Creating Novel Therapeutics By People With Excellent Expertise In Drug Design



IR BOOK

June 16, 2025

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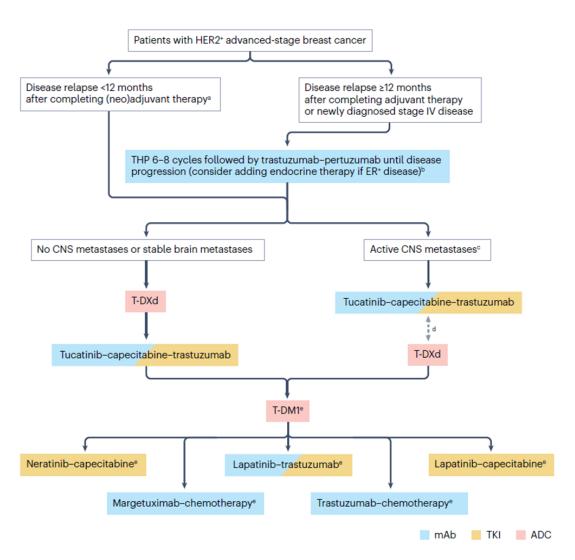


2. VRN16, a Novel PKMYT1 Selective Kinase Inhibitor

3. VRN19, USP1 inhibitor w/ excellent safety profile

VRN10, A Brain Permeable and selective irreversible HER2 inhibitor for HER2 driven solid tumor

Unmet Medical Needs in HER2-driven cancer



Key points to development

- High potency to overcome resistance mutations
- High Selectivity to HER2
- High Selectivity over EGFR
- Brain permeability for CNS metastasis

PD or discontinuation from SOC

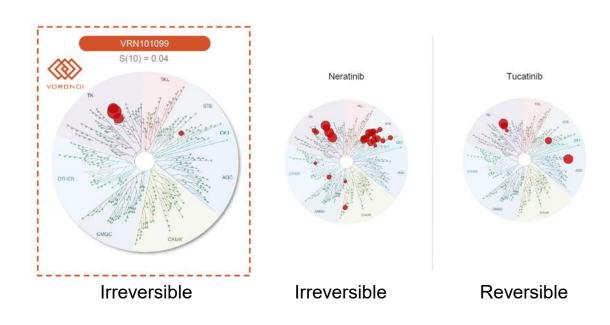
- ➤ Toxicity (ILD, Cardiactox, Skin rash, Diarrhea)
- Overcome TDxd or Abs Resistance
- Brain permeability for CNS progression

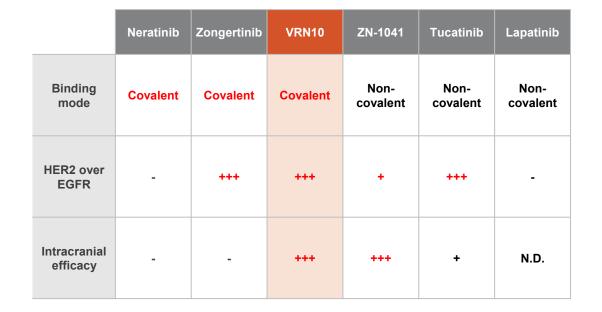
2024 Nature Review Clinical Oncology, Marra A et al.,

VRN10, Selective and Brain permeable HER2 Inhibitor

Kinase selectivity over human kinome

Covalent, EGFR-sparing, Brain permeable





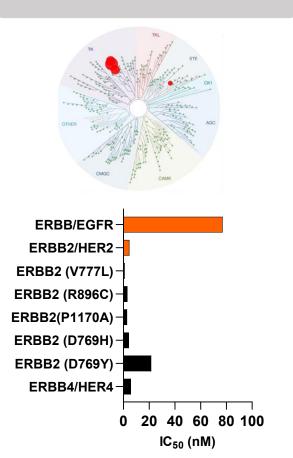
Characterization

1. Mode of Action (Potency)

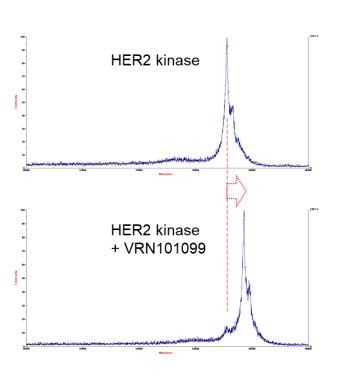
Selective covalent HER2 kinase inhibitor

VRN10 irreversibly inhibits HER2 kinase activity and proliferation of HER2+ cancer cells

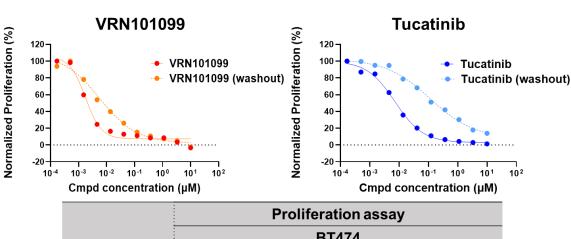
Selective to HER2 and HER2m



Covalent bond formation MALDI-TOF MS



Higher potency with longer resident time by covalent binding **Wash-out Assay**



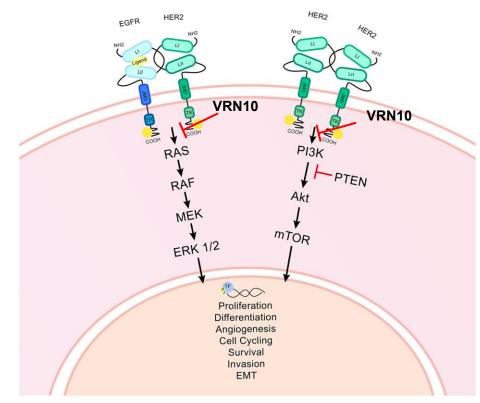
	BT474			
Compound				
	GI ₅₀	Fold change		
	- Washout	+ Washout	Fold change	
VRN101099	0.002	0.009	3.6	
Tucatinib	0.009	0.193	21.9	
Lapatinib	0.017	0.099	5.7	
Neratinib	0.001	0.005	4.1	

2024 EORTC-NCI-AACR, Kim S, et al.

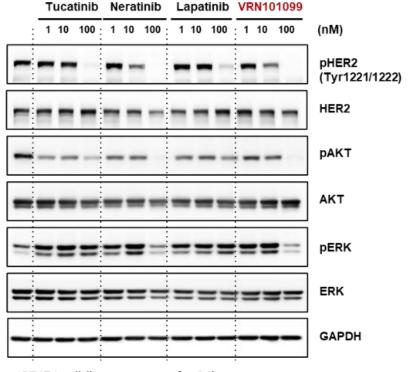
Inhibition of HER2 signal pathways

VRN10 inhibits HER2 signal pathways in HER2-driven cancer cells

Activation, Dimerization and Cell Signalling



https://doi.org/10.18632/oncotarget.27789

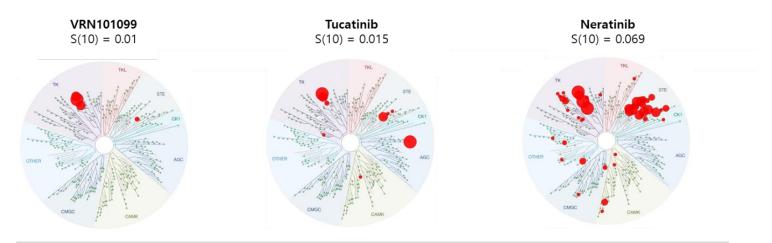


*BT474 cell line, treatment for 24hr

Characterization

2. Selectivity (Safety)

Selectivity over other Kinases



Gene	Activity	
EGFR	0	
ERBB2	0.35	
ERBB4	0.45	
MEK5	7	

Gene	Activity	
ADCK4	0	
ERBB2	0	
MRCKA	0	
MEK5	0.25	
EGFR	0.45	
ERBB4	6	

Gene	Activity	Gene	Activity	
ERBB2	0	BLK	2	
ERBB3	0	МАРЗК3	2	
ERBB4	0	LCK	2.2	
LOK	0.1	MAP4K3	2.7	
EGFR	0.15	MINK	3.2	
MST4	0.4	TNIK	3.9	
MAP4K5	0.6	HPK1	4.1	
SLK	0.6	PIK4CB	5.8	
MEK5	0.7	MAP4K4	6.9	
MEK1	0.75	MAP4K2	7.7	
MEK2	0.9	ICK	8	
MST2	1	GAK	9.2	
YSK4	1	МАРЗК4	9.4	
SNARK	1.9			

