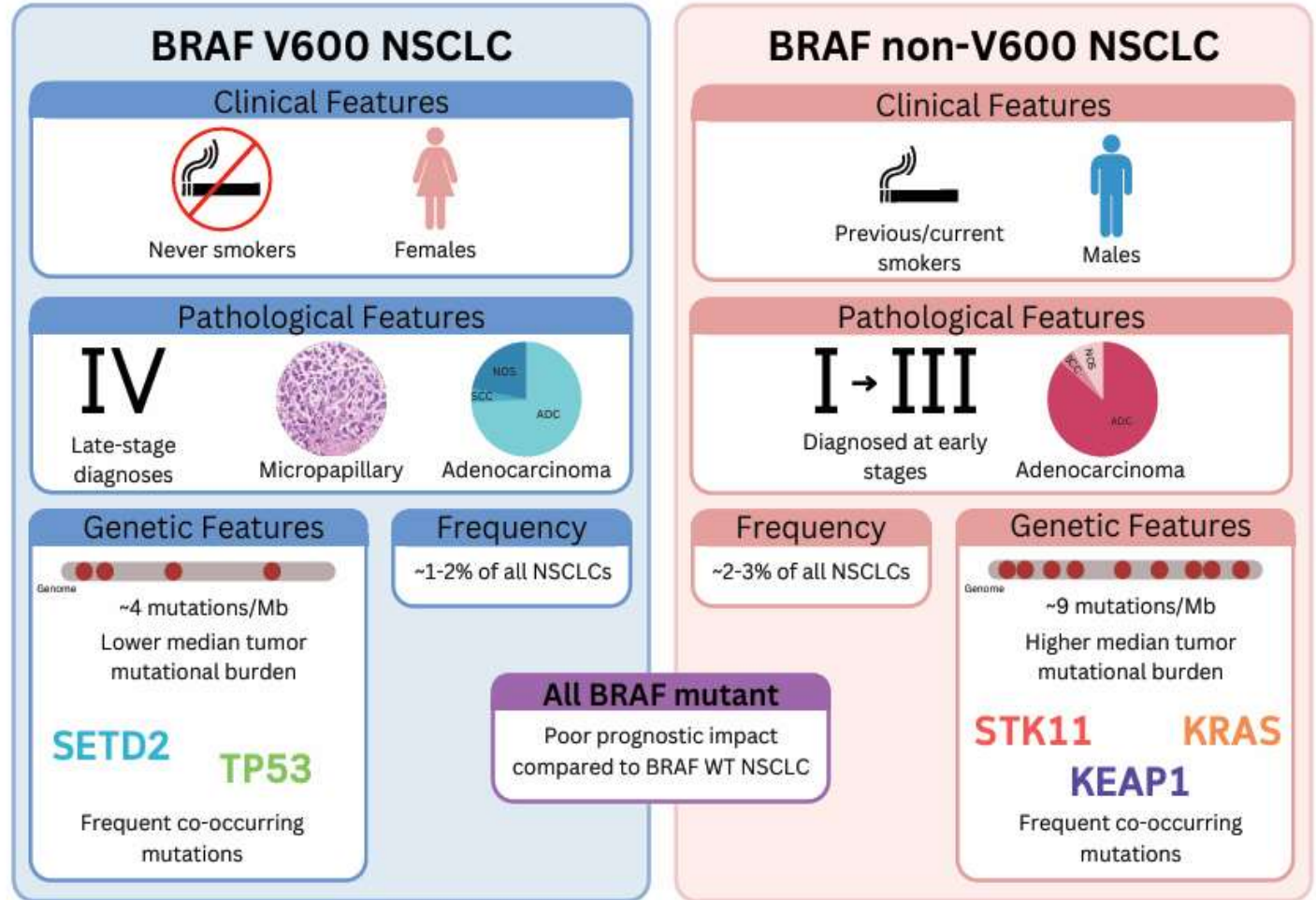
Clinical Characteristics of BRAF-Mutant NSCLC

- BRAF mutations in NSCLC**

CAUCASIAN POPULATION¹



CHINESE POPULATION²



1. Ibiayi D et al. Clin Cancer Res; 25(1) January 1, 2019. 2. Lin Q et al. J transl Med 2019;30;17(1):298. 3. Dankner M, Maxwell J, Rose AAN. The evolving treatment landscape for BRAF-mutated non-small cell lung cancer. Transl Lung Cancer Res. 2024;13(4):930-935. doi:10.21037/tlcr-24-117.

V600E: A “Small Change” With Big Consequences

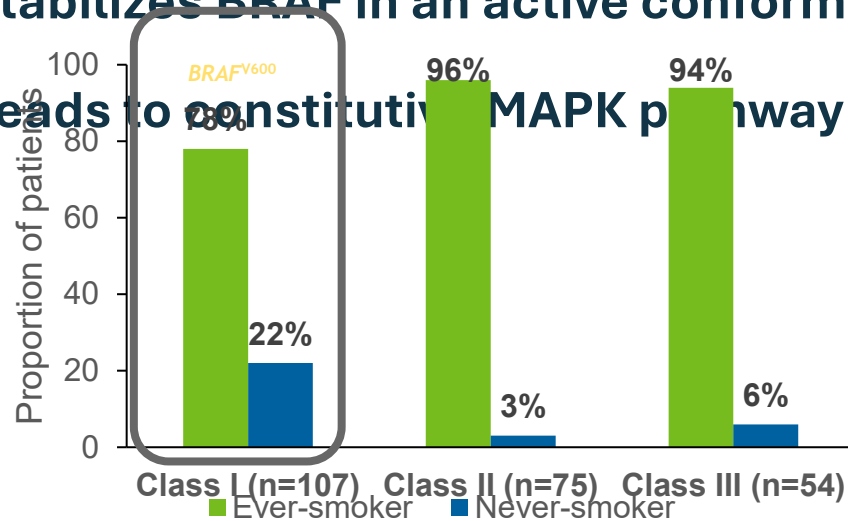
- Valine → glutamic acid substitution at codon

600

- Mimics phosphorylation of the activation segment

- Stabilizes BRAF in an active conformation

- Leads to constitutive MAPK pathway activation



Class I

- V600 mutant
- Kinase activated
- RAS-independent
- BRAF monomers



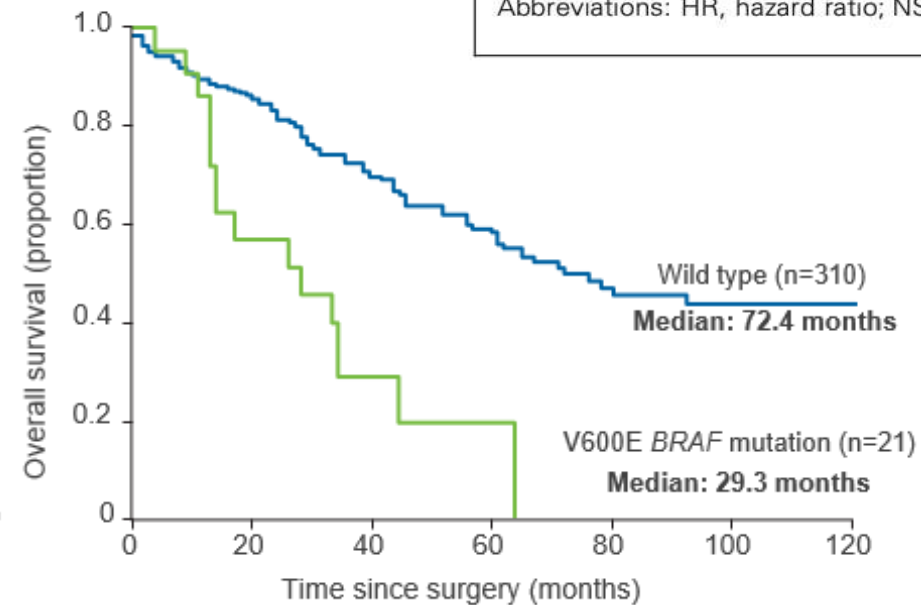
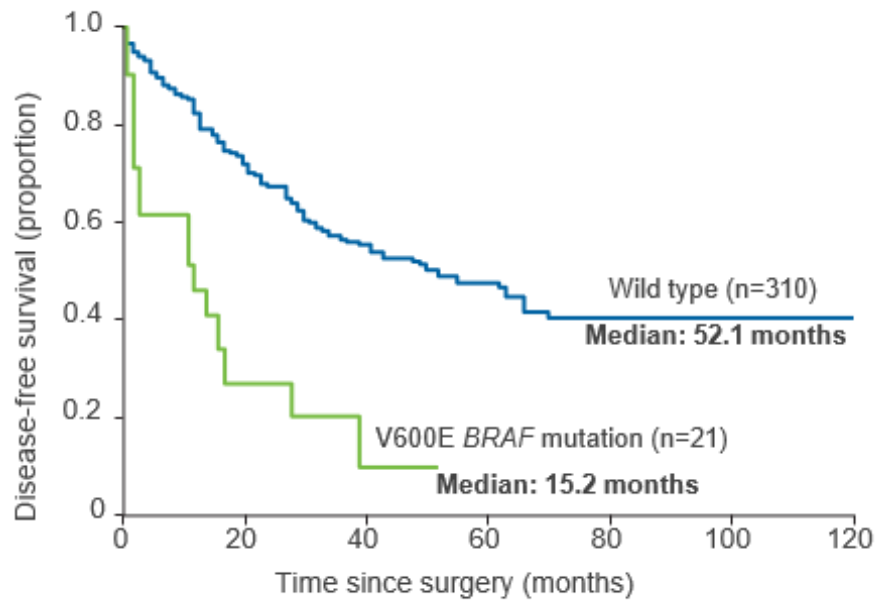
Clinical Impact of BRAF V600E in NSCLC

- **n=331 adenocarcinoma patients**
- **Bad prognostic, more common in women and never smokers, and Advanced stages**

Table 4. Association Between V600E *BRAF* Mutations and Independent Covariates Computed by Multivariate Logistic Regression Analysis

Variable	Category	Logistic Regression Analysis		
		HR	95% CI	P
Sex	Female/male	11.29	3.65 to 34.87	< .001
Smoking	Never smoker/smoker	1.19	0.45 to 3.21	.7; NS
Stage	III + IV/I + II	2.25	0.92 to 5.51	.08; NS

Abbreviations: HR, hazard ratio; NS, not significant.

