Gemeinsamer Bundesausschuss

Kriterien zur Bestimmung der zweckmäßigen Vergleichstherapie

und

Recherche und Synopse der Evidenz zur Bestimmung der zweckmäßigen Vergleichstherapie nach § 35a SGB V

und

Schriftliche Beteiligung der wissenschaftlich-medizinischen Fachgesellschaften und der Arzneimittelkommission der deutschen Ärzteschaft (AkdÄ) zur Bestimmung der zweckmäßigen Vergleichstherapie nach § 35a SGB V

Vorgang: 2022-B-223-z Capmatinib

Stand: November 2022

I. Zweckmäßige Vergleichstherapie: Kriterien gemäß 5. Kapitel § 6 VerfO G-BA	
Capmatinib **[Behandlung des fortgeschrittenen NSCLC mit METex14-Skipping-Mutation]**	
Kriterien gemäß 5. Kapitel § 6 VerfO	
Sofern als Vergleichstherapie eine Arzneimittelanwendung in Betracht kommt, muss das Arzneimittel grundsätzlich eine Zulassung für das Anwendungsgebiet haben.	Siehe Übersicht „II. Zugelassene Arzneimittel im Anwendungsgebiet“
Sofern als Vergleichstherapie eine nicht-medikamentöse Behandlung in Betracht kommt, muss diese im Rahmen der GKV erbringbar sein.	Nicht angezeigt.
Beschlüsse/Bewertungen/Empfehlungen des Gemeinsamen Bundesausschusses zu im Anwendungsgebiet zugelassenen Arzneimitteln/nicht-medikamentösen Behandlungen	**Beschlüsse über die Nutzenbewertung von Arzneimitteln mit neuen Wirkstoffen nach § 35a SGB V:** • Afatinib: Beschluss vom 20.10.2016 • Alectinib: Beschluss vom 19.10.2017 • Amivantamab: Beschluss vom 07.07.2022 • Atezolizumab: Beschluss vom 16.03.2018 • Brigatinib: Beschluss vom 15.10.2020 und 04.07.2019 • Ceritinib: Beschluss vom 16.03.2017 • Crizotinib: Beschlüsse vom 16.03.2017, 16.06.2016, 15.12.2016 • Dacomitinib: Beschluss vom 17.10.2019 • Dabrafenib: Beschluss vom 19.10.2017 • Entrectinib: Beschluss vom 18.02.2021 • Lorlatinib: Beschluss vom 22.11.2019 • Nintedanib: Beschluss vom 18.06.2015 • Nivolumab: Beschlüsse vom 04.02.2016 und 20.10.2016 • Osimertinib: Beschlüsse vom 19.10.2017, 17.01.2019

	• Pembrolizumab: Beschluss vom 02.02.2017 • Pralsetinib: Beschluss vom 16.06.2022 • Trametinib: Beschluss vom 19.10.2017 • Ramucirumab: Beschluss vom 01.09.2016 • Selpercatinib: Beschluss vom 02.09.2021 • Sotorasib: Beschluss vom 04.08.2022 • Tepotinib: Beschluss vom 01.09.2022 **Richtlinien:** Anlage VI zum Abschnitt K der Arzneimittel-Richtlinie - Verordnungsfähigkeit von zugelassenen Arzneimitteln in nicht zugelassenen Anwendungsgebieten (Off-Label-Use): • Carboplatin-haltige Arzneimittel bei fortgeschrittenem nicht-kleinzelligem Bronchialkarzinom (NSCLC) – Kombinationstherapie
Die Vergleichstherapie soll nach dem allgemein anerkannten Stand der medizinischen Erkenntnisse zur zweckmäßigen Therapie im Anwendungsgebiet gehören.	Siehe systematische Literaturrecherche