Selectivity over EGFR

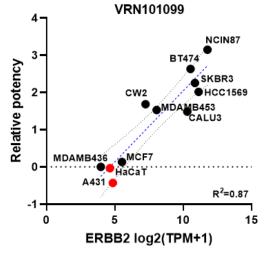
pHER2 vs pEGFR inhibition

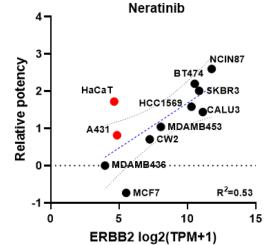
pEGFR reduction in HaCaT pHER2 reduction in BT-474 (WT EGFR) (pHER2) 150-150 Tucatinib Neratinib % pEGFR .001 % pHER2 VRN101099 0.00001 0.0001 0.001 0.01 0.00001 0.0001 0.001 Cmpd concentration (µM) Cmpd Concentration (µM)

		pIC50 (μM)		Ratio	
Cmpd.	Class	HaCaT	BT-474	EGFR/HER2	
		(pEGFR)	(pHER2)	EGFR/HERZ	
VRN101099	Covalent	0.3046	0.0074	41.2	
Neratinib	Covalent	0.0045	0.0067	0.7	
Tucatinib	Non-covalent	N.A	0.0269	N.A.	

N.A, pIC₅₀ couldn't be determined

Correlation between potency to HER2 expression



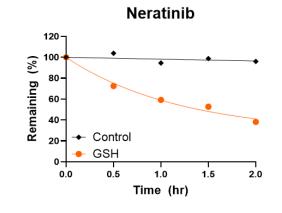


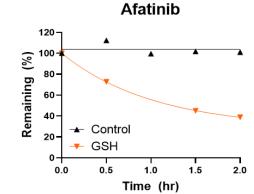
Selective covalent HER2 kinase inhibitor

Oxidative Stress Glutathione reductase + NADPH Reduced Glutathione (GSH) Oxidized Glutathione (GSSG)

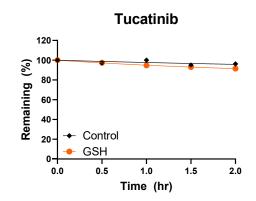
Low GSH reactivity / Less non-specific toxicity

Covalent inhibitors (non-selective)

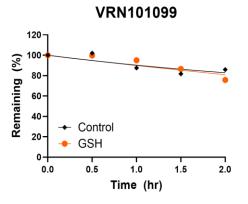




Non-covalent inhibitor



Covalent inhibitor (selective)



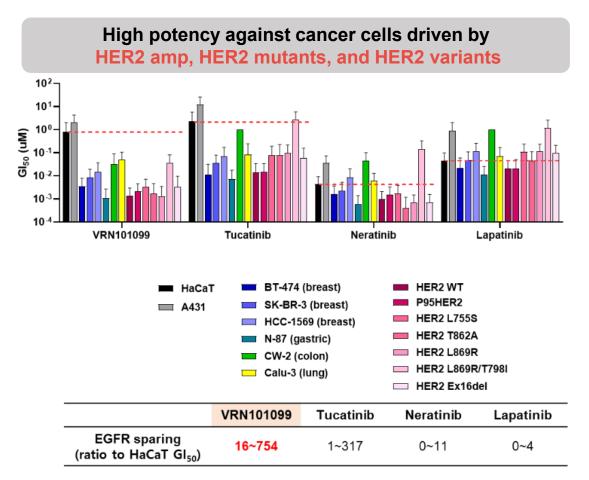
2024 EORTC-NCI-AACR, Kim S, et al.

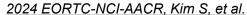
Characterization

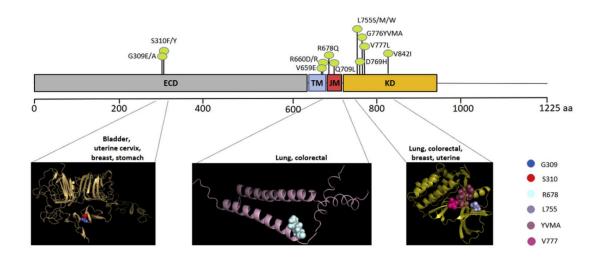
3. Indications and Efficacy

Anti-proliferation potency against HER2-driven cancers

VRN10 has potency HER2+, HER2 activating TKI mutations, and Trastuzumab-resistant isoforms





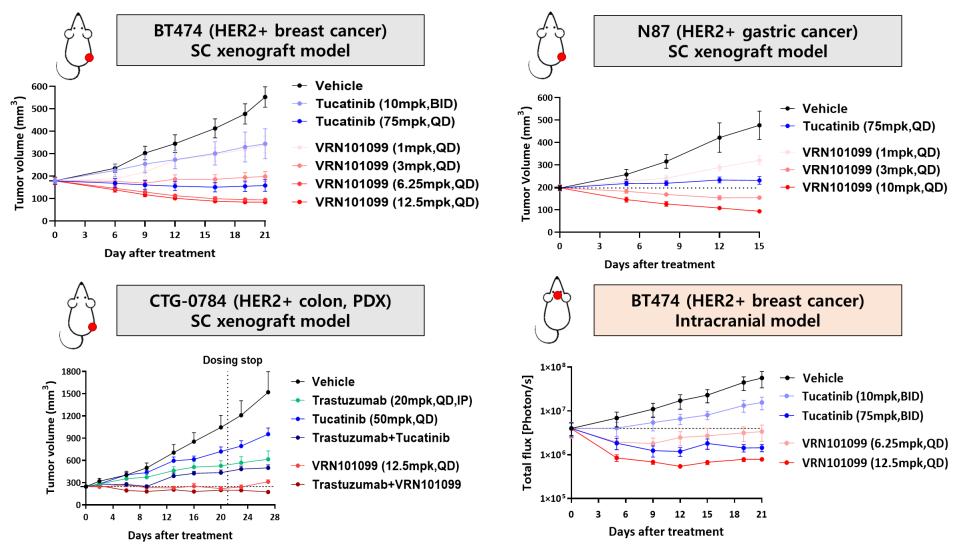


- HER2 amplification (HER2+)
- HER2 activating mutations / resistant mutations (L755S, T862A, L869R, T798I)
- Antibody-resistant isoform (p95HER2, Ex16del)