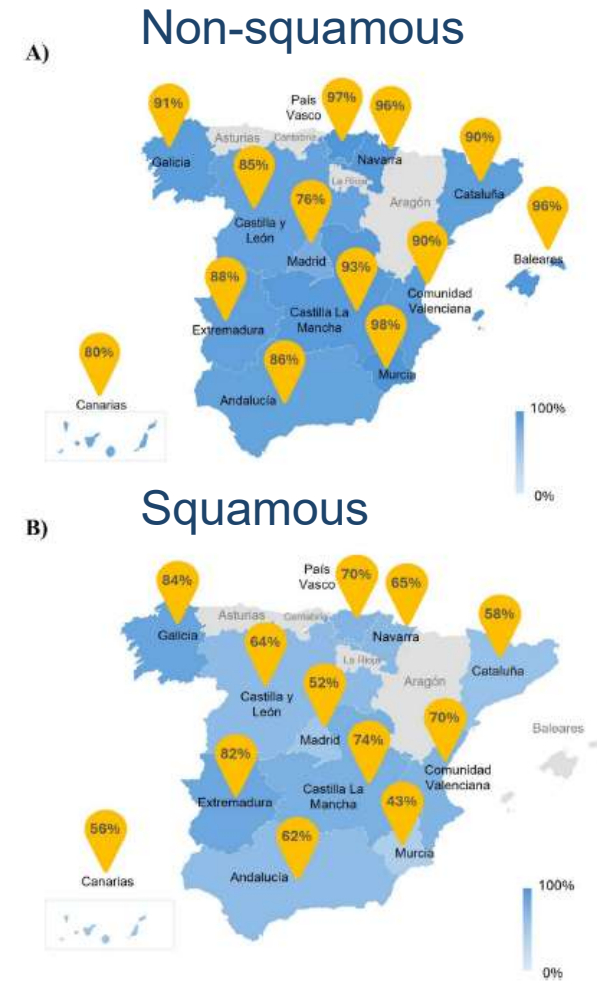


Diagnostic of BRAF in Spain

- Information from RRTT of GCEP: n= 13,583 patients with stage IV NSCLC

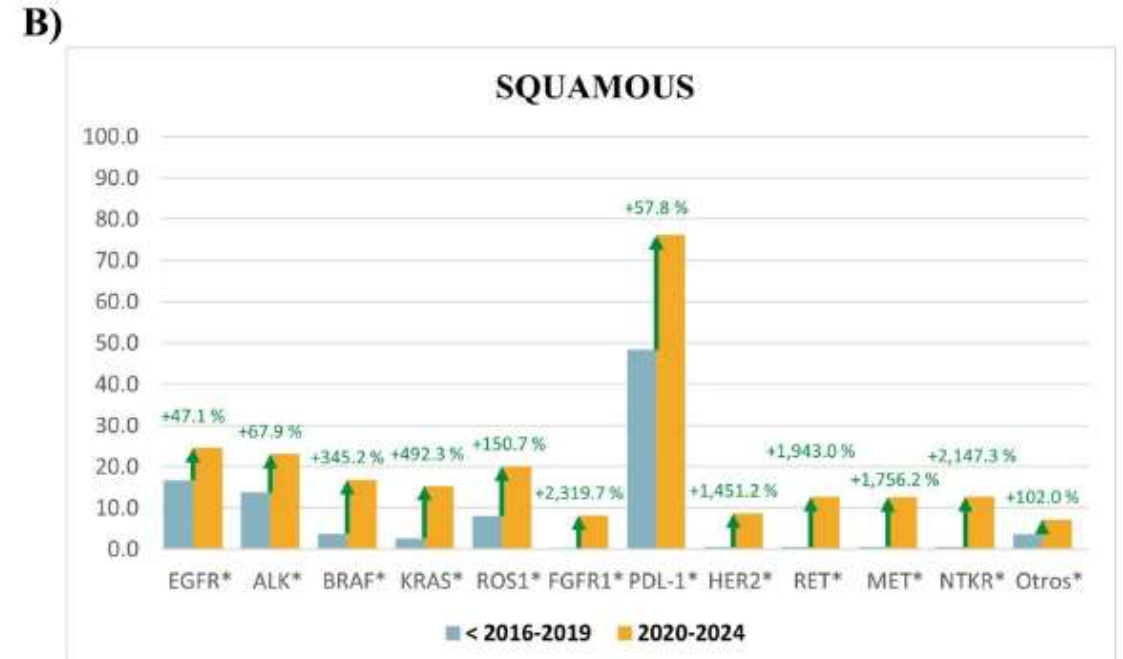
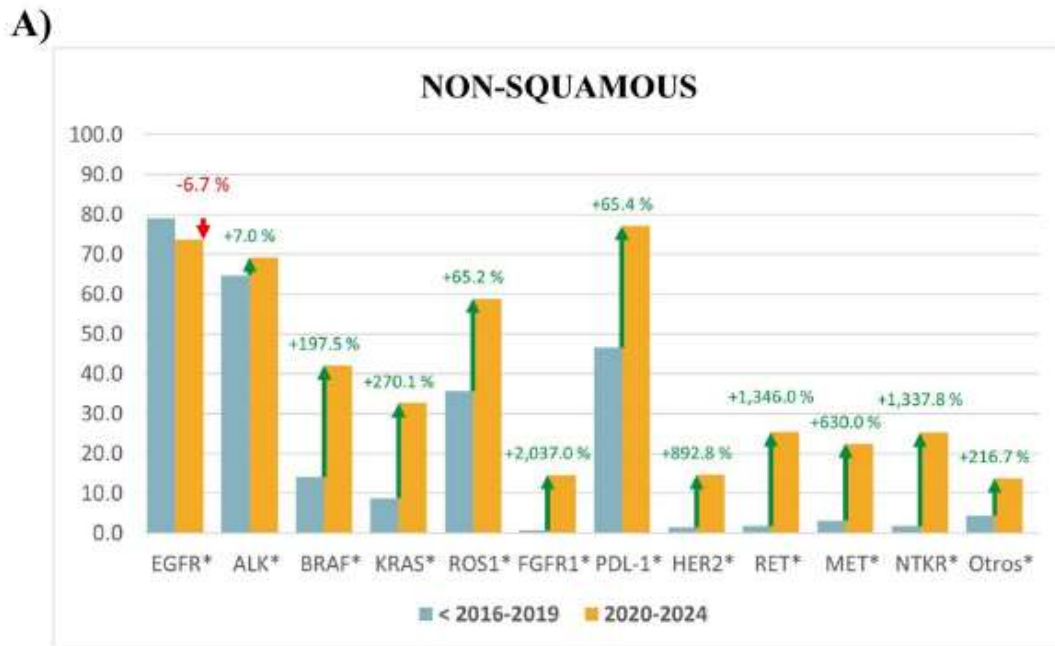
- BRAF was tested in 2,726 of 13,583 patients (20.1%)
- Non-squamous NSCLC: BRAF was tested in 23.0% of patients
- Squamous NSCLC: BRAF was tested in only 8.2% of patients.
- 4.5% of tested patients had a detectable BRAF alteration
 - (Non-squamous: 4.9% / Squamous: 0.5%)

	>600 beds	600-300 beds	<300 beds
	24.5%	13.7%	15%



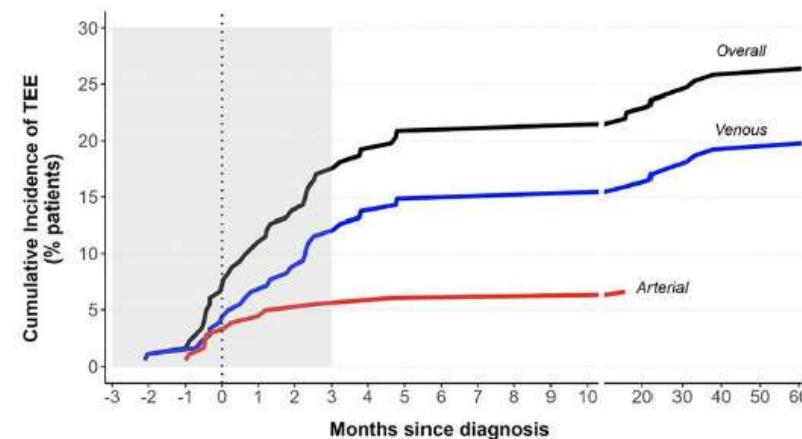
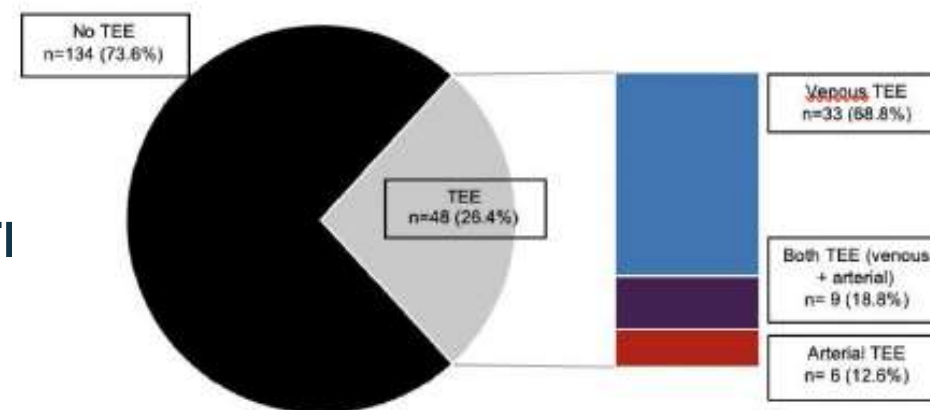
Diagnostic of BRAF in Spain

- **Information from RRTT of GECP: n= 13,583 patients with stage IV NSCLC**
 - • Increase in time: currently around 40% in Non-squamous and 15% in squamous histology



Study of Thromboembolic Risk in BRAF mutated patients

- Multicenter retrospective study in Spain (2008-2021)
- N=182 patients with BRAF mutations (70 with V600E)
- Objective: characterize incidence, timing and impact of TE
- Incidence 26.4 % (95 % CI 19.9–32.9)
- Venous TEE (82%), Arterial TEE (18%)
- Median time to TEE: 2 months (range -0.2–4.8) -> 69 % of TEE occurred in the peridiagnostic window (± 90 days of diagnosis)
- Classical risk factors and Khorana score did not identify high risk patients



Thrombosis appears as a distinct clinical hallmark of BRAF-mutant NSCLC

Timeline of treatment of NSCLC BRAF V600E

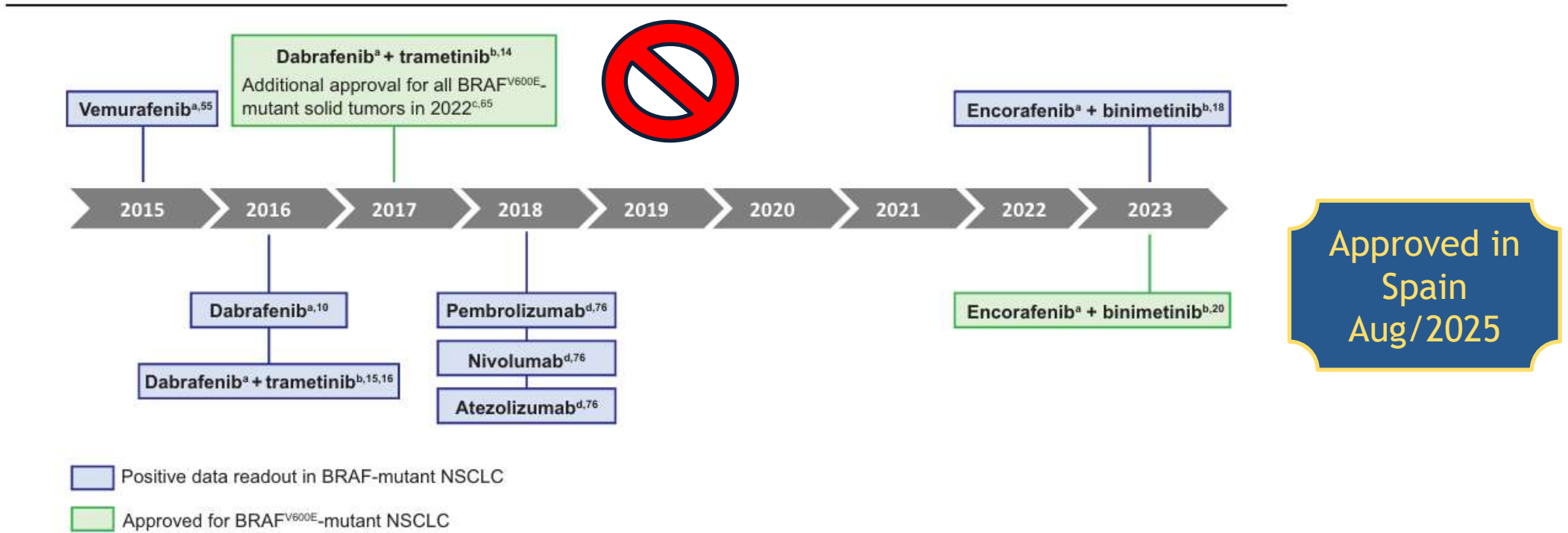


Fig. 2 | Timeline of key advancements in the treatment of BRAF^{V600E}-mutant NSCLC. Positive data readouts for BRAF-mutant NSCLC (blue) and approved treatments for BRAF^{V600E}-mutant NSCLC (green) are shown. ^aBRAF inhibitors. ^bMEK inhibitors. ^cIn 2022, dabrafenib plus trametinib was approved for

patients with unresectable metastatic BRAF^{V600E}-mutant solid tumors who progressed on previous treatments and have no acceptable alternative option. ^dImmunotherapy that targets PD-1. ^eImmunotherapy that targets PD-L1.

