



## Sample Information

**Patient Name:** 談旭中

**Gender:** Male

**ID No.:** B121226079

**History No.:** 46442459

**Age:** 46

**Ordering Doctor:** DOC3064F 陳育民

**Ordering REQ.:** D5E9856

**Signing in Date:** 2020/10/07

**Path No.:** S109-89710

**MP No.:** F20082

**Assay:** Oncomine Focus Assay

**Sample Type:** FFPE

**Block No.:** S109-78063A+B

**Percentage of tumor cells:** 40%

**Note:**

## Sample Cancer Type: Non-Small Cell Lung Cancer

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### Report Highlights

1 Relevant Biomarkers  
 0 Therapies Available  
 55 Clinical Trials

## Relevant Non-Small Cell Lung Cancer Findings

Gene	Finding	Gene	Finding
ALK	Not detected	NTRK1	Not detected
BRAF	Not detected	NTRK2	Not detected
EGFR	<b>EGFR p.(?) c.2284-6C&gt;CTCCAGGAAGCCT</b>	NTRK3	Not detected
ERBB2	Not detected	RET	Not detected
KRAS	Not detected	ROS1	Not detected
MET	Not detected		



## Relevant Biomarkers

Tier	Genomic Alteration	Relevant Therapies (In this cancer type)	Relevant Therapies (In other cancer type)	Clinical Trials
IA	<b>EGFR p.(?)</b> <b>c.2284-6C&gt;CTCCAGGAAGCCT</b> epidermal growth factor receptor Allele Frequency: 25.60%	None	None	55

Public data sources included in relevant therapies: FDA1, NCCN, EMA2, ESMO

Tier Reference: Li et al. *Standards and Guidelines for the Interpretation and Reporting of Sequence Variants in Cancer: A Joint Consensus Recommendation of the Association for Molecular Pathology, American Society of Clinical Oncology, and College of American Pathologists.* J Mol Diagn. 2017 Jan;19(1):4-23.

## Variants (Exclude variant in Taiwan BioBank with >1% allele frequency)

### DNA Sequence Variants

Gene	Amino Acid Change	Coding	Variant ID	Locus	Allele Frequency	Transcript	Variant Effect	Coverage
EGFR	p.(?)	c.2284-6C>CTCCAGGAAGCCT	COSM26720	chr7:55248980	25.60%	NM_005228.4	unknown	
MET	p.(=)	c.1131C>T	.	chr7:116340269	41.42%	NM_001127500.2	synonymous	1999
MET	p.(T1114S)	c.3341C>G	.	chr7:116417470	56.48%	NM_001127500.2	missense	1983

## Biomarker Descriptions

### EGFR (epidermal growth factor receptor)

**Background:** The EGFR gene encodes the epidermal growth factor receptor (EGFR) tyrosine kinase, a member of the human epidermal growth factor receptor (HER) family. Along with EGFR/ERBB1/HER1, ERBB2/HER2, ERBB3/HER3, and ERBB4/HER4 make up the HER protein family<sup>1</sup>. EGFR ligand induced dimerization results in kinase activation and leads to stimulation of oncogenic signaling pathways including the PI3K/AKT/MTOR and RAS/RAF/MEK/ERK pathways. Activation of these pathways promote cell proliferation, differentiation, and survival<sup>2,3</sup>.

**Alterations and prevalence:** Recurrent somatic mutations in the tyrosine kinase domain of EGFR are observed in approximately 10-20% of lung adenocarcinoma and at higher frequencies in never-smoker, female, and in Asian populations with lung cancer<sup>4,5,6,7</sup>. The most common mutations occur near the ATP-binding pocket of the kinase domain and include short in-frame deletions in exon 19 (EGFR exon 19 deletion) and the L858R amino acid substitution in exon 21<sup>8</sup>. These mutations constitutively activate the EGFR kinase resulting in downstream signaling and represent 80% of the EGFR mutations observed in lung cancer. A second group of recurrent activating mutations that are less common include E709K, G719X, S768I, L861Q, and short in-frame insertions in exon 20<sup>9,10,11,12</sup>. EGFR activating mutations in lung cancer tend to be mutually exclusive to KRAS activating mutations<sup>13</sup>. Although these variants are common in lung cancer, they are rare in other cancer types. In glioblastoma, recurrent activating EGFR mutations in the extracellular domain include R108K, A289V and G598V<sup>8,14</sup>. The recurrent focal amplification of the EGFR gene leads to an increase in expression in several cancer types. EGFR is amplified in up to 30% of glioblastoma, 12% of esophageal cancer, 10% of head and neck cancer, 5% of bladder cancer, and 5% of lung squamous cell carcinoma<sup>5,6,7,14,15</sup>. Deletion of exons 2-7 encoding the extracellular domain of EGFR (EGFRvIII) results in overexpression of a ligand-independent constitutively active protein which is frequently observed in glioblastoma and has been shown to lead to lung cancer development as well as sensitivity to TKIs<sup>16,17,18</sup>.