2019 Pharmacology & Therapeutics, Cocco E, et al.



Anti-tumor efficacy to HER2+ solid tumors and brain metastasis



2024 EORTC-NCI-AACR, Kim S, et al.,

Anti-tumor efficacy to HER2+ solid tumors and brain metastasis

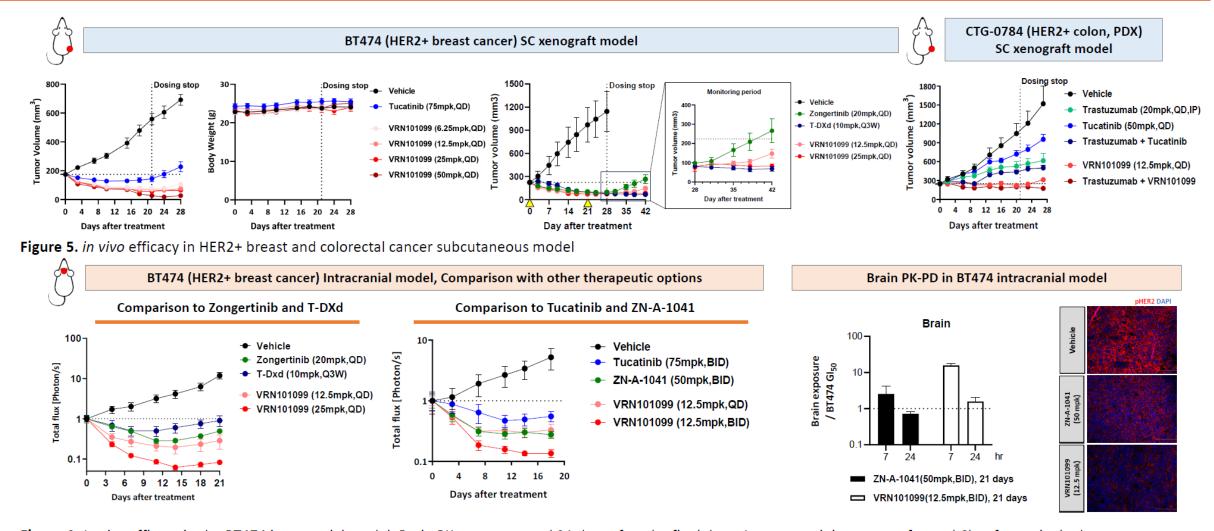
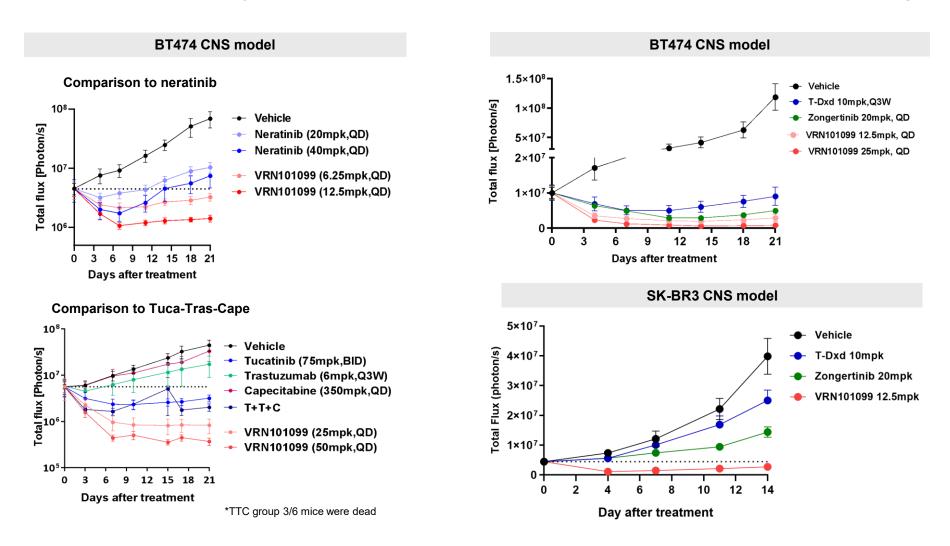


Figure 6. In vivo efficacy in the BT474 intracranial model. Brain PK was measured 21 days after the final dose. Immunostaining was performed 6hr after a single dose.

2025 AACR. Kim S. et al.

Additional comparison to other regimen in intracranial xenograft models

VRN10, superior anti-tumor efficacy compared to Tucatinib, Neratinib, Trastuzumab, T-DXd and Zongertinib



Characterization

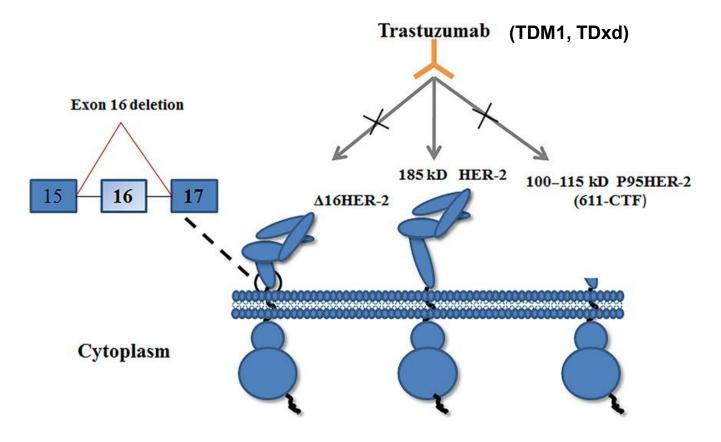
4. T-DXd resistance

Anti-tumor efficacy against acquired resistant cancer to T-DXd

Potential HER2-ADC Resistance Mechanism	T-DXd	Other HER2 ADC	Other HER2 TKI	VRN10
✓ Internalization defect	Low potency	Low	Effective	Effective
✓ Topoisomerase bypass or mutants	Low potency	case by case	Effective	Effective
✓ Extracellular domain shedding	No binding	No binding	Effective	Effective
✓ Exon16skipping	Low affinity	Low affinity	case by case	Effective
✓ BCRP overexpression	Dxd Efflux	Depending on phenotype	Depending on phenotype	Effective
✓ MRP1 overexpression	Dxd Efflux	Depending on phenotype	Depending on phenotype	Effective
✓ ARK1C overexpression	Dxd metabolism	Depending on phenotype	Depending on phenotype	Effective
✓ Decrease of HER2 expression	Low binding	Low binding	case by case	tumor by tumor

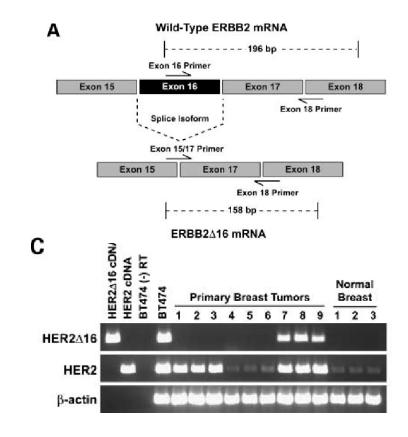
Efficacy to HER2 variants resistant to Trastuzumab (T-DM1, T-Dxd)

Extracellular shedding (p95HER2) and Exon16 skipping (Δ16HER2) can't be recognized by HER2 antibody



J. Cell. Mol. Med. Vol 19, No 12, 2015 pp. 2691-2701

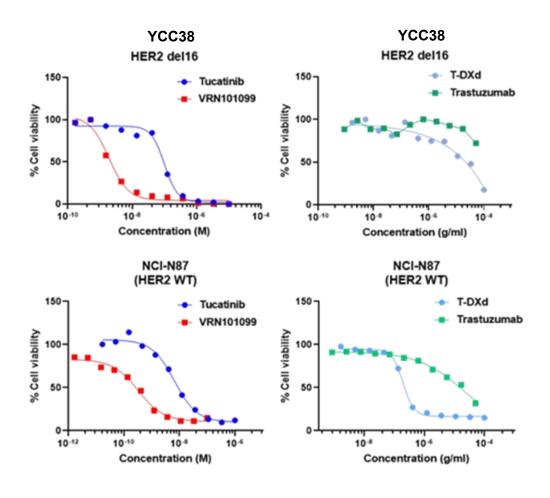
Expression of HER2 and Δ16HER2 in human tissues and breast tumors

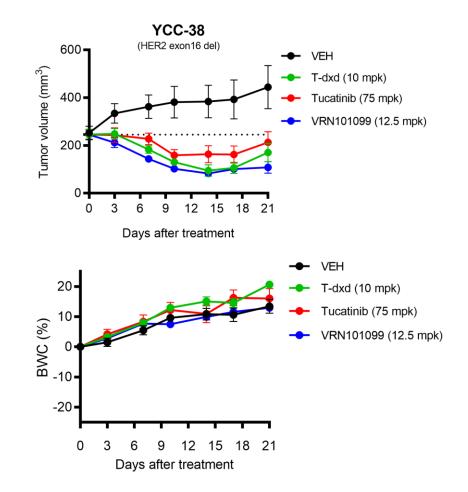


Mol Cancer Ther 2009;8(8). August 2009

YCC38, GC with HER2-Exon16skip mutation

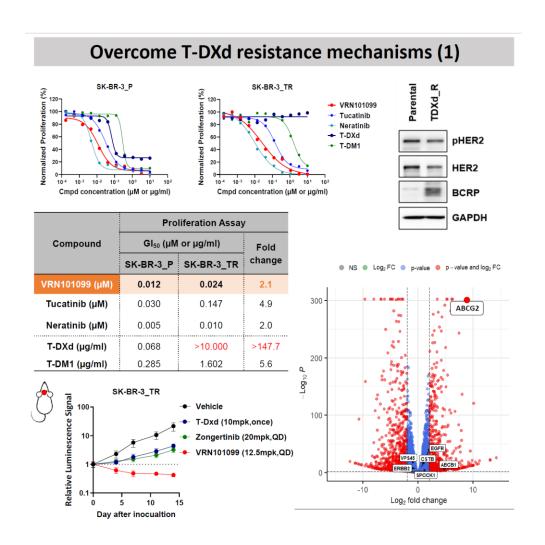
VRN10 showed tumor regression efficacy against tumor expressing Δ16HER2 variant