Treatment with IO of BRAF V600E NSCLC

- No data from pivotal trials of IO / IO-CT for BRAF mutated patients (if included):

A) IO-CT non selected molecular patients:

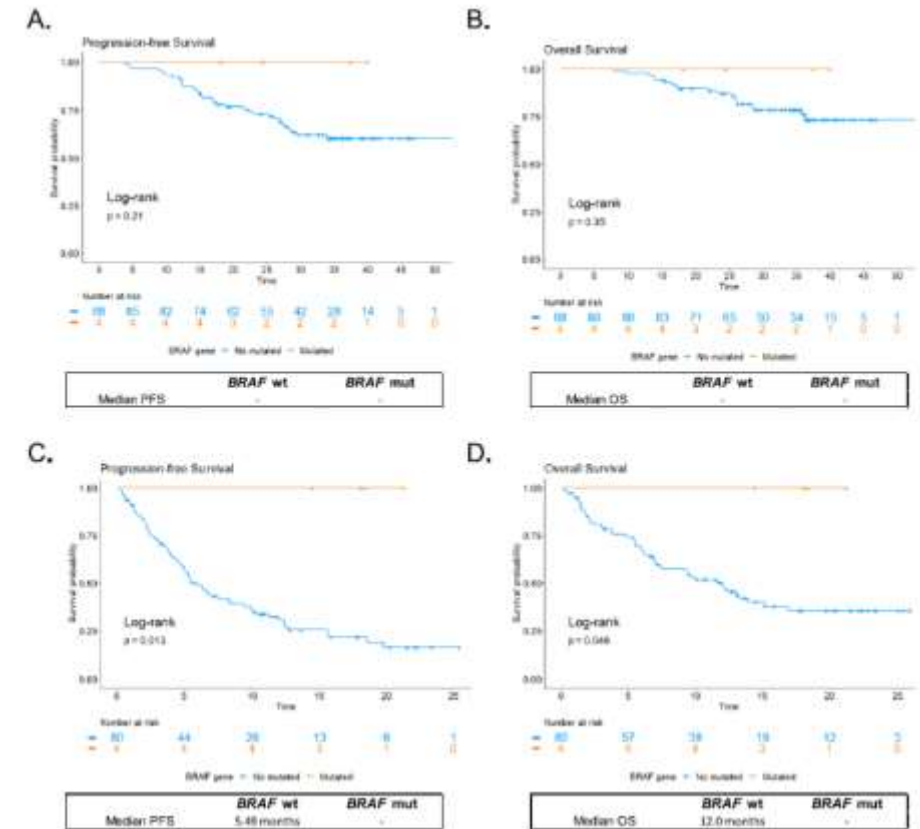
PFS: 7-8.8 months / OS: 15.6-22.2 months

B) IO (PD-L1 high):

PFS: 8.1-10.3 months / OS: 20.2-30 months

- Are BRAF mutated patients more sensitive to IO?

Results from NADIM trials (neoadjuvant CT-IO, n=4 (3.5%)) and retrospective analysis (n=4 (4.76%)) shows better results but small number of BRAFm patients

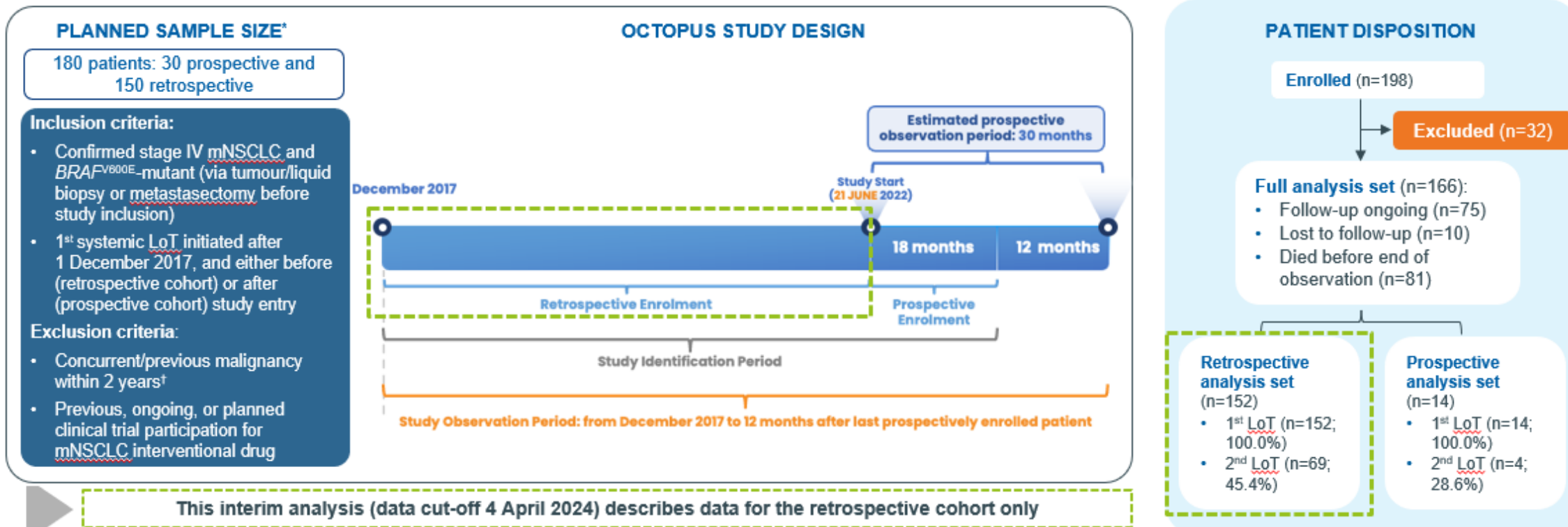


Treatment of BRAF V600E NSCLC

Objective: OCTOPUS (NCT05546905) is an ongoing study which aims to address knowledge gaps in the real-world management of BRAF^{V600E}-mutant metastatic NSCLC (mNSCLC) in Europe by analysing clinical characteristics, treatment patterns, and outcomes

Study design: OCTOPUS is a multicentre, observational, descriptive, ambispective study in patients aged ≥ 18 years with BRAF^{V600E}-mutant mNSCLC

Study site locations: France, Germany, Italy, Spain, and the United Kingdom



*The sample size was determined based on the precision with which the 95% CI of the primary outcome could be estimated (<6%). [†]Except for curatively treated basal or squamous cell skin cancer, prostate intraepithelial neoplasm, cervical carcinoma *in situ*, Bowen's disease or Gleason ≤ 6 prostate cancer.

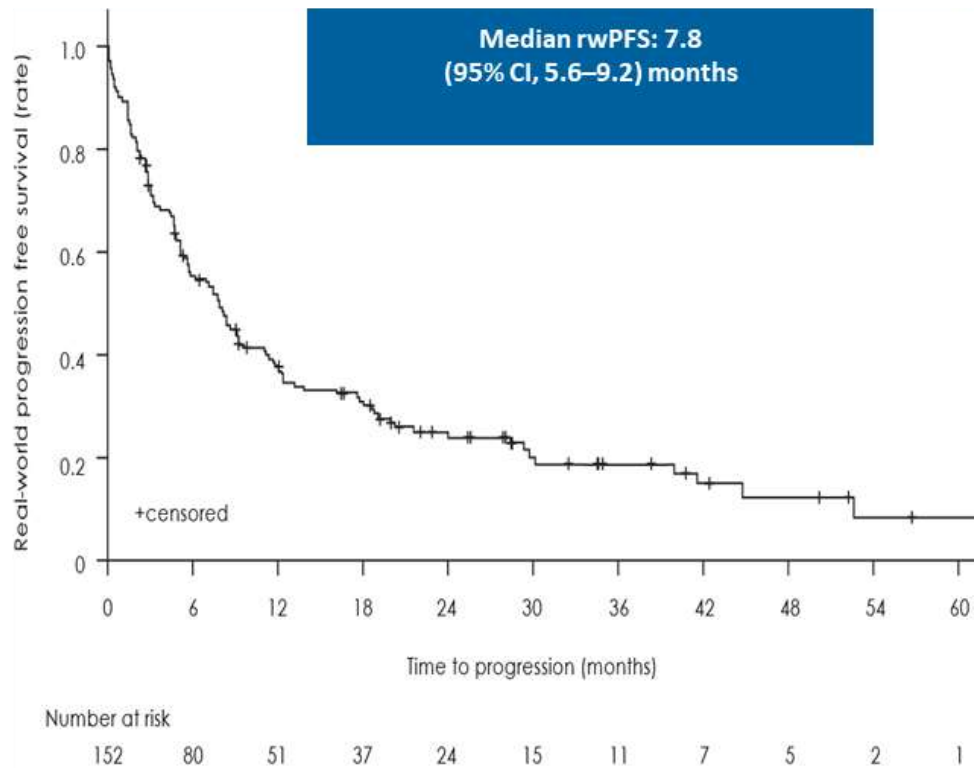
BRAF, B-Raf proto-oncogene serine/threonine-protein kinase; CI, confidence interval; LoT, line of therapy; mNSCLC, metastatic non-small cell lung cancer.

Treatment of BRAF V600E NSCLC

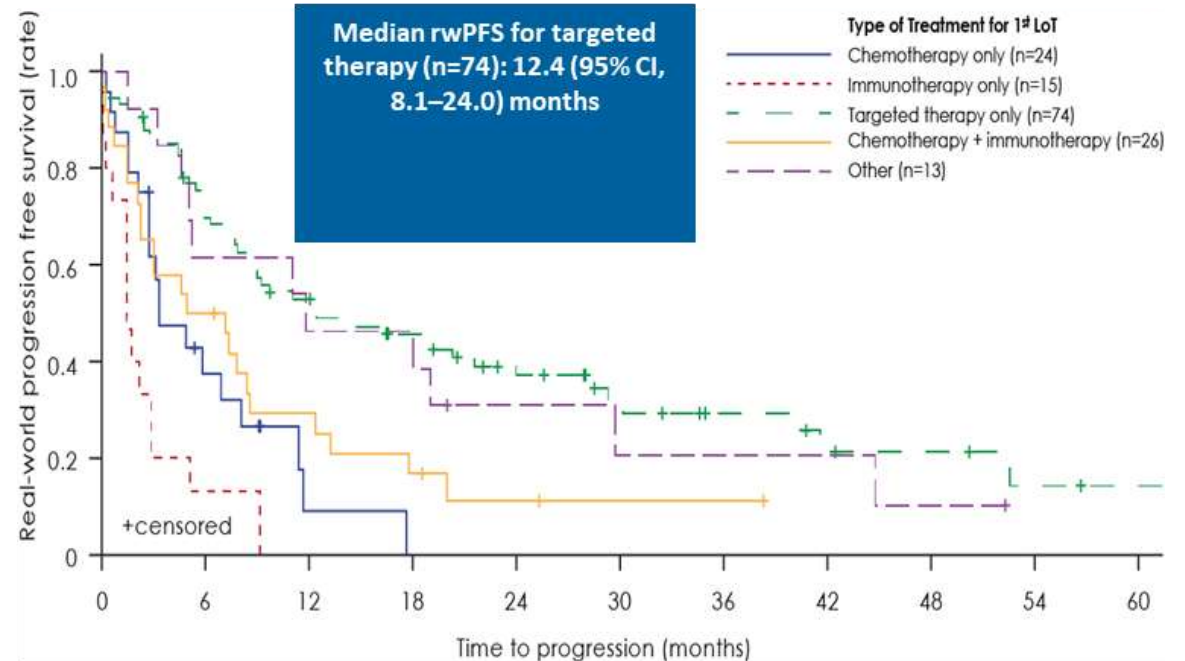
OCTOPUS: outcomes 1st line (interim analysis, data cut-off 4 April 2024)

First line Targeted therapy seems better, than CT, CT-IO or IO (n=152 patients)

rwPFS* in 1st LoT (n=152)