II. Zugelassene Arzneimittel im Anwendungsgebiet	
Wirkstoff ATC-Code Handelsname	**Anwendungsgebiet** (Text aus Beratungsanforderung/Fachinformation)
Zu prüfendes Arzneimittel:	
Capmatinib L01EX17 Tabrecta	<u>Zugelassenes Anwendungsgebiet</u> Capmatinib als Monotherapie wird angewendet zur Behandlung von erwachsenen Patienten mit einem fortgeschrittenen nicht-kleinzelligen Bronchialkarzinom (non-small cell lung cancer, NSCLC) mit Veränderungen, die zu METex14-Skipping (Exon-14-Skipping im mesenchymal-epithelialen Transitionsfaktor-Gen) führen, die eine systemische Therapie nach einer Behandlung mit Immuntherapie und/oder Platin-basierter Chemotherapie benötigen.
Zytostatika	
Cisplatin L01XA01 generisch	Cisplatin wird angewendet zur Behandlung des fortgeschrittenen oder metastasierten nichtkleinzelligen Bronchialkarzinoms. Cisplatin kann als Mono- oder Kombinationstherapie angewendet werden.
Docetaxel L01CD02 generisch	• TAXOTERE ist zur Behandlung von Patienten mit lokal fortgeschrittenem oder metastasiertem, nicht kleinzelligem Bronchialkarzinom nach Versagen einer vorausgegangenen Chemotherapie angezeigt. • […]
Etoposid L01CB01 Riboposid	Kombinationstherapie folgender Malignome: • Palliative Therapie des fortgeschrittenen, nicht-kleinzelligen Bronchialkarzinoms bei Patienten mit gutem Allgemeinzustand (Karnofsky-Index > 80 %), • […]
Ifosfamid L01AA06 Holoxan	Nicht-kleinzellige Bronchialkarzinome: Zur Einzel- oder Kombinationschemotherapie von Patienten mit inoperablen oder metastasierten Tumoren.

II. Zugelassene Arzneimittel im Anwendungsgebiet	
Wirkstoff ATC-Code Handelsname	**Anwendungsgebiet** (Text aus Beratungsanforderung/Fachinformation)
Mitomycin L01DC03 generisch	Mitomycin wird in der palliativen Tumortherapie eingesetzt. Die intravenöse Anwendung von Mitomycin ist in der Monochemotherapie oder in kombinierter zytostatischer Chemotherapie bei Erwachsenen mit folgenden Erkrankungen angezeigt: […] - nicht-kleinzelliges Bronchialkarzinom […].
Paclitaxel L01CD01 generisch	Fortgeschrittenes nicht-kleinzelliges Bronchialkarzinom (NSCLC): Paclitaxel ist, in Kombination mit Cisplatin, zur Behandlung des nicht-kleinzelligen Bronchialkarzinoms bei Patienten angezeigt, für die potentiell kurative chirurgische Maßnahmen und/oder eine Strahlentherapie nicht in Frage kommen.
Pemetrexed L01BA04 generisch	• Pemetrexed ist in Kombination mit Cisplatin angezeigt zur first-line Therapie von Patienten mit lokal fortgeschrittenem oder metastasiertem nicht-kleinzelligen Lungenkarzinom außer bei überwiegender plattenepithelialer Histologie. • Pemetrexed in Monotherapie ist angezeigt für die Erhaltungstherapie bei lokal fortgeschrittenem oder metastasiertem nicht-kleinzelligen Lungenkarzinom außer bei überwiegender plattenepithelialer Histologie bei Patienten, deren Erkrankung nach einer platinbasierten Chemotherapie nicht unmittelbar fortgeschritten ist. • Pemetrexed in Monotherapie ist angezeigt zur Behandlung in Zweitlinientherapie von Patienten mit lokal fortgeschrittenem oder metastasiertem nicht-kleinzelligen Lungenkarzinom außer bei überwiegender plattenepithelialer Histologie.
Vindesin L01CA03 Eldesine	Kombinationschemotherapie: Lokal fortgeschrittenes oder metastasiertes nicht-kleinzelliges Bronchialkarzinom (Stadium IIIB, IV).
Vinorelbin L01CA04 generisch	Behandlung des nicht kleinzelligen Bronchialkarzinoms (Stadium 3 oder 4).
Proteinkinase-Inhibitoren:	
Afatinib L01XE13	GIOTRIF als Monotherapie wird angewendet zur Behandlung von:

II. Zugelassene Arzneimittel im Anwendungsgebiet	
Wirkstoff **ATC-Code** **Handelsname**	**Anwendungsgebiet** (Text aus Beratungsanforderung/Fachinformation)
Giotrif	• erwachsenen Patienten mit lokal fortgeschrittenem oder metastasiertem NSCLC mit Plattenepithel-Histologie, das unter oder nach Platinbasierter Chemotherapie fortschreitet • epidermaler Wachstumsfaktorrezeptor (EGFR, epidermal growth factor receptor)-Tyrosinkinaseinhibitor (TKI)-naiven erwachsenen Patienten mit lokal fortgeschrittenem und/oder metastasiertem nicht-kleinzelligen Lungenkarzinom (NSCLC, non-small cell lung cancer) mit aktivierenden EGFR-Mutationen
Alectinib L01XE36 Alecensa	• Alecensa wird als Monotherapie angewendet zur Behandlung des Anaplastische-Lymphomkinase (ALK)-positiven, fortgeschrittenen nichtkleinzelligen Bronchial-karzinoms (non-small cell lung cancer, NSCLC) bei erwachsenen Patienten, die zuvor mit Crizotinib behandelt wurden. • […]
Brigatinib L01XE43 Alunbrig	• Alunbrig ist als Monotherapie bei erwachsenen Patienten mit anaplastischer-Lymphomkinase (ALK)-positivem, fortgeschrittenem, nicht-kleinzelligem Lungenkarzinom (NSCLC) angezeigt, die zuvor nicht mit einem ALK-Inhibitor behandelt wurden. • Alunbrig ist als Monotherapie bei erwachsenen Patienten mit ALK-positivem, fortgeschrittenem NSCLC angezeigt, die zuvor mit Crizotinib behandelt wurden
Ceritinib L01XE28 Zykadia	• Zykadia wird als Monotherapie angewendet bei erwachsenen Patienten zur Behandlung des fortgeschrittenen, Anaplastische-Lymphomkinase (ALK)-positiven, nicht-kleinzelligen Bronchialkarzinoms (NSCLC), die mit Crizotinib vorbehandelt wurden. • […]
Dabrafenib L01XE23 Tafinlar	Dabrafenib in Kombination mit Trametinib ist angezeigt zur Behandlung von erwachsenen Patienten mit fortgeschrittenem nicht-kleinzelligen Lungenkarzinom mit einer BRAF-V600-Mutation.
Trametinib L01XE25 Mekinist	Trametinib in Kombination mit Dabrafenib ist angezeigt zur Behandlung von erwachsenen Patienten mit fortgeschrittenem nicht-kleinzelligen Lungenkarzinom mit einer BRAF-V600-Mutation.

II. Zugelassene Arzneimittel im Anwendungsgebiet	
Wirkstoff **ATC-Code** **Handelsname**	**Anwendungsgebiet** (Text aus Beratungsanforderung/Fachinformation)
Erlotinib L01XE03 generisch	<u>Nicht-kleinzelliges Lungenkarzinom (NSCLC)</u> • Tarceva ist auch zur Behandlung von Patienten mit lokal fortgeschrittenem oder metastasiertem NSCLC angezeigt, bei denen mindestens eine vorausgegangene Chemotherapie versagt hat. Bei Patienten mit Tumoren ohne aktivierende EGFR-Mutationen ist Tarceva angezeigt, wenn andere Therapieoptionen als ungeeignet erachtet werden. • […]
Entrectinib L01XE56 Rozlytrek	Rozlytrek als Monotherapie wird angewendet bei erwachsenen Patienten mit ROS1-positivem, fortgeschrittenem nicht-kleinzelligem Lungenkarzinom (NSCLC), die zuvor keine Behandlung mit ROS1-Inhibitoren erhalten haben.
Crizotinib L01XE16 Xalkori	XALKORI als Monotherapie wird angewendet bei: • Erwachsenen zur Erstlinienbehandlung des Anaplastische-Lymphom-Kinase (ALK)-positiven, fortgeschrittenen nicht kleinzelligen Lungenkarzinoms (non small cell lung cancer, NSCLC) • Erwachsenen zur Behandlung des vorbehandelten Anaplastische-Lymphom-Kinase (ALK)-positiven, fortgeschrittenen nicht-kleinzelligen Lungenkarzinoms (non-small cell lung cancer, NSCLC) • Erwachsenen zur Behandlung des ROS1-positiven, fortgeschrittenen nicht kleinzelligen Lungenkarzinoms (non small cell lung cancer, NSCLC)
Gefitinib L01XE02 Iressa	IRESSA ist als Monotherapie angezeigt zur Behandlung von erwachsenen Patienten mit lokal fortgeschrittenem oder metastasiertem, nicht-kleinzelligem Lungenkarzinom (NSCLC) mit aktivierenden Mutationen der EGFR-TK.
Osimertinib L01XE35 Tagrisso	TAGRISSO ist als Monotherapie angezeigt zur: • Erstlinientherapie von erwachsenen Patienten mit lokal fortgeschrittenem oder metastasiertem, nicht-kleinzelligem Lungenkarzinom (NSCLC) mit aktivierenden Mutationen des epidermalen Wachstumsfaktor-Rezeptors (Epidermal Growth Factor Receptor, EGFR). • Behandlung von erwachsenen Patienten mit lokal fortgeschrittenem oder metastasiertem EGFR-T790M-mutationspositivem NSCLC. • […]