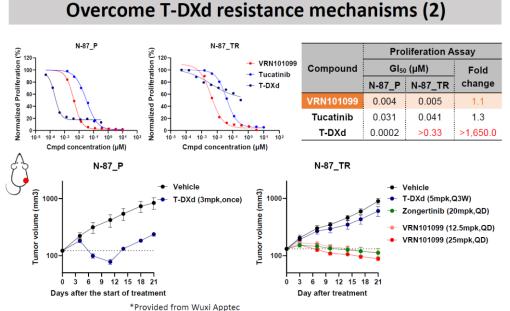




Anti-tumor efficacy against acquired resistant cancer to T-DXd

Overcoming T-DXd resistant mechanism, including ABCG2 overexpression and AKR1C overexpression



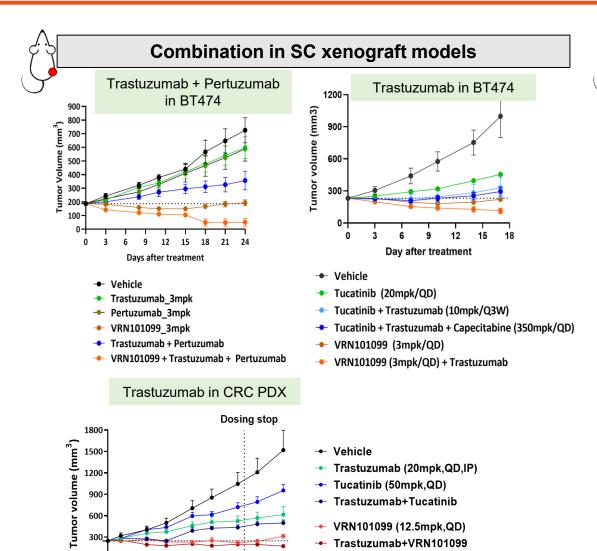


2025 AACR. Kim S. et al.

Characterization

5. Combi Potential

Combinatory Potential with Antibody or ADC



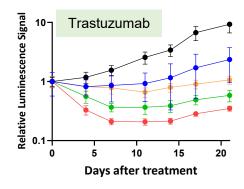
24 28

12 16 20

Days after treatment

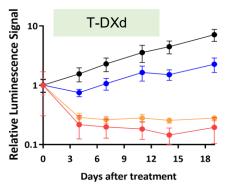


Combination in BT474 intracranial models



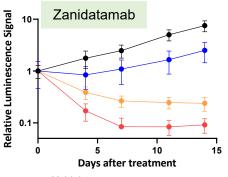


- Tucatinib 20mpk + Trastuzumab 10mpk + Capecitabine 350mpk
- Trastuzumab 10mpk
- VRN101099 3mpk
- VRN101099 + Trastuzumab





- T-Dxd (10mpk, Q3W)
- VRN101099 (12.5mpk, QD)
- VRN101099 + T-Dxd



- Vehicle
- Zanidatamab 4mpk
- VRN101099 12.5mpk
- Zanidatamab 4mpk + VRN101099 12.5mpk

Clinical trials

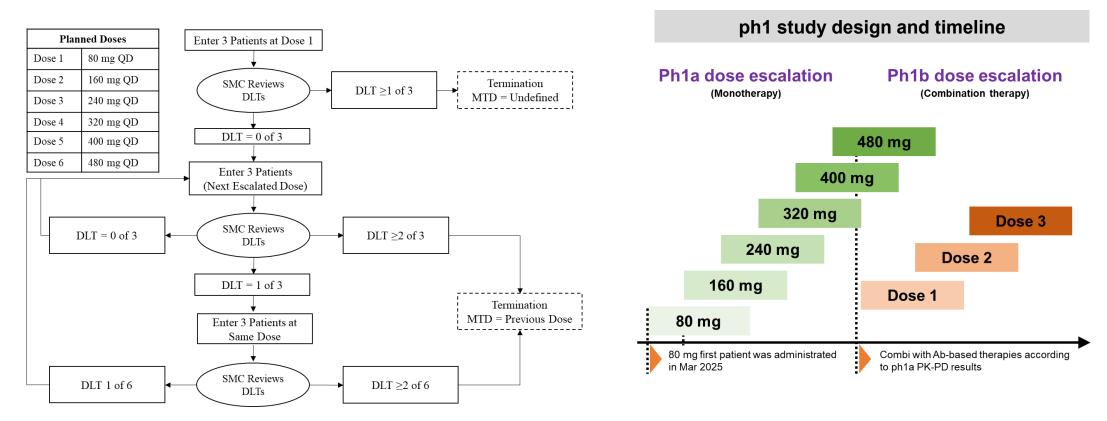
Phase 1a, Dose Escalation

Key inclusion: Solid tumors with documented HER2+ (IHC1~3+, FISH+, or NGS) or HER2 activating mutants

Study design: A standard "3+3"

Sites: AU 2 sites + KR 5 sites

FIH: Mar 2025

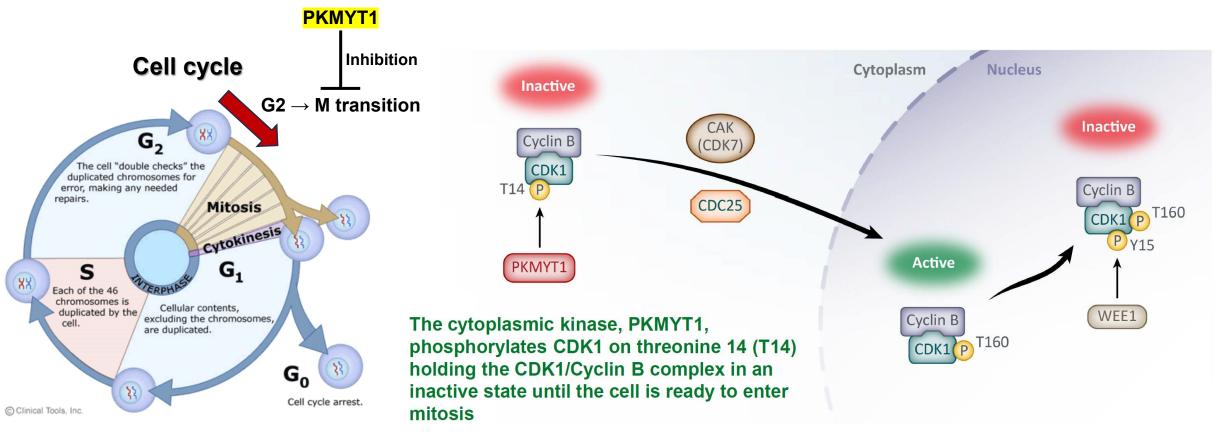


Abbreviations: DLT = dose-limiting toxicity; MTD = maximum tolerated dose; QD = once daily; SMC = Safety Monitoring Committee.

VRN16, a Novel PKMYT1 Selective Kinase Inhibitor

Function of PKMYT1 kinase: Regulation of G2/M phase transition

PKMYT1 selectively regulates CDK1 during the G2/M phase transition to prevent mitotic entry in the presence of DNA damage.



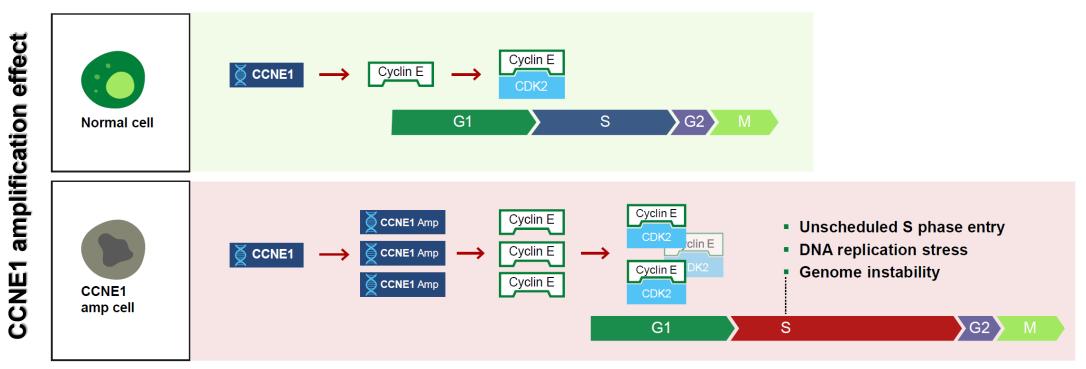
https://le.ac.uk/vgec/topics/cell-cycle/the-cell-cycle-higher-education

Repare Corporate Presentation, Q3 2023.