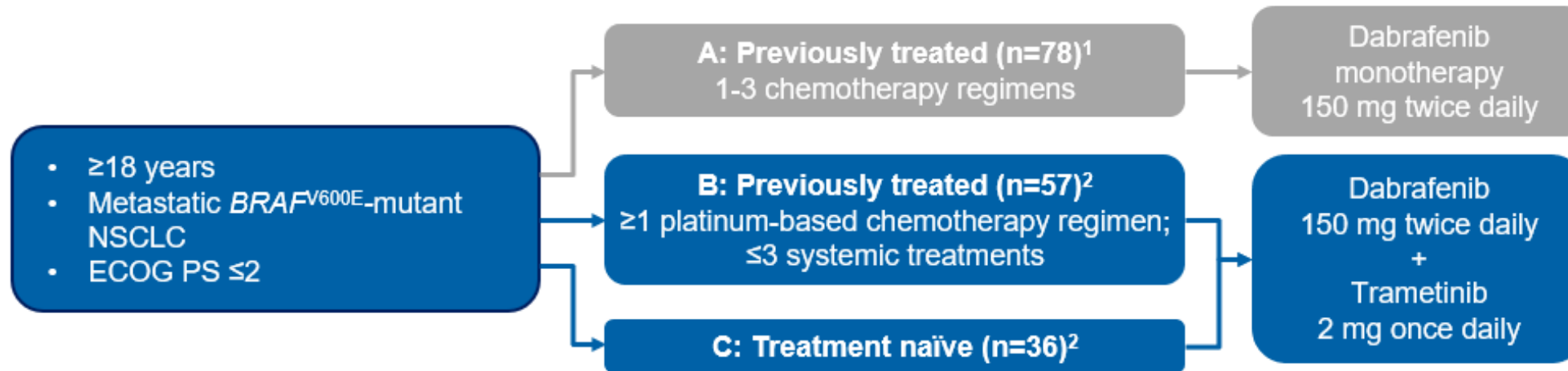
rwPFS* in 1st LoT by treatment type (n=152)



Targeted therapy for NSCLC BRAF V600E

BRF113928: Dabrafenib + Trametinib

- Phase 2 multicentric trial. 3 arms: Monotherapy, combo previously treated, combo naive.
- Small number of patients



Endpoints

- Primary: ORR (investigator assessed)
- Secondary: PFS and DOR (investigator assessed), OS, safety, tolerability and pharmacokinetics

Targeted therapy for NSCLC BRAF V600E

BRF113928: Dabrafenib + Trametinib

Investigator-assessed best response	Previously treated (n=57)	Treatment naïve (n=36)
ORR (CR + PR), % (95% CI)	68.4 (54.8-80.1)	63.9 (46.2-79.2)
CR, n (%)	3 (5)	2 (6)
DCR (CR + PR + SD), % (95% CI)	80.7 (68.1-90.0)	75.0 (57.8-87.9)
Median PFS, months (95% CI)	10.2 (6.9-16.7)	10.8 (7.0-14.5)
Median OS, months (95% CI)	18.2 (14.3-28.6)	17.3 (12.3-40.2)
Median DOR, months (95% CI)	9.8 (6.9-18.3)	10.2 (8.3-15.2)



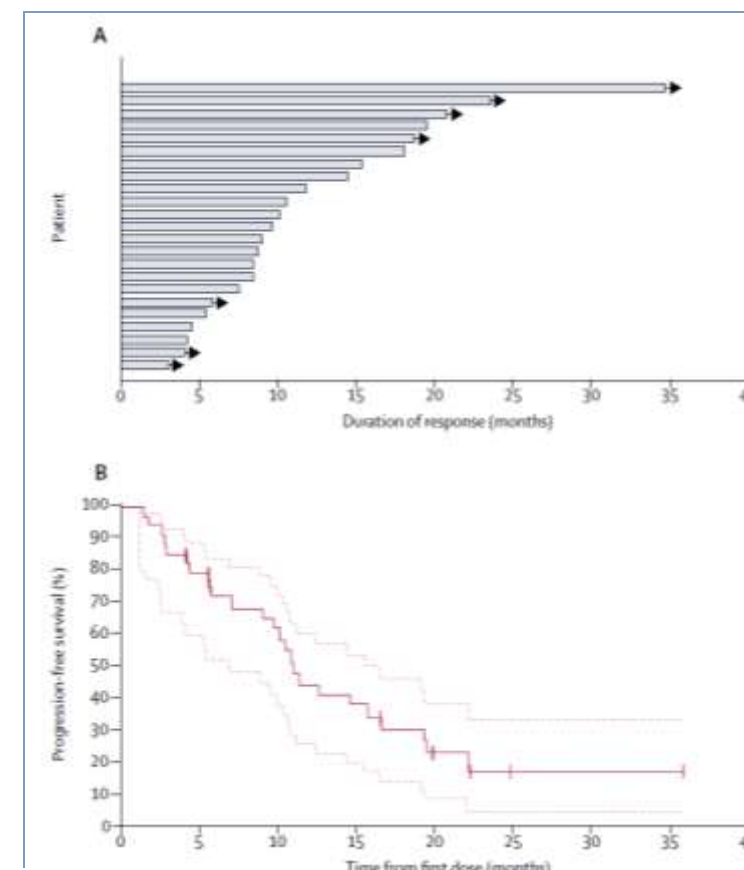
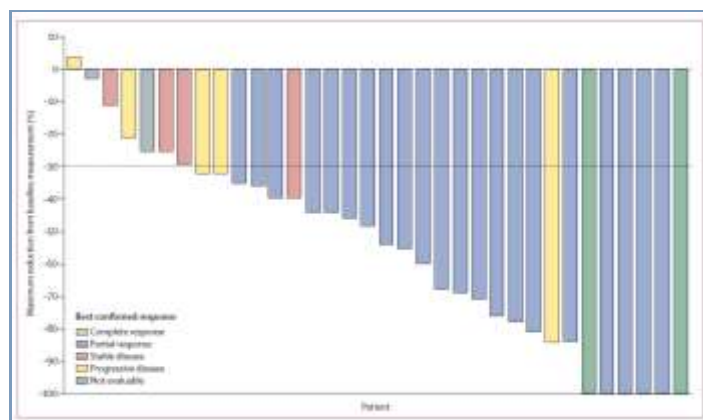
June/2017



Aug/2017



Oct/2018



1. Planchard D, et al. *Lancet Oncol.* 2016;17(5):642-650; 2. Planchard D, et al. *J Thorac Oncol.* 2022;17(1):103-115.

Targeted therapy for NSCLC BRAF V600E

PHAROS: Encorafenib-binimetinib

- Phase 2 multicentric trial. 2 arms: previously treated or naive.



Objective: To determine the safety, tolerability and efficacy of encorafenib given in combination with binimetinib in patients with BRAF^{V600E}-mutant metastatic NSCLC who are either treatment naïve or who have been previously treated with platinum-based chemotherapy and/or anti-PD-1/PD-L1 inhibitor therapy*

Key eligibility criteria

- Metastatic BRAF^{V600E}-mutant NSCLC
- ECOG performance status 0 or 1
- No EGFR mutation, ALK fusion or ROS1 rearrangement
- No more than 1 prior line of treatment in the advanced setting
- No prior treatment with BRAF or MEK inhibitor
- No symptomatic brain metastases

BRAF mutation testing

- Determined locally by PCR- or NGS-based assay; sent to central laboratory[†]
- Pleural fluid, fresh and archived tissue, and fine needle aspiration were acceptable[‡]

Patients enrolled

Treatment naïve
n=59

Previously treated
n=39

Encorafenib: 450 mg QD
Binimetinib: 45 mg BID
28-day cycles
Treat until progression or unacceptable toxicity

Primary endpoint

- ORR[‡] by IRR

Secondary endpoints

- ORR by investigator
- DOR, DCR, PFS and TTR (all by IRR and investigator)
- OS
- Safety

Exploratory endpoints

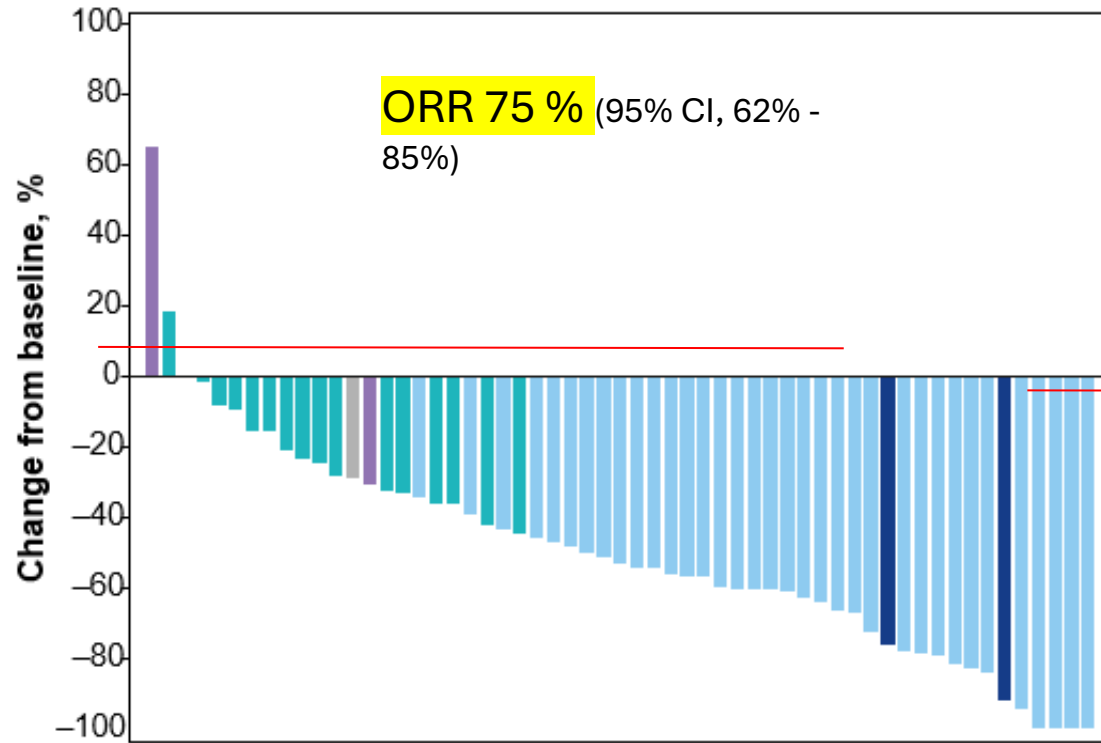
- Biomarker and pharmacokinetic analyses

*PHAROS also allowed for the enrollment of patients with less common BRAFV600 mutations other than V600E in a third arm, but no patients were recruited into this arm so are not shown above. [†]BRAF^{V600} mutations were retrospectively confirmed by FoundationOne CDx (Foundation Medicine, Cambridge, MA). [‡]According to RECIST 1.1.