II. Zugelassene Arzneimittel im Anwendungsgebiet	
Wirkstoff ATC-Code Handelsname	**Anwendungsgebiet** (Text aus Beratungsanforderung/Fachinformation)
Tepotinib L01EX21 Tepmetko	TEPMETKO als Monotherapie wird angewendet bei erwachsenen Patienten mit einem fortgeschrittenen nicht-kleinzelligen Bronchialkarzinom (NSCLC) mit Veränderungen, die zu METex14-Skipping (Exon-14-Skipping im mesenchymal-epithelialen Transitionsfaktor-Gen) führen, die eine systemische Therapie nach Platin-basierter Chemotherapie und/oder einer Behandlung mit Immuntherapie benötigen.
Lorlatinib L01ED05 Lorviqua	Lorviqua als Monotherapie wird angewendet zur Behandlung erwachsener Patienten mit Anaplastische-Lymphomkinase (ALK)-positivem, fortgeschrittenen nicht-kleinzelligen Lungenkarzinom (non-small cell lung cancer, NSCLC), deren Erkrankung fortgeschritten ist nach: • Alectinib oder Ceritinib als erste Therapie mit ALK-Tyrosinkinase-Inhibitoren (TKI); oder • Crizotinib und mindestens einem anderen ALK-TKI.
Sotorasib L01XX73 Lumykras	LUMYKRAS wird als Monotherapie angewendet für die Behandlung von Erwachsenen mit fortgeschrittenem nicht-kleinzelligen Lungenkarzinom (NSCLC, non-small cell lung cancer) mit KRAS G12C-Mutation, bei denen nach mindestens einer vorherigen systemischen Therapie eine Progression festgestellt wurde.
Pralsetinib L01EX23 Gavreto	Gavreto wird angewendet als Monotherapie zur Behandlung von erwachsenen Patienten mit Rearranged-during-Transfection (RET)-Fusions-positivem, fortgeschrittenem nicht-kleinzelligem Lungenkarzinom (NSCLC), die zuvor nicht mit einem RET-Inhibitor behandelt wurden.
Selpercatinib L01EX22 Retsevmo	Retsevmo als Monotherapie wird angewendet zur Behandlung von Erwachsenen mit: • fortgeschrittenem RET-Fusions-positivem nicht-kleinzelligen Lungenkarzinom (NSCLC), die zuvor nicht mit einem RET-Inhibitor behandelt wurden […]
Nintedanib L01EX09 Vargatef	Vargatef wird angewendet in Kombination mit Docetaxel zur Behandlung von erwachsenen Patienten mit lokal fortgeschrittenem, metastasiertem oder lokal rezidiviertem nicht-kleinzelligen Lungenkarzinom (NSCLC) mit Adenokarzinom-Histologie nach Erstlinienchemotherapie.
Antikörper:	

II. Zugelassene Arzneimittel im Anwendungsgebiet	
Wirkstoff ATC-Code Handelsname	**Anwendungsgebiet** (Text aus Beratungsanforderung/Fachinformation)
Nivolumab L01XC17 Opdivo	Nicht-kleinzelliges Lungenkarzinom (NSCLC) • OPDIVO ist als Monotherapie zur Behandlung des lokal fortgeschrittenen oder metastasierten nicht-kleinzelligen Lungenkarzinoms nach vorheriger Chemotherapie bei Erwachsenen indiziert. • […]
Atezolizumab L01XC32 Tecentriq	• Tecentriq als Monotherapie wird angewendet bei erwachsenen Patienten zur Behandlung des lokal fortgeschrittenen oder metastasierten NSCLC nach vorheriger Chemotherapie. Patienten mit EGFR-Mutationen oder ALK-positivem NSCLC sollten vor der Therapie mit Tecentriq zudem auch bereits entsprechende zielgerichtete Therapien erhalten haben. • […]
Pembrolizumab L01XC18 KEYTRUDA	• KEYTRUDA ist als Monotherapie zur Behandlung des lokal fortgeschrittenen oder metastasierenden nicht-kleinzelligen Lungenkarzinoms mit PD -L1-exprimierenden Tumoren (TPS ≥ 1 %) nach vorheriger