CCNE1 amplification: A biomarker for the PKMYT1 inhibitors

CCNE1 amplification is observed in 8% of all solid tumor patients and is particularly prevalent in ovarian cancer (31%), gastric cancer (14%), and breast cancer (8%).

CCNE1 amplification drives premature S-phase entry, resulting in genome instability due to DNA replication stress.

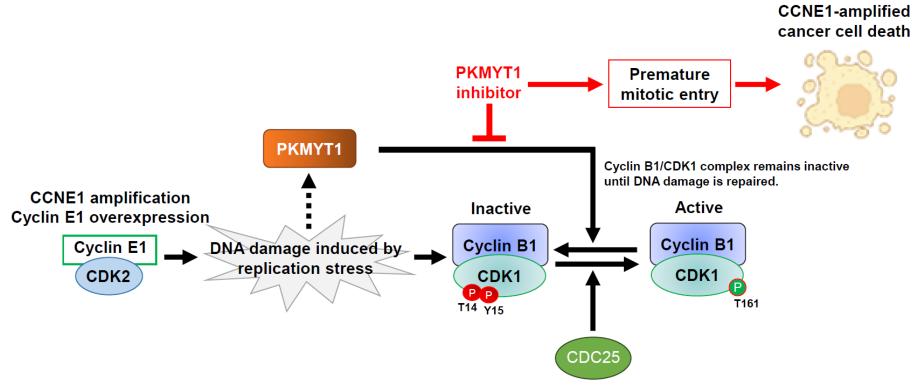


Repare Corporate Presentation, June 2023.

Synthetic lethality: CCNE1 amplification with PKMYT1 inhibition leading to cell death

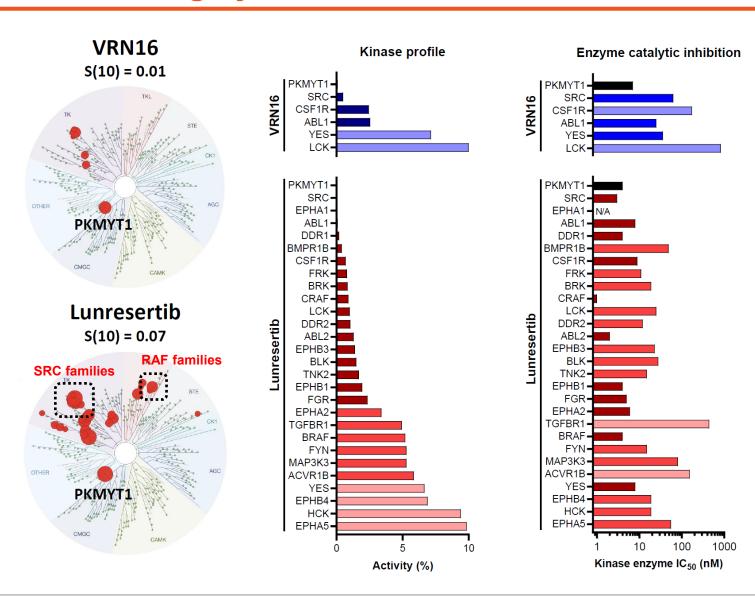
PKMYT1 inhibition forces cancer cells to prematurely enter mitosis without repairing DNA damage, ultimately leading to cell death.

Despite the significant patient population harboring CCNE1 amplification, no targeted therapy has been approved, emphasizing critical unmet medical needs.

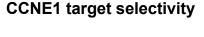


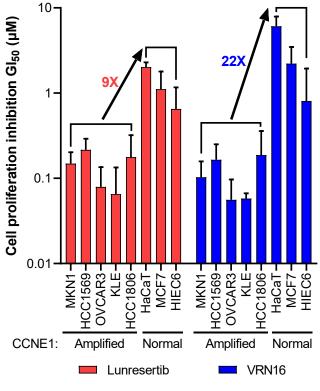
CDC25 phosphatase facilitates mitotic entry by activating Cyclin B1/CDK1 when DNA repair is completed.

VRN16: A highly selective PKMYT1 kinase inhibitor



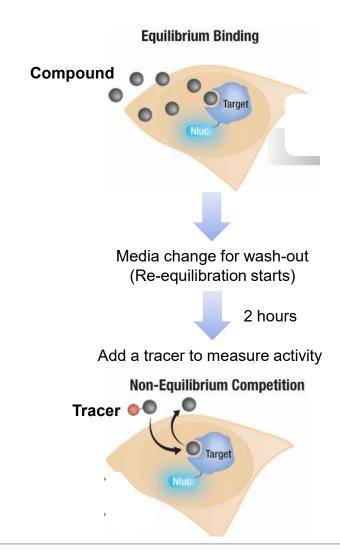
Kinase selectivity → **CCNE1 target selectivity**

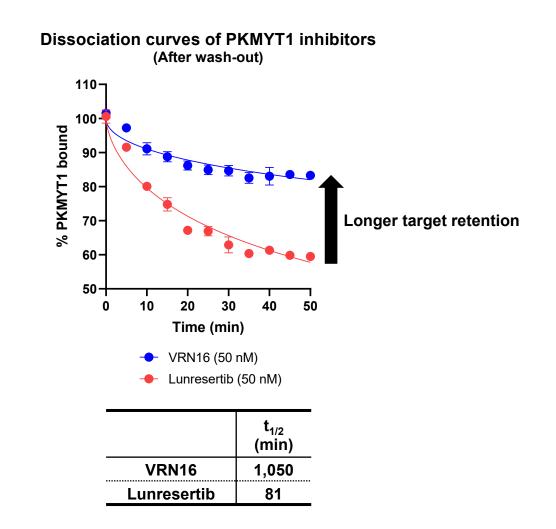




PKMYT1 NanoBRET: Longer target residence time

The PKMYT1 NanoBRET assay showed that VRN16 has a 13-fold longer target residence time than lunresertib.