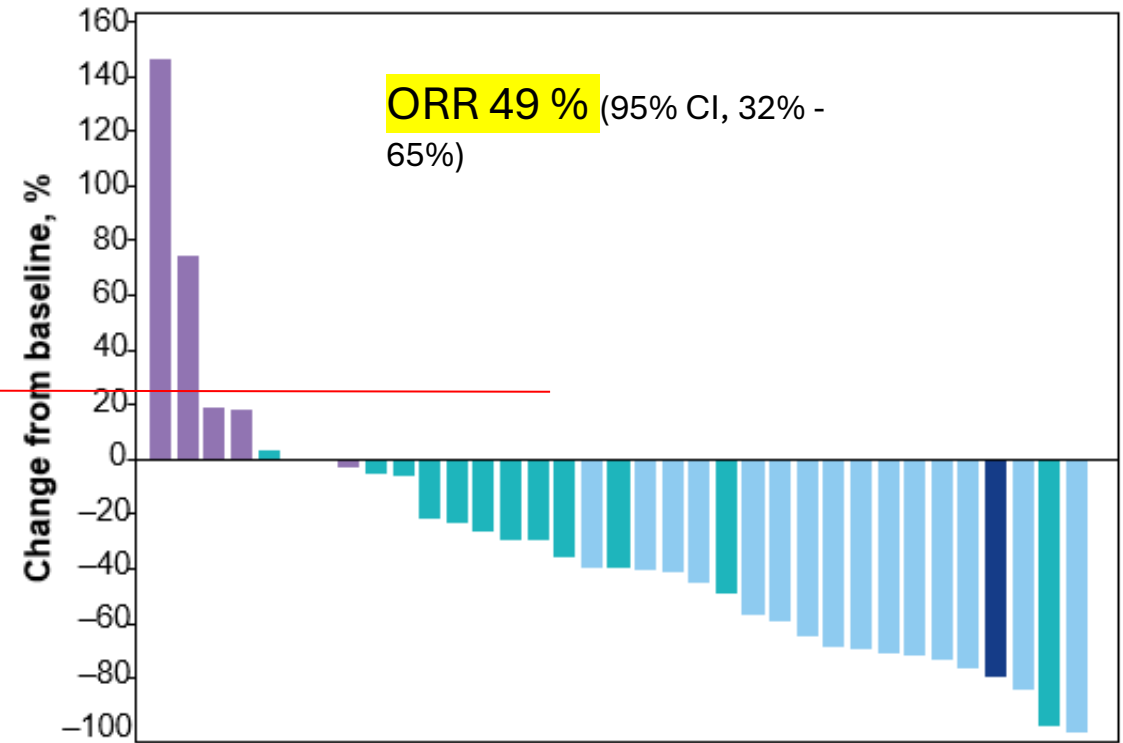
Targeted therapy for NSCLC BRAF V600E

PHAROS: Encorafenib-binimetinib

Treatment naïve (n=57)



Previously treated (n=35)



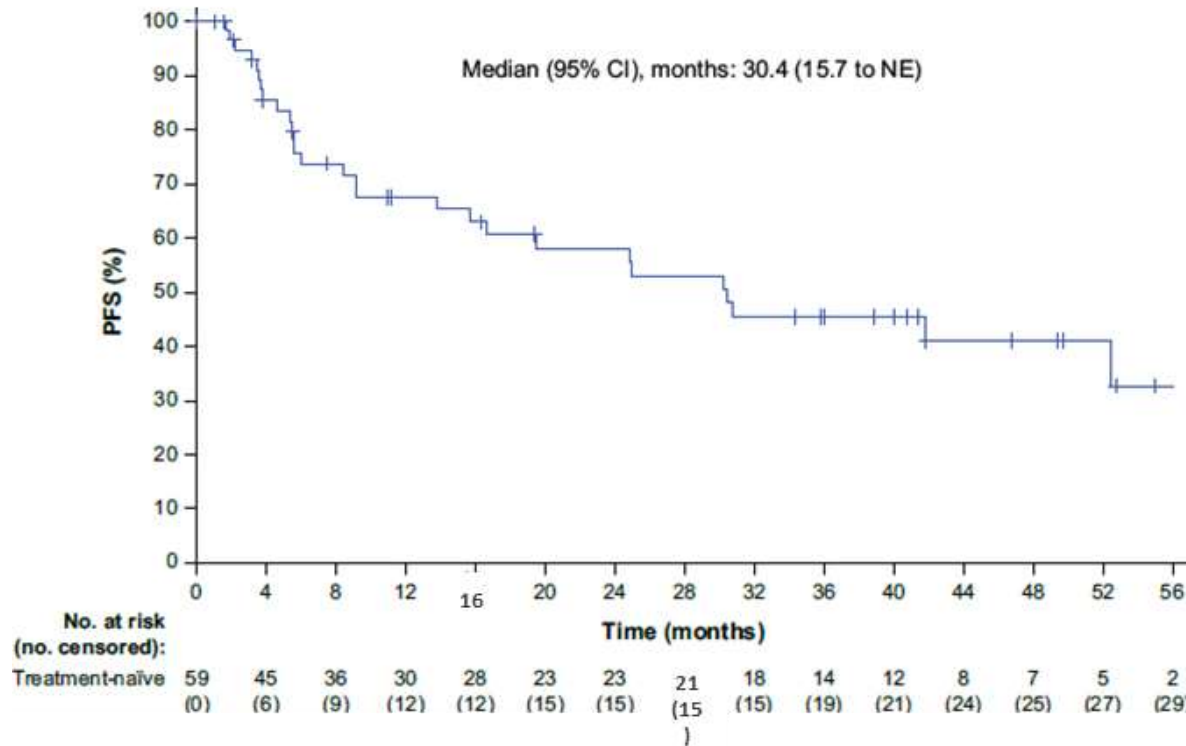
■ Complete response ■ Partial response ■ Stable disease ■ Progressive disease ■ Not evaluable