**Potential relevance:** Erlotinib<sup>19</sup> (2004), afatinib<sup>20</sup> (2013), gefitinib<sup>21</sup> (2015), osimertinib<sup>22</sup> (2015), and dacomitinib<sup>23</sup> (2018) are small molecule TKIs that are FDA approved for non-small cell lung cancer (NSCLC) patients with sensitizing exon 19 deletions and exon 21 L858R mutations. Acquired secondary mutations often confer resistance to first line TKI therapy with the T790M amino acid substitution accounting for 50-60% of cases<sup>8</sup>. Osimertinib is also indicated for NSCLC patients harboring EGFR T790M mutations whose disease has progressed on or after treatment with a first line TKI. EGFR targeting antibodies including cetuximab<sup>24</sup> (2004),



## Biomarker Descriptions (continued)

panitumumab<sup>25</sup> (2006), and necitumumab<sup>26</sup> (2016) are also under investigation in combination with EGFR-targeting TKIs for efficacy against EGFR mutations. The bispecific antibody, JNJ-61186372<sup>27</sup>, targeting EGFR and MET, and the tyrosine kinase inhibitor<sup>28</sup> each received a breakthrough designation from the FDA (2020) for NSCLC tumors harboring EGFR exon 20 insertion mutations. The Oncoprex immunogene therapy CNVN-202<sup>29</sup> in combination with the EGFR inhibitor, osimertinib, received a fast track designation from the FDA (2020) for NSCLC tumors harboring EGFR mutations. The use of cetuximab in combination with afatinib is currently recommended by the NCCN for patients who have progressed after receiving erlotinib, afatinib, dacomitinib, or gefitinib and chemotherapy<sup>30</sup>.

## Relevant Therapy Summary

● In this cancer type    ○ In other cancer type    ● In this cancer type and other cancer types    ⛔ Contraindicated    ⚠ Both for use and contraindicated    ✕ No evidence

### EGFR p.(?) c.2284-6C>CTCCAGGAAGCCT

Relevant Therapy	FDA	NCCN	EMA	ESMO	Clinical Trials*
apatinib + EGFR tyrosine kinase inhibitor	✕	✕	✕	✕	● (IV)
apatinib, gefitinib	✕	✕	✕	✕	● (IV)
EGFR tyrosine kinase inhibitor	✕	✕	✕	✕	● (IV)
gefitinib, radiation therapy	✕	✕	✕	✕	● (IV)
icotinib hydrochloride, radiation therapy	✕	✕	✕	✕	● (IV)
bevacizumab, atezolizumab, chemotherapy	✕	✕	✕	✕	● (III)
durvalumab, chemotherapy	✕	✕	✕	✕	● (III)
gefitinib	✕	✕	✕	✕	● (III)
icotinib hydrochloride, chemotherapy	✕	✕	✕	✕	● (III)
nivolumab, chemotherapy	✕	✕	✕	✕	● (III)
afatinib	✕	✕	✕	✕	● (II)
afatinib, bevacizumab	✕	✕	✕	✕	● (II)
afatinib, chemotherapy, radiation therapy	✕	✕	✕	✕	● (II)
anlotinib hydrochloride	✕	✕	✕	✕	● (II)
anlotinib hydrochloride, gefitinib	✕	✕	✕	✕	● (II)
bevacizumab, osimertinib	✕	✕	✕	✕	● (II)
EGFR tyrosine kinase inhibitor + chemotherapy	✕	✕	✕	✕	● (II)
EGFR tyrosine kinase inhibitor + chemotherapy, EGFR tyrosine kinase inhibitor	✕	✕	✕	✕	● (II)

\* Most advanced phase (IV, III, II/III, II, I/II, I) is shown and multiple clinical trials may be available.



## Relevant Therapy Summary (continued)

● In this cancer type    ○ In other cancer type    ● In this cancer type and other cancer types    ⛔ Contraindicated    ⚠ Both for use and contraindicated    ✕ No evidence