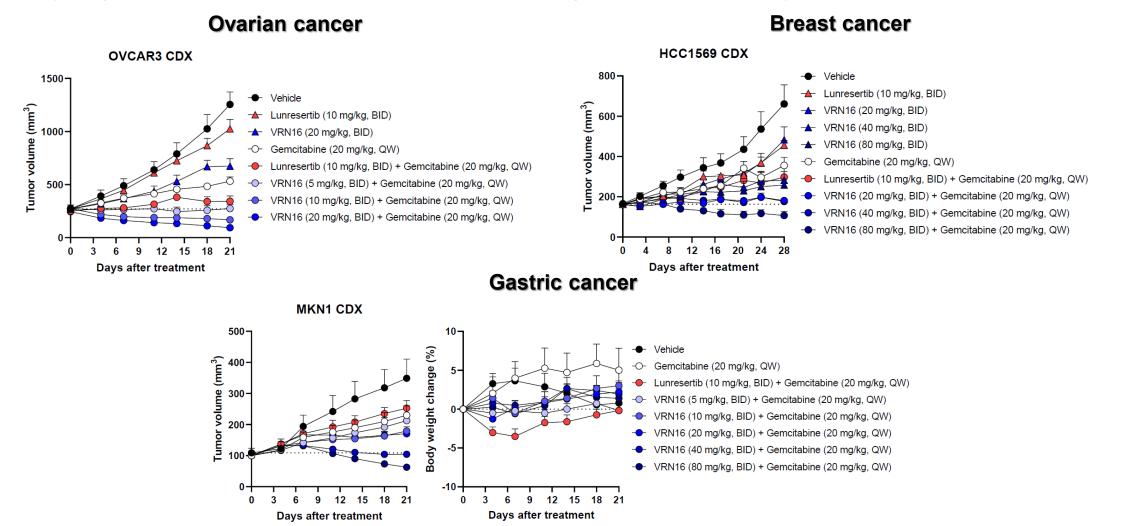




Superior efficacy in CCNE1-amplified tumors

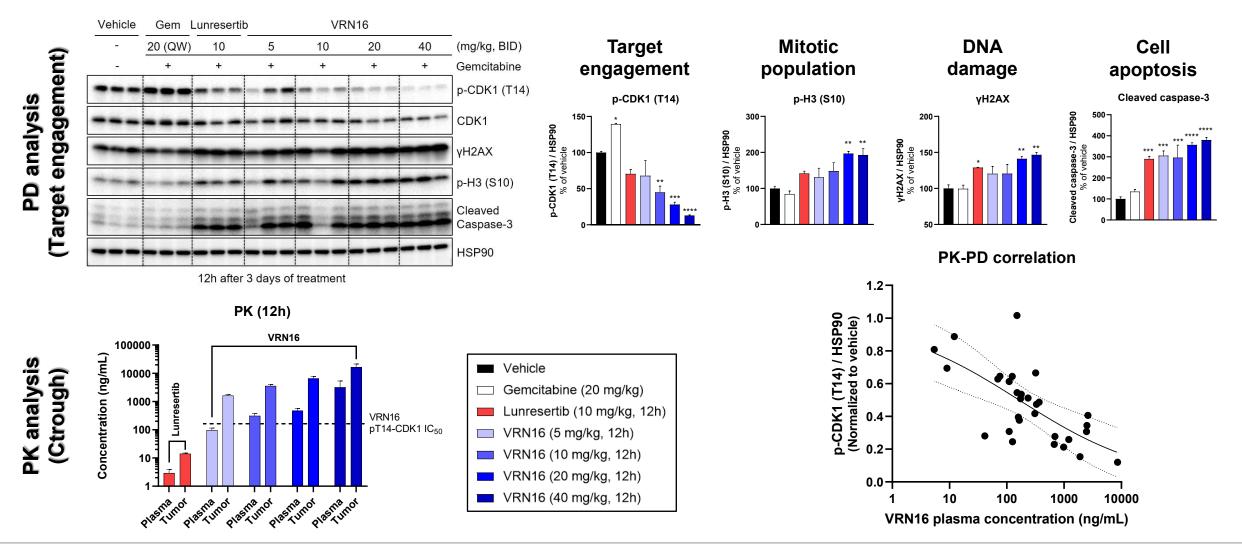
VRN16 showed superior efficacy compared to lunresertib in CCNE1-amplified ovarian, breast, and gastric cancer xenograft models.

Greater body weight loss was observed with lunresertib, demonstrating the superior tolerability of VRN16.



Superior target engagement and strong PK-PD correlation

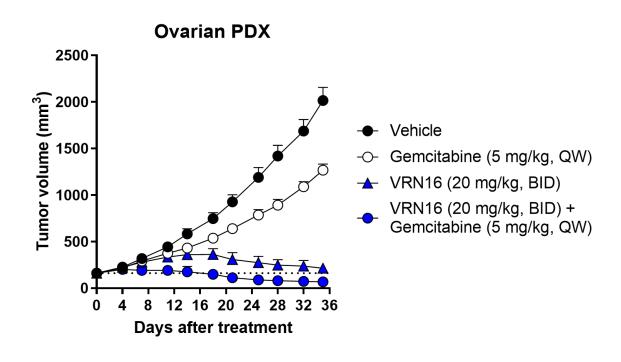
VRN16 showed superior target engagement compared to lunresertib, with a well-correlated PK-PD relationship.

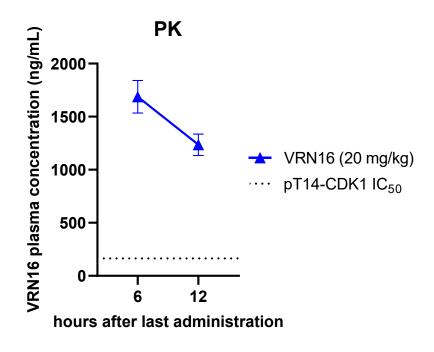


Tumor regression efficacy in a Cyclin E1-overexpressing ovarian PDX model

In a Cyclin E1-overexpressing ovarian PDX model, VRN16 monotherapy showed efficacy close to stable disease (SD), while its combination with gemcitabine resulted in efficacy approaching complete response (CR).

The plasma exposure of VRN16 remained well above the phospho-CDK1 IC_{50} for up to 12 hours.

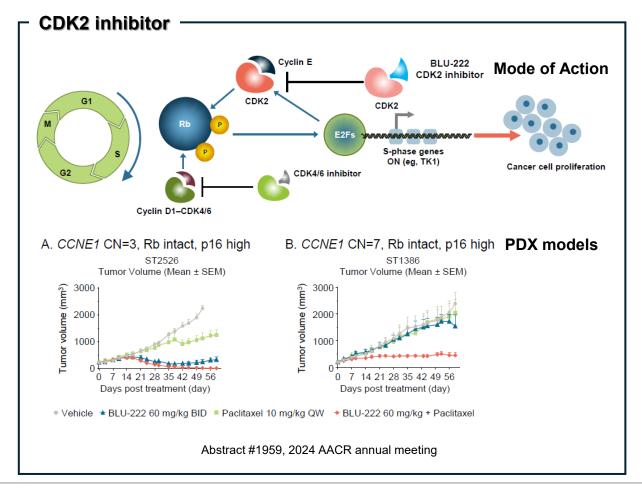




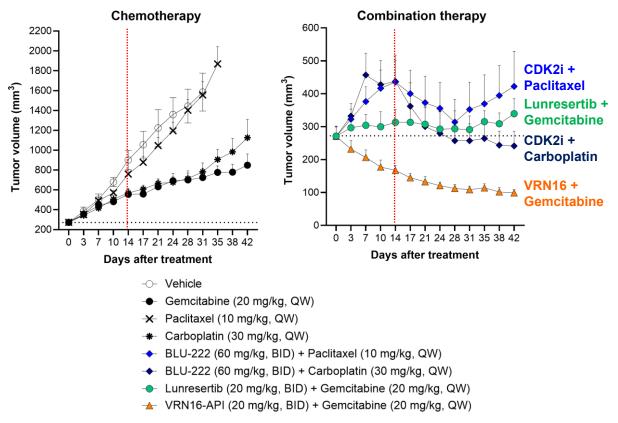
Superior efficacy compared to CDK2 inhibitor in the OVCAR3 CDX model

CDK2 inhibitors are currently undergoing clinical trials with CCNE1 amplification as a biomarker.

In CCNE1-amplified OVCAR3 CDX model, VRN16 combination with gemcitabine showed greater efficacy compared to CDK2 inhibitor combination with paclitaxel or carboplatin.



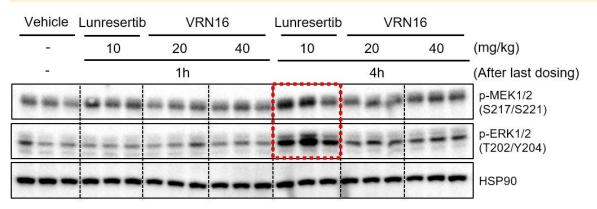
Comparative efficacy with CDK2 inhibitor



Off-targets related adverse events

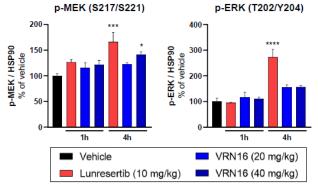
Lunresertib inhibits RAF and causes paradoxical MAPK activation and related side effects, whereas VRN16 does not.

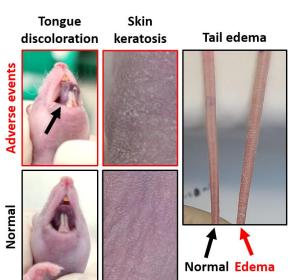
Paradoxical MAPK activation by inhibiting RAF

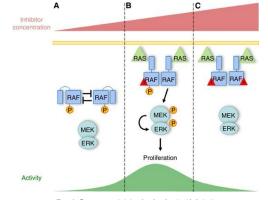


Lunresertib + Camonsertib (ATRi) safety profile (Repare Corporate Presentation Q3 2024)

TRAEs in ≥10% of patients, n (%)	All Grades	Gr3	Gr4	
Nausea/Vomiting	34 (52.3)	0	0	Ĺ
Rash ^a	26 (40.0)	1 (1.5)	0	
Fatigue	18 (27.7)	1 (1.5)	0	
Stomatitis	18 (27.7)	4 (6.2)	0	
Decreased appetite	13 (20.0)	0	0	ĺ
Diarrhea	10 (15.4)	0	0	
Headache	7 (10.8)	0	0	İ
Constipation	5 (7.7)	0	0	





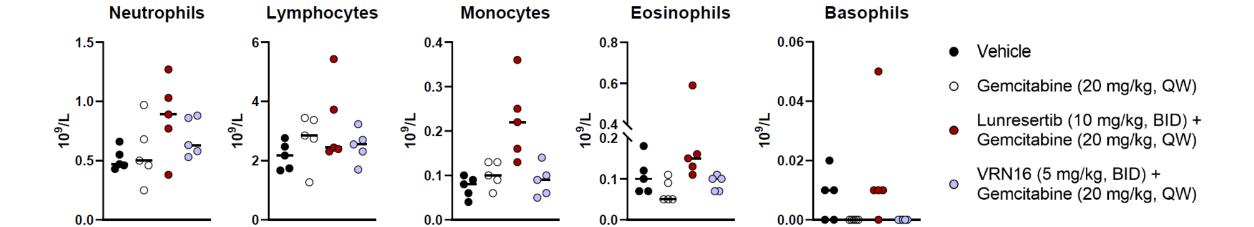


Br J Cancer 111, 640-645 (2014). https://doi.org/10.1038/bjc.2014.139

No hematologic toxicity in gemcitabine combination

In a clinical trial with gemcitabine combination, lunresertib exhibited hematologic toxicity (EORTC-NCI-AACR symposium 2024).