Targeted therapy for NSCLC BRAF V600E

PHAROS: Encorafenib-binimetinib

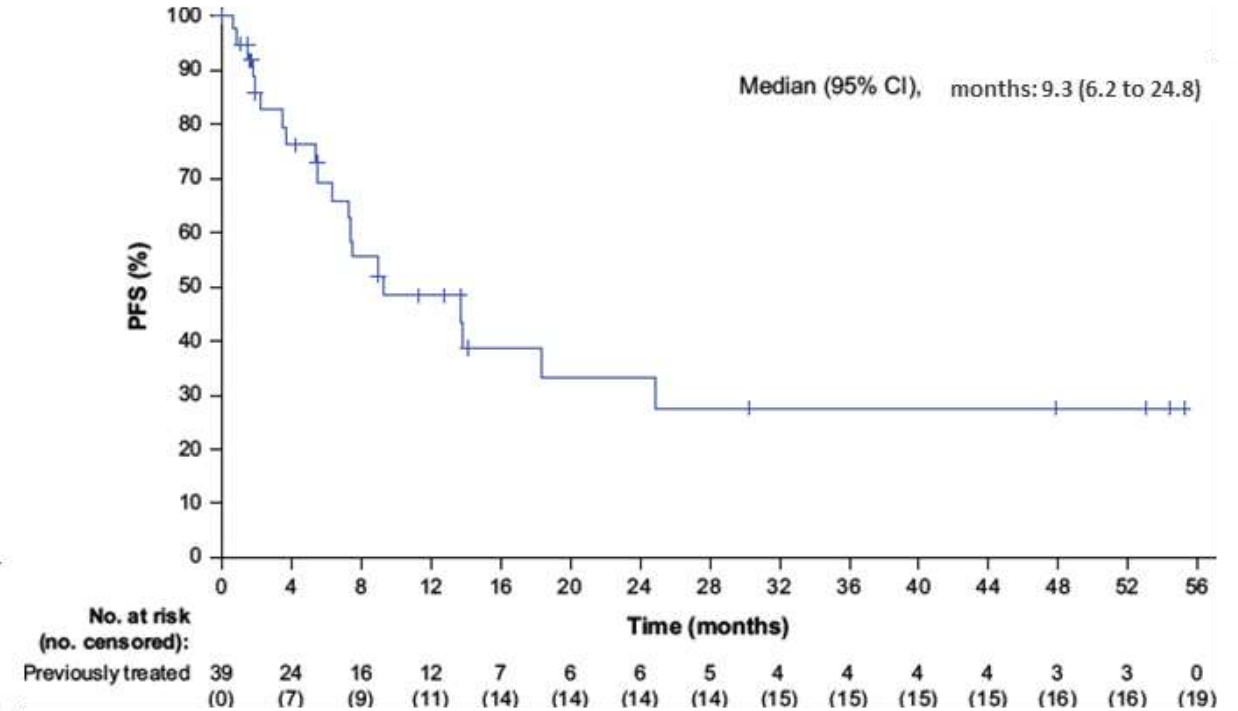
Treatment Naïve

PFS= 30.4 m



Previously treated

PFS= 9.3 m



Targeted therapy for NSCLC BRAF V600E

PHAROS: Encorafenib-binimetinib



Oct/2023



Aug/2024

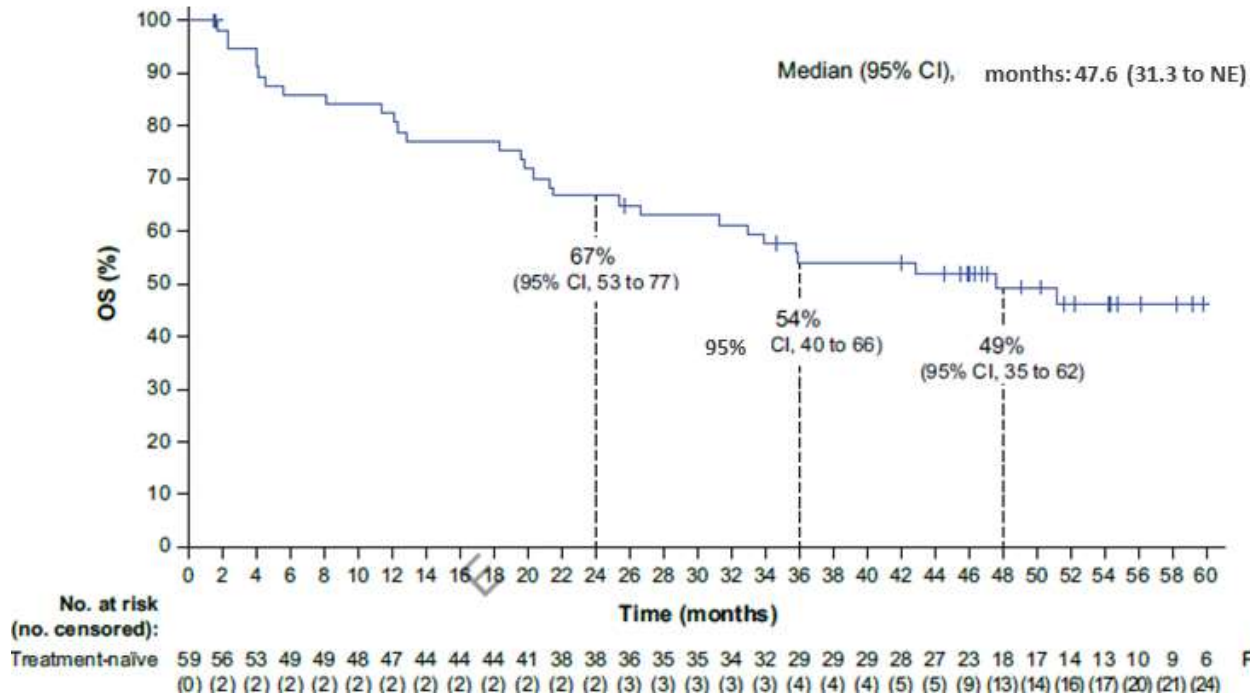


Jul/2025



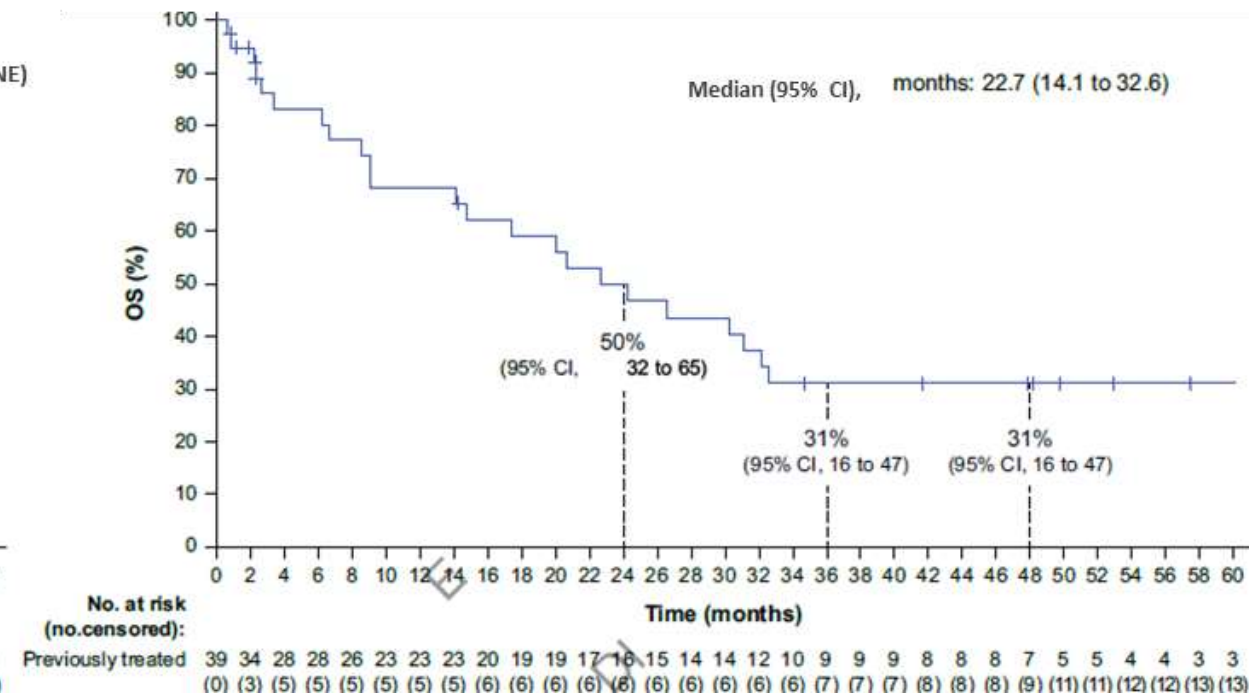
OS= 47.6 m

Treatment Naïve



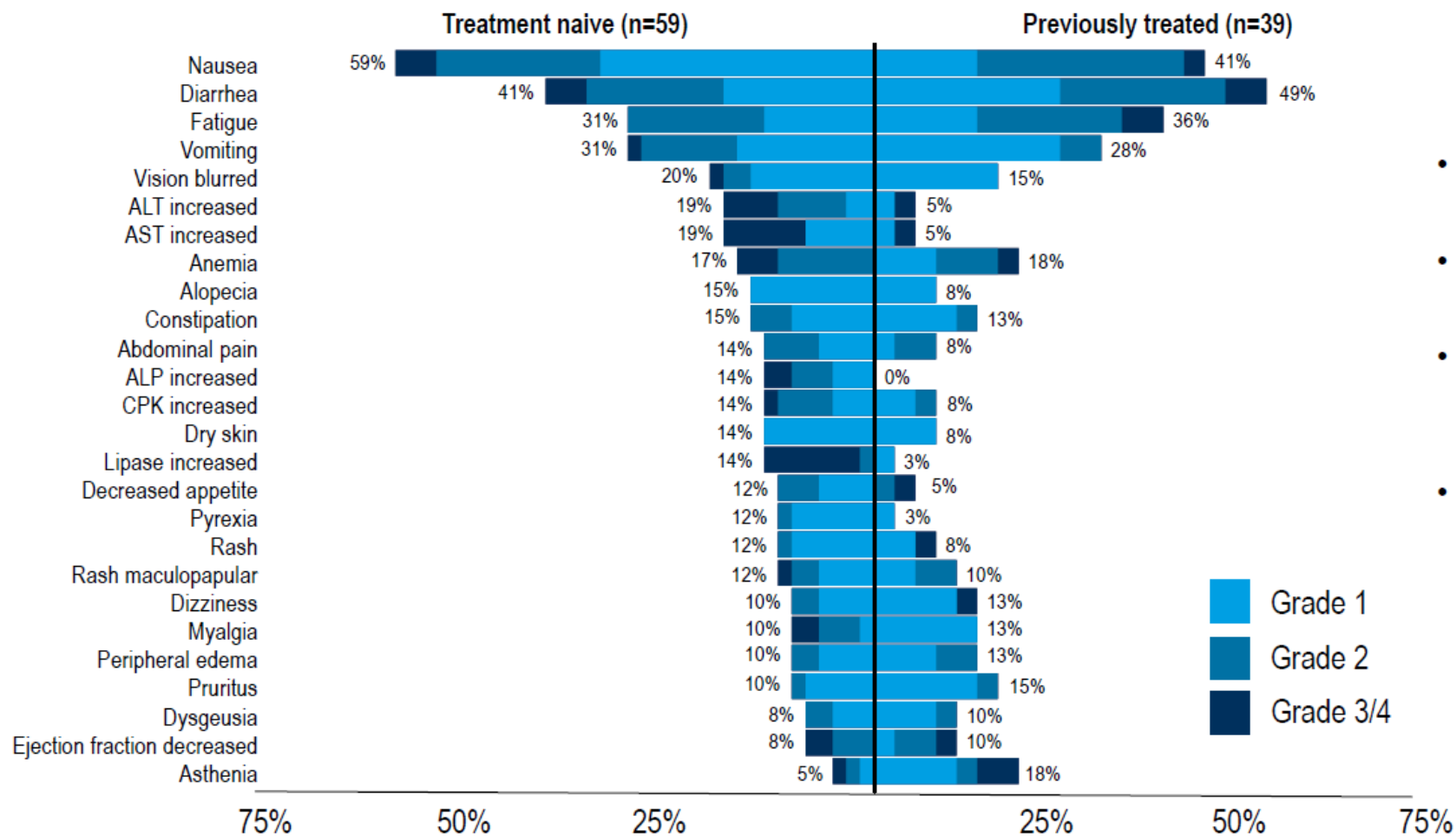
OS= 22.7 m

Previously treated



Targeted therapy for NSCLC BRAF V600E

PHAROS: Encorafenib-binimetinib



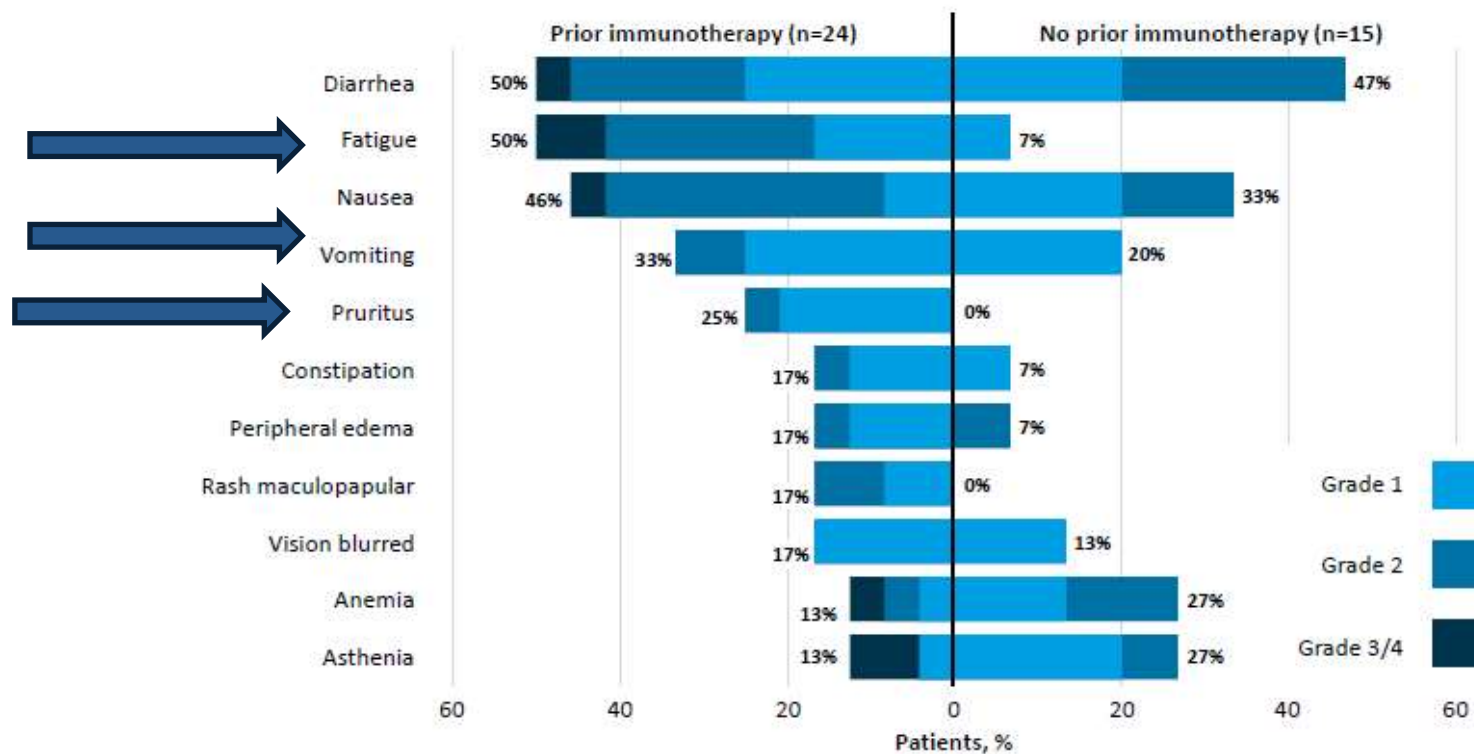
- Safety profile was consistent with prior analyses^{1,2}
- No new safety signals were observed with longer follow-up
- Treatment-related AE profiles were comparable across both treatment lines
- Similar to the prior analysis,² any-grade treatment-related pyrexia occurred in 8% of patients; all were grade 1/2 in severity

AE, adverse event; ALP, alkaline phosphatase; ALT, alanine aminotransferase; AST, aspartate aminotransferase; CPK, creatine phosphokinase.
 1. Riely GJ, et al. *J Clin Oncol*. 2023;41(21):3700-3711. 2. Riely GJ, et al. *J Thorac Oncol*. Published online June 4, 2025.

Targeted therapy for NSCLC BRAF V600E

PHAROS: Encorafenib-binimetinib

TRAEs ($\geq 15\%$) in previously treated patients with or without prior immunotherapy: current analysis



TRAE, treatment-related adverse event.

Targeted therapy for NSCLC BRAF V600E

Encorafenib-binimetinib: IFCT 1904 ENCO-BRAF

ENCO-BRAF Study Design

single-arm, open-label, multicenter phase II trial

Patients with BRAF-V600E-mutant metastatic NSCLC

Key inclusion criteria

- ≥ 18 years
- WHO performance status 0-1
- BRAF V600E mutation (enrolment by local assay)
- No prior anti-BRAF cancer therapy
- Stable CNS metastases allowed
- 1st or 2nd line

COHORT A
1st line

N = 60

Binimetinib: 45mg bid
Encorafenib: 450 mg QD
28-Day cycles

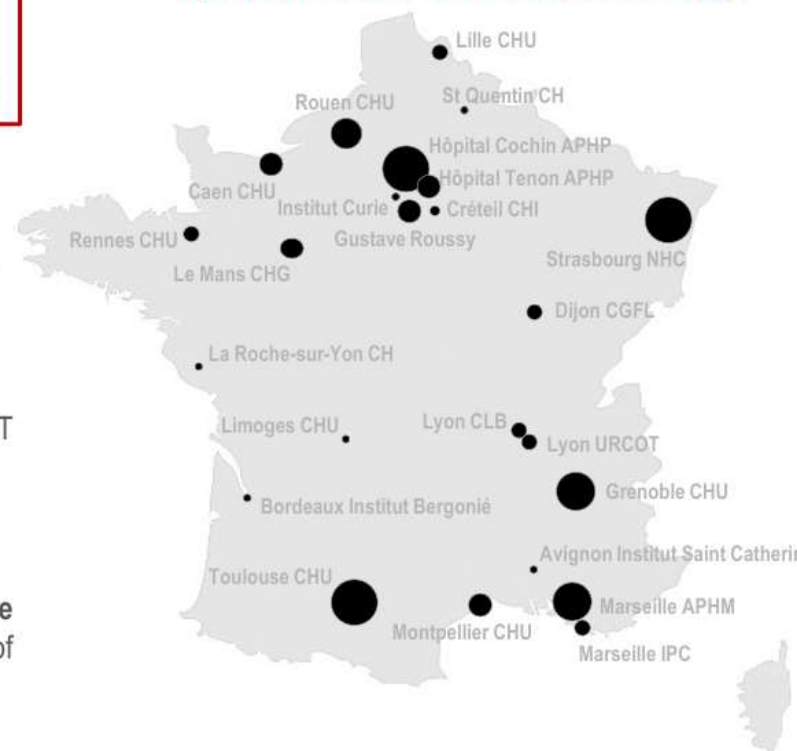
COHORT B
2nd line

N = 59

Binimetinib: 45mg bid
Encorafenib: 450 mg QD
28-Day cycles

24 French sites

(enrolment : March 2021 to September 2023)