### EGFR p.(?) c.2284-6C>CTCCAGGAAGCCT (continued)

Relevant Therapy	FDA	NCCN	EMA	ESMO	Clinical Trials*
EGFR tyrosine kinase inhibitor, apatinib	✕	✕	✕	✕	● (II)
EGFR tyrosine kinase inhibitor, radiation therapy	✕	✕	✕	✕	● (II)
erlotinib	✕	✕	✕	✕	● (II)
erlotinib + chemotherapy	✕	✕	✕	✕	● (II)
erlotinib, chemotherapy, sintilimab, anlotinib hydrochloride	✕	✕	✕	✕	● (II)
erlotinib, radiation therapy	✕	✕	✕	✕	● (II)
famitinib, HS-10296	✕	✕	✕	✕	● (II)
icotinib hydrochloride	✕	✕	✕	✕	● (II)
nivolumab, ipilimumab	✕	✕	✕	✕	● (II)
osimertinib	✕	✕	✕	✕	● (II)
pirotinib	✕	✕	✕	✕	● (II)
ramucirumab, chemotherapy, cytokine	✕	✕	✕	✕	● (II)
targeted therapy, chemotherapy	✕	✕	✕	✕	● (II)
tyrosine kinase inhibitors, radiation therapy	✕	✕	✕	✕	● (II)
anlotinib hydrochloride, chemotherapy	✕	✕	✕	✕	● (I/II)
bevacizumab + erlotinib + chemotherapy	✕	✕	✕	✕	● (I/II)
DZD-9008	✕	✕	✕	✕	● (I/II)
EMB01	✕	✕	✕	✕	● (I/II)
icotinib hydrochloride + chemotherapy	✕	✕	✕	✕	● (I/II)
ningetinib, gefitinib	✕	✕	✕	✕	● (I/II)
lazertinib, JNJ-61186372	✕	✕	✕	✕	● (I)
neratinib, palbociclib, everolimus, trametinib	✕	✕	✕	✕	● (I)
TP-0903	✕	✕	✕	✕	● (I)
TQB 3804	✕	✕	✕	✕	● (I)

\* Most advanced phase (IV, III, II/III, II, I/II, I) is shown and multiple clinical trials may be available.



## Relevant Therapy Summary (continued)

● In this cancer type  
 ○ In other cancer type  
 ⓘ In this cancer type and other cancer types  
 ⛔ Contraindicated  
 ⚠ Both for use and contraindicated  
 ✕ No evidence

### EGFR p.(?) c.2284-6C>CTCCAGGAAGCCT (continued)

Relevant Therapy	FDA	NCCN	EMA	ESMO	Clinical Trials*
tyrosine kinase inhibitors, tyrosine kinase inhibitors + chemotherapy	✕	✕	✕	✕	● (I)

\* Most advanced phase (IV, III, II/III, II, I/II, I) is shown and multiple clinical trials may be available.

## Relevant Therapy Details

### Current NCCN Information

● In this cancer type  
 ○ In other cancer type  
 ⓘ In this cancer type and other cancer types  
 ⛔ Contraindicated  
 ⚠ Not recommended  
 🛡 Resistance

NCCN information is current as of 2020-05-01. For the most up-to-date information, search [www.nccn.org](http://www.nccn.org).  
 For NCCN International Adaptations & Translations, search [www.nccn.org/global/international\\_adaptations.aspx](http://www.nccn.org/global/international_adaptations.aspx).

### EGFR p.(?) c.2284-6C>CTCCAGGAAGCCT

#### ⚠ atezolizumab

Cancer type: Non-Small Cell Lung Cancer

Variant class: EGFR mutation

##### Summary:

NCCN Guidelines® include the following supporting statement(s):

- "Therefore, subsequent therapy with pembrolizumab, nivolumab, or atezolizumab is not recommended in patients with EGFR mutations or ALK fusions."

Reference: NCCN Guidelines® - NCCN-Non-Small Cell Lung Cancer [Version 4.2020]

#### ⚠ nivolumab

Cancer type: Non-Small Cell Lung Cancer

Variant class: EGFR mutation

##### Summary:

NCCN Guidelines® include the following supporting statement(s):

- "Therefore, subsequent therapy with pembrolizumab, nivolumab, or atezolizumab is not recommended in patients with EGFR mutations or ALK fusions."

Reference: NCCN Guidelines® - NCCN-Non-Small Cell Lung Cancer [Version 4.2020]



## EGFR p.(?) c.2284-6C>CTCCAGGAAGCCT (continued)

### — pembrolizumab

Cancer type: Non-Small Cell Lung Cancer

Variant class: EGFR mutation

#### Summary:

NCCN Guidelines® include the following supporting statement(s):

- "Therefore, subsequent therapy with pembrolizumab, nivolumab, or atezolizumab is not recommended in patients with EGFR mutations or ALK fusions."

Reference: NCCN Guidelines® - NCCN-Non-Small Cell Lung Cancer [Version 4.2020]

### — pembrolizumab

Cancer type: Non-Small Cell Lung Cancer

Variant class: EGFR mutation

Other criteria: CD274 overexpression

#### Summary:

NCCN Guidelines® include the following supporting statement(s):

- "A small study suggests that single-agent pembrolizumab is not effective as first-line therapy in patients with metastatic NSCLC and EGFR mutations, even those with PD-L1 levels more than 50%."

Reference: NCCN Guidelines® - NCCN-Non-Small Cell Lung Cancer [Version 4.2020]



## Signatures

Testing Personnel:

Laboratory Supervisor:

Pathologist:



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