In ICR mice, lunresertib showed hematologic toxicity under gemcitabine combination treatment, whereas VRN16 did not.



VRN16: A superior PKMYT1 selective inhibitor that outperforms lunresertib

VRN16 outperforms lunresertib in every aspect, including both efficacy and toxicity.





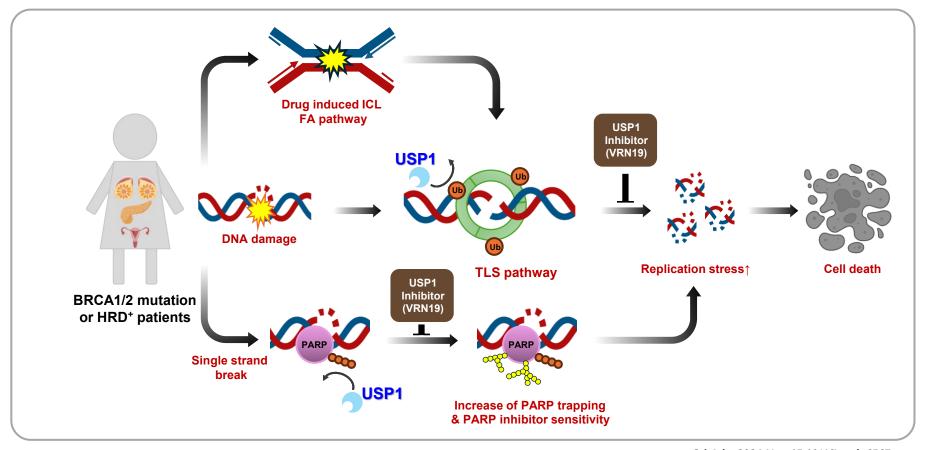
Lunresertib (RP-6306)

In vitro Efficacy In vivo	CCNE1 target selectivity	22X	9X		
	PKMYT1 target residence time (t _{1/2} , min)	1,050 (13-fold longer)	81		
		CCNE1-amplified cancer CDX models (Ovarian, breast, and gastric cancers)	+++	+	
	In vivo	Cyclin E1-overexpressed ovarian cancer PDX model	+++	N/A	
		Comparison to CDK2 inhibitor	+++	+	
Target	Target In vivo	PD: pT14-CDK1 inhibition	+++	+	
engagement		PK-PD correlation	Strong PK-PD correlation	N/A	
Off torget	Kinase selectivity	S(10)	0.01	0.07 (7-fold more off-targets)	
Off-target RAF inhibition		BRAF kinase inhibition (IC ₅₀ , μM)	0.813	0.029 (28-fold more potent)	
Toyloity	Off-targets related	Stomatitis / Keratosis / Edema	+	+++	
Toxicity Hematologic	Hematologic	Abnormal numbers of WBC components	-	+++	

VRN19, USP1 inhibitor w/ excellent safety profile

USP1, ubiquitin-specific protease 1, synthetic lethal with BRCA mutants

USP1 (ubiquitin-specific protease 1) regulates DNA repair via the FA complex and TLS pathway, making its inhibition a synthetic lethality target that sensitizes cancer cells to DNA-damaging therapies



Sci Adv. 2024 Nov 15;10(46):eadp6567.

Competitive Landscape

Generic name	Company	Line of treatment	Phase	Combination treatment	Status	Number of patients	Start ~ Completion date
KSQ-4279 (RG6614)	Roche	Second line	Phase I	Olaparib / Carboplatin	Recruiting	250	2021. 08 ~ 2027. 06
XL309 (ISM3091)	EXELI <mark>X</mark> IS°	Second line	Phase I		Recruiting	377	2023. 08 ~ 2029. 08
SIM0501	Simcere	Second line	Phase I	Olaparib	Recruiting	176	2024. 03 ~ 2027. 12
HSK39775	Harsco	Second line	Phase I / Phase II		Recruiting	243	2024. 03 ~ 2028. 09
Generic name	Company	Line of treatment	Phase	Combination treatment	Status	Number of patients	Start ~ Completion date
Debio 0432 (FT-3171)	Debiopharm	Preclinical	IND enabling				
IMP13	Impact Therapeutics	Preclinical					
Protai-XX	Protai	Preclinical					
LAE120	Laekna Therapeutics	Preclinical	IND enabling				
AIG-USP1	AIGEN Sciences	Preclinical					
XZP-6924	Xuanzhu Biopharmaceutical	Preclinical	IND enabling				
VRTX531	VRise Therapeutics	Preclinical	IND enabling				
APL-2302	Asieris Pharmaceutical	Preclinical	IND enabling				

Limitation of current investigational USP1 inhibitors in clinic



First-in-human trial of the oral first-in-class Ubiquitin Specific Peptidase 1 (USP1) inhibitor RO7623066 (KSQ-4279), given as single agent and in combination with olaparib or carboplatin in patients with advanced solid tumors, enriched for deleterious homologous recombination repair (HRR) mutations

2024 ASCO Annual Meeting

Adverse Event All TEAEs in > 20% for single agent and in > 30% for	Single agent (n=42)		RO7623066 + OLA* (n=15)		RO7623066 + CARBO (n=13)	
combination	All Grades	Grade ≥3	All Grades	Grade ≥3	All Grades	Grade ≥3
Anemia	35.7%	4.8%	86.7%	73.3%	69.2%	30.8%
Blood creatinine increased	33.3%	0	33.3%	0	30.8%	0
Hyponatremia	28.6%	11.9%	-	-	61.5%	7.7%
GGT increased	26.2%	9.5%	40.0%	13.3%	38.5%	15.4%

^{*} Anemia adverse events were reversible and manageable



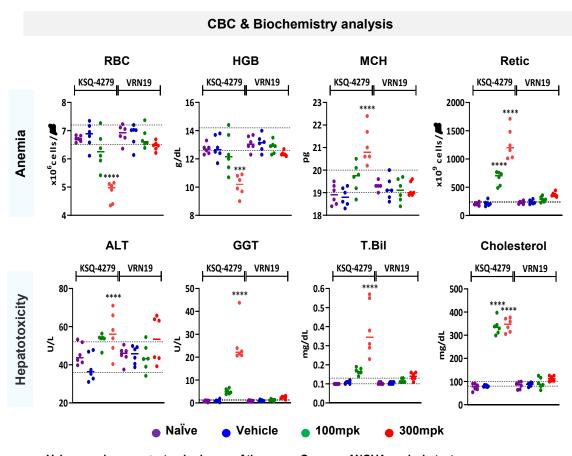
May 23, 2024

Hematotoxicity + Hepatotoxicity

Hepatotoxicity

>> USP1 on-target toxicity or off-target toxicity?

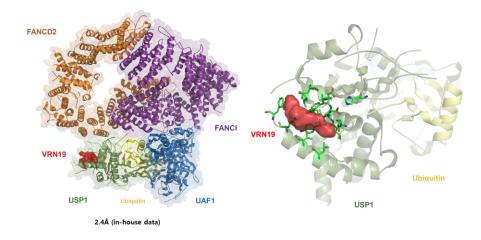
VRN19, a novel USP1 inhibitor without Anemia and Hepatoxicity



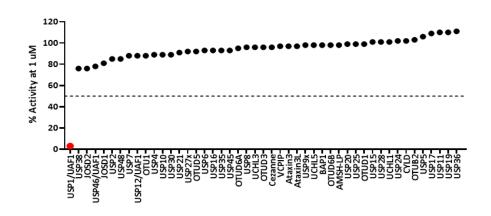
250,000 200,000 250,000 TOXICITY rat 100mpk Mild heme tox. & hepatotox. 150,000 200,000 TOXICITY rat 300mpk Severe heme tox. 100,000 & hepatotox. 150,000 Non TOXICITY 100,000 50,000 TOXICITY rat 100mpk rat 100mpk **EFFICACY** Mild heme tox. Mouse 30mpk & hepatotox. 50,000 0 KSQ-4279 VRN19 Safety margin Safety margin 9x 1x

VRN19, high selectivity and potency

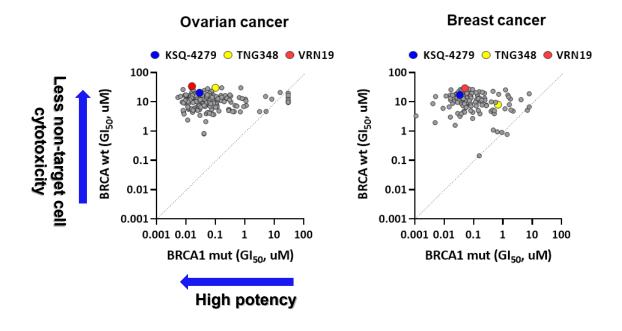
Selective binding to USP1-USA complex



DUBprofiler™ assay

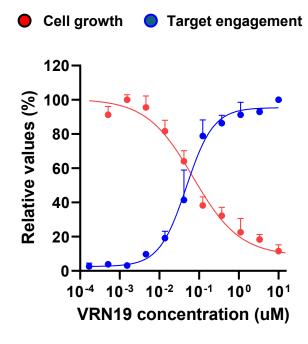


High potency against target cancer cells Less non-target cell cytotoxicity

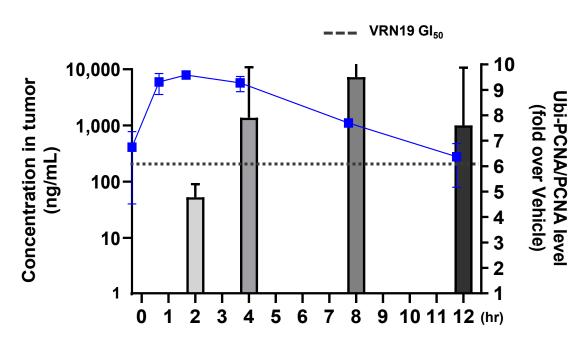


VRN19, Target engagement

In vitro cell viability & target engagement



PK/PD

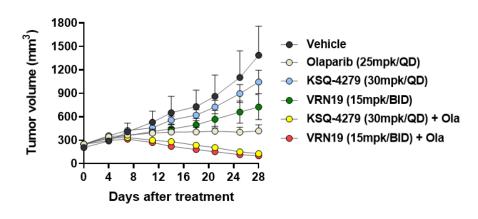


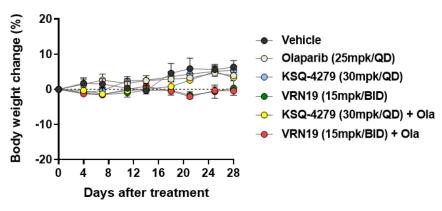
30 mg/kg (PO), BID for 7 days in the MDA-MB-436 model

VRN19, in vivo efficacy against BRCAm or HRD solid tumor

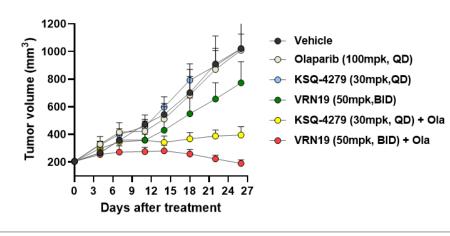
Superior synergistic efficacy with PARP Inhibitor or Carboplatin in CDX Models

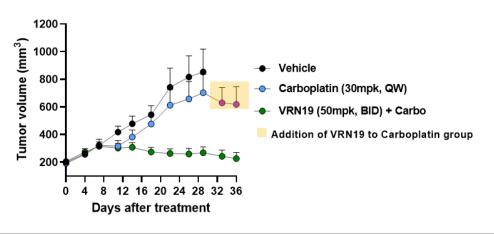
MDA-MB-436 (BRCA1 mut / HRD) SC xenograft model



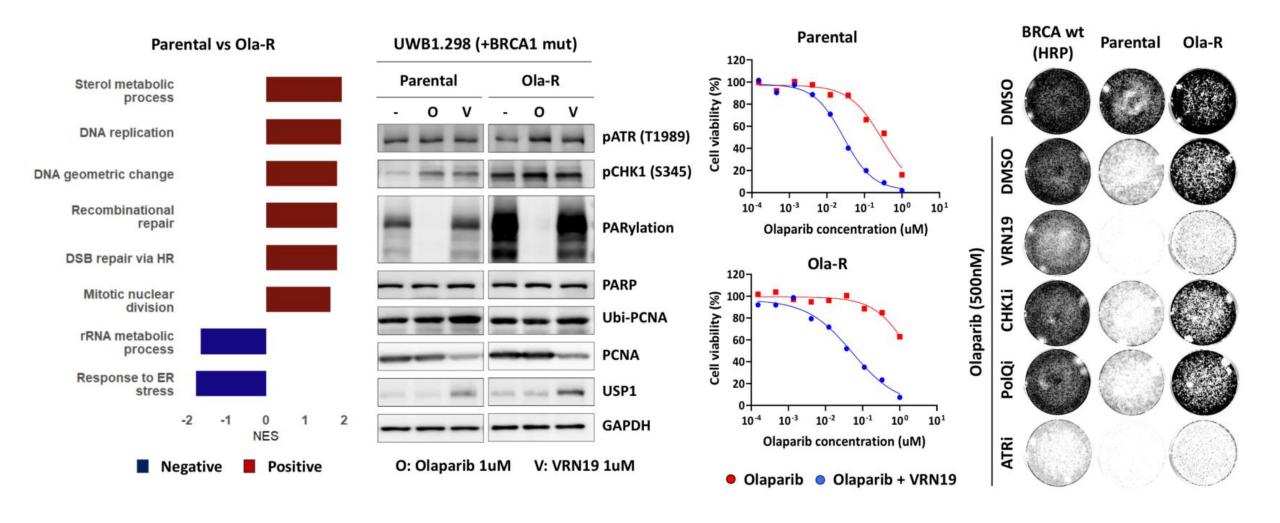


OVCAR3 (BRCA wt / HRD) SC xenograft model





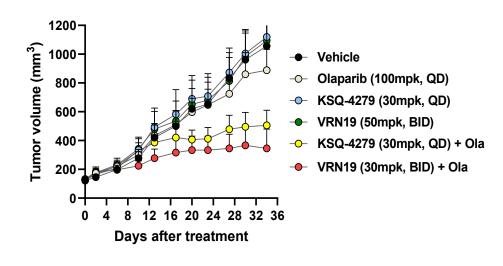
VRN19, Overcoming Acquired PARP Inhibitor Resistance

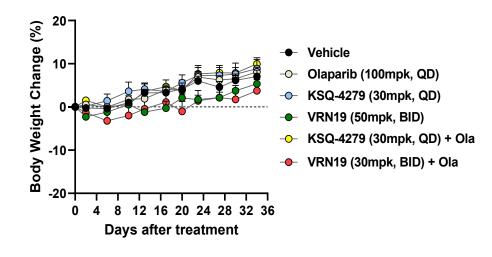


VRN19, in vivo efficacy against Olaparib resistance PDX

Combination of VRN19 and Olaparib overcomes resistance in Olaparib-resistant PDX model

Olaparib resistance TNBC PDX model





CRO: Xentech

VRN19, best-in-class USP1 inhibitor

- ✓ VRN19 is a highly potent and selective allosteric USP1 inhibitor.
- ✓ VRN19 showed anti-tumor efficacy in CDX or PDX model and superior synergistic efficacy with Olaparib.
- √ VRN19 can overcome acquired PARP inhibitor resistance.
- ✓ VRN19 is a promising novel USP1 inhibitor with favorable safety and improved therapeutic outcomes.
- √ VRN19 is advancing under IND enabling

Creating Novel Therapeutics By People With Excellent Expertise In Drug Design



Thank You