Cohort A: 1st line Encorafenib plus Binimetinib

The primary endpoint: confirmed ORR according to the investigator evaluation RECIST (v1.1) every 8 weeks (for 12months then every 12 weeks)

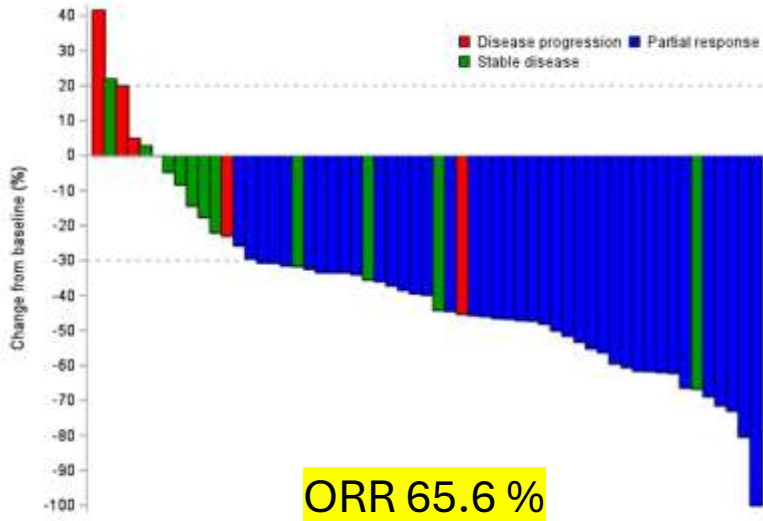
Secondary endpoints include PFS, DOR, DCR, OS and safety.

Study was designed to test the null hypothesis (H0) of $\leq 40\%$ ORR in treatment-naïve patients and an alternative target rate of at least 60% (H1) with a one-sided α error of 0.05. 60 patients to be included

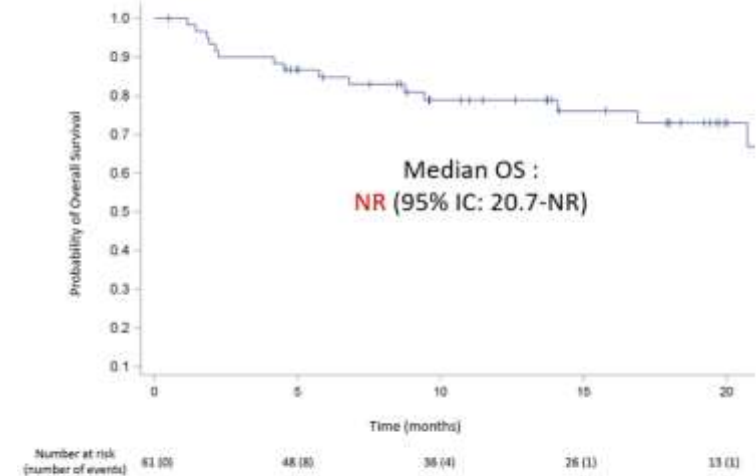
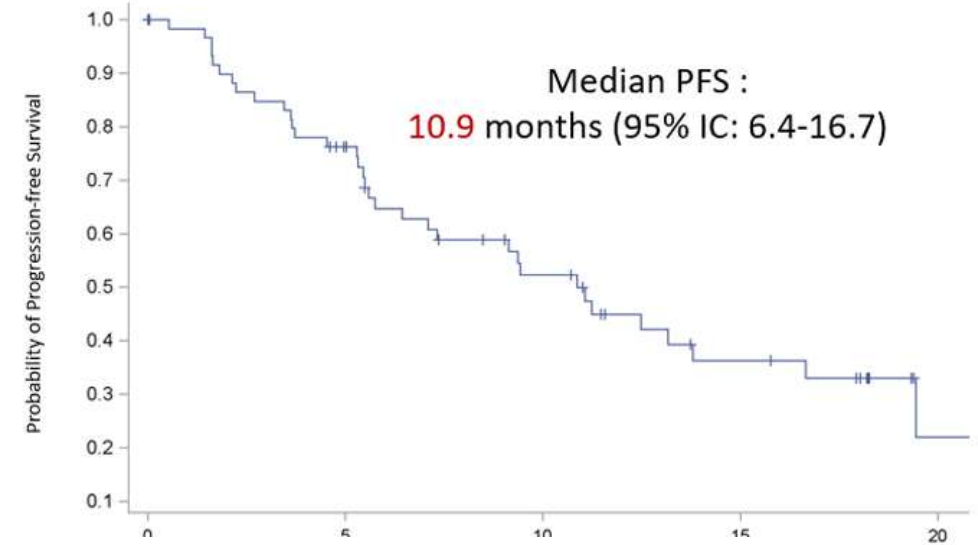
Data cut-off: MARCH 28, 2024 and Cohort B is still being recruited.

Targeted therapy for NSCLC BRAF V600E

Encorafenib-binimetinib: IFCT 1904 ENCO-BRAF

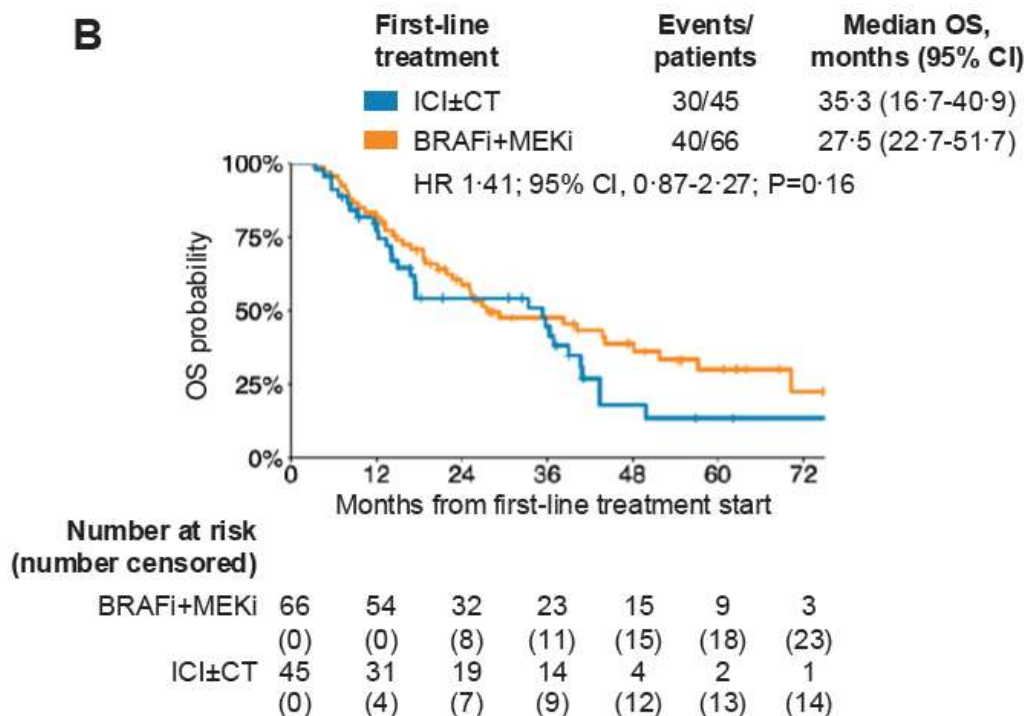
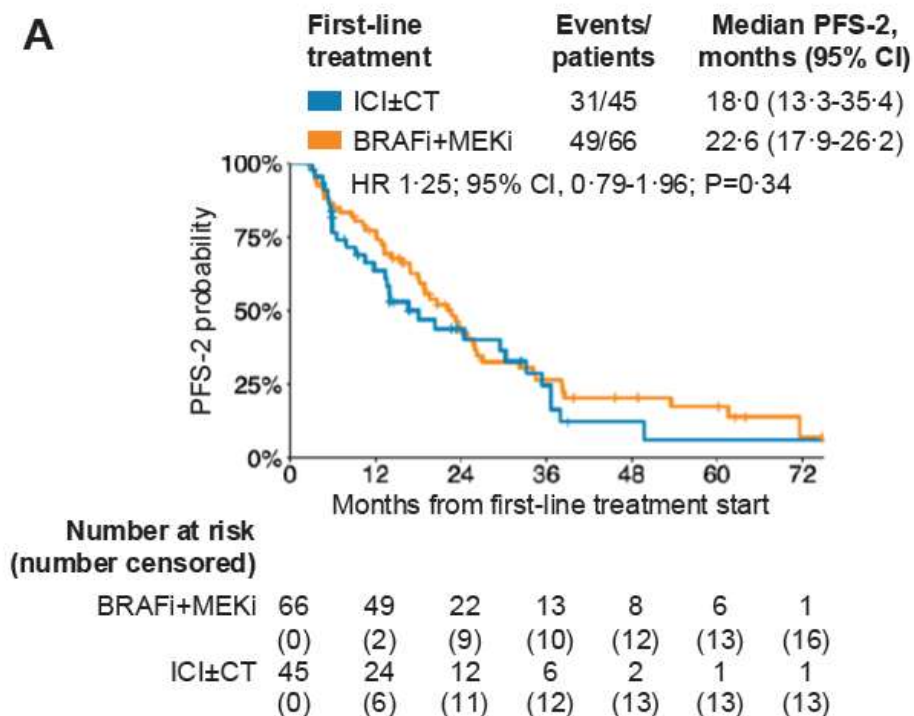


	Cohorte A (n=61)
Overall response confirmed, n (%) [95% CI]	40 (65.6%) [53.7% - 77.5%]
Partial response, n (%)	40 (65.6%)
Stable disease, n (%)	12 (19.7%)
Progressive disease, n (%)	5 (8.2%)
Not evaluable*, n (%)	4 (6.6%)
DOR, median [95% CI], months	13 months [9.1-NR]
DCR, % [95% CI] <small>* 4 patients were not evaluable</small>	85.2% [76.3% - 94.1%]



Median follow-up OS of 18 months (95% CI: 12.6 – 19.4)

FRONT-BRAF (retrospective): Results – IO / TT sequentially



Di Federico A, et al. First-line immunotherapy with or without chemotherapy versus BRAF plus MEK inhibitors in BRAFV600E-mutated metastatic non-small-cell lung cancer (FRONT-BRAF): a multicentre, retrospective cohort study. *Lancet Oncol.* 2025;26(10):1357-1369.

Sequence of IO – TKI for NSCLC BRAF V600E



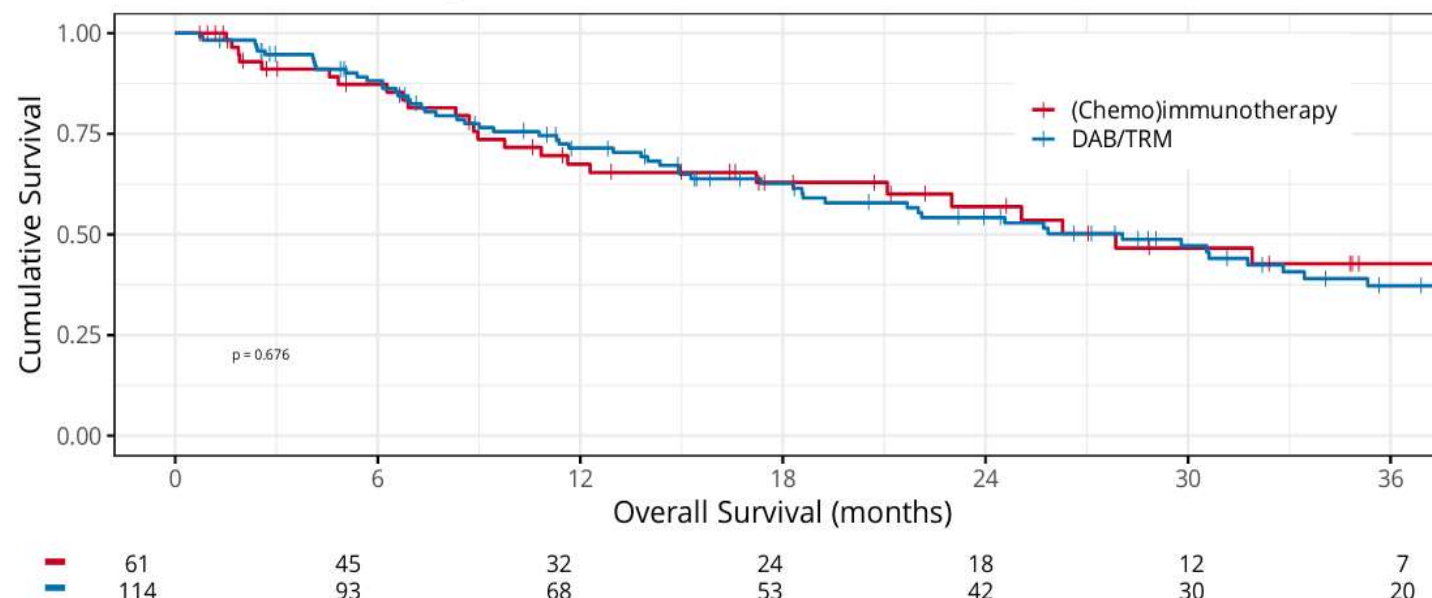
Treatment sequences in BRAF-V600-mutated non-small cell lung cancer: First-line targeted therapy versus first-line (chemo-) immunotherapy



Table 1: Patient Characteristics (n=205)

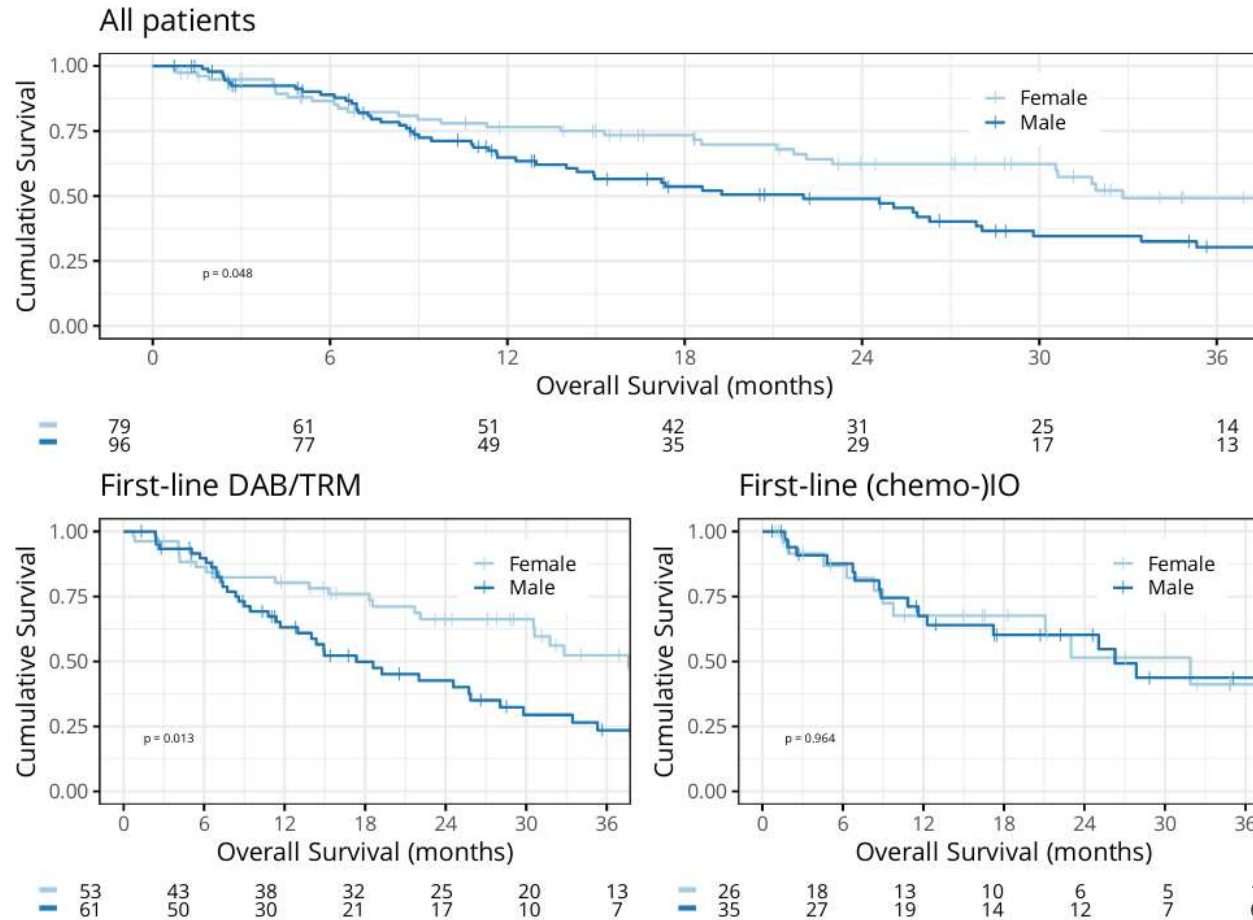
Sex	Female	90	43.9%
	Male	115	56.1%
Age at Diagnosis	Median (Min – Max)	67.7 years (40.0 – 82.8)	
Smoking History	Smoker	144	70.2%
	Never Smoker	49	23.9%
	Undocumented	12	5.9%
ECOG PS	ECOG 0	71	34.6%
	ECOG 1	66	32.2%
	ECOG ≥ 2	41	20.0%
	Undocumented	27	13.2%
Tumor Histology	Adenocarcinoma	199	97.1%
	Squamous	2	1.0%
	Sarcomatoid	2	1.0%
	LCNEC	1	0.5%
	Undocumented	1	0.5%
V600 Mutation Subtype	p.V600E	202	98.5%
	p.V600L	1	0.5%
	p.Val600_Lys601delinsGlu	1	0.5%
	p.V600x	1	0.5%
PD-L1 TPS	PD-L1 TPS < 1%	42	20.5%
	PD-L1 TPS 1 – 49%	73	35.6%
	PD-L1 TPS ≥ 50%	83	40.5%
	Undocumented	7	3.4%
Stage at diagnosis	Initial stage I-III, later recurrence	56	27.3%
	Initially stage IV	149	72.7%
First-line regimen	DAB/TRM	114	55.6%
	Immunotherapy	34	16.6%
	Chemoimmunotherapy	27	13.2%
	Platinum doublet	17	8.3%
Undocumented	13	6.3%	

Effect of first-line targeted or IO-based treatment on overall survival



Sequence of IO – TKI for NSCLC BRAF V600E

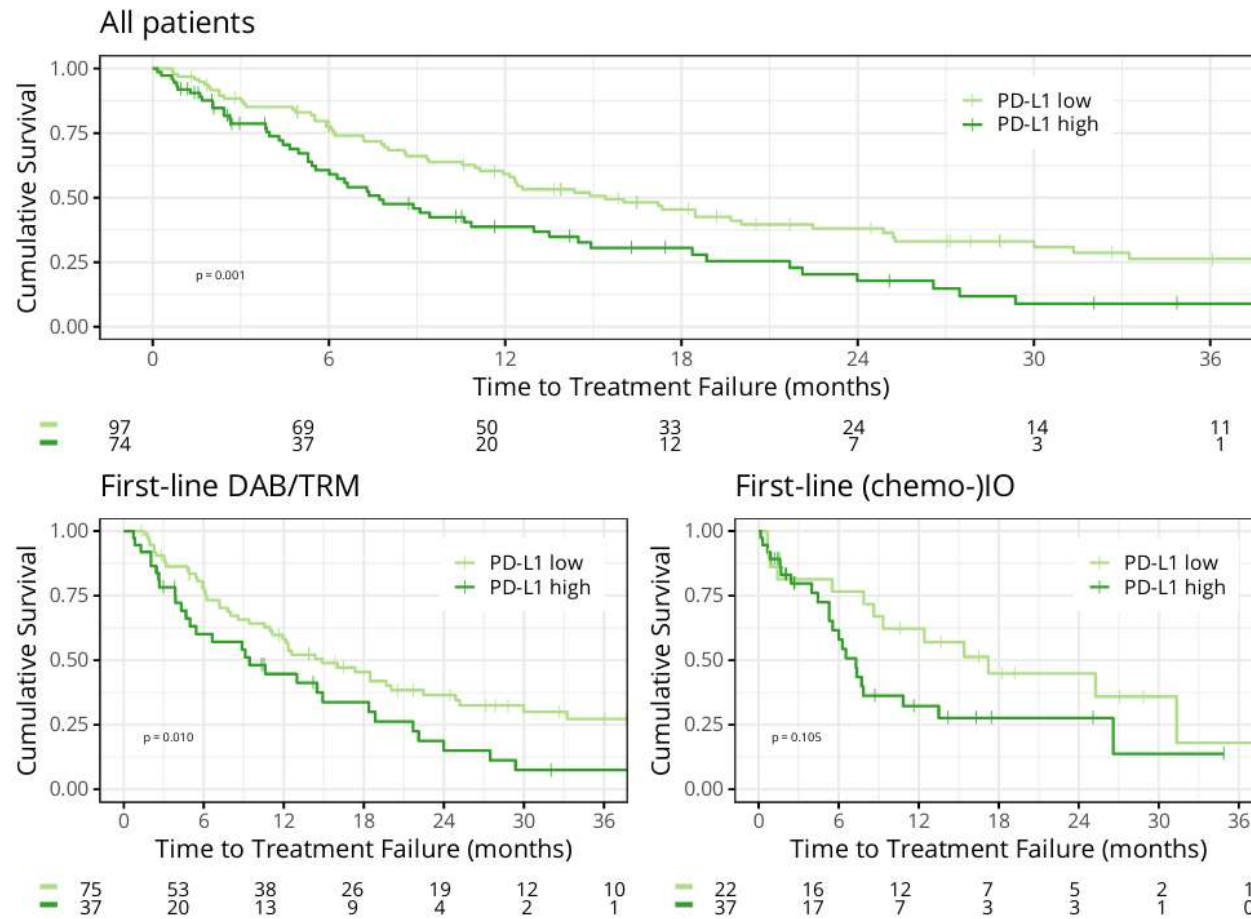
Treatment sequences in BRAF-V600-mutated non-small cell lung cancer:
First-line targeted therapy versus first-line (chemo-) immunotherapy



Better results of
targeted therapy in
female

Sequence of IO – TKI for NSCLC BRAF V600E

Treatment sequences in BRAF-V600-mutated non-small cell lung cancer:
First-line targeted therapy versus first-line (chemo-) immunotherapy



Worst prognostic in
PD-L1 high

Conclusions

- **BRAF mutations are rare (1-4%) but impactful in NSCLC: we have to find them (NGS)**
- **Thrombosis is emerging as a clinical hallmark, with high incidence (26%)**
- **Immunotherapy in BRAF-mutant patients is active (add IO at some point of the treatment strategy)**
- **BRAF V600E is a clearly targetable driver; non-V600 remains a therapeutic challenge**
- **Targeted therapies are active (higher ORR and PFS in 1st line): encora-bini is the only approved in Spain (since first targeted therapy approved 8 years ago)**
- **Best sequence still unclear**

16th
CONGRESS
Lung ON
CANCER

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27 / 28
NOVEMBER 2025

THANK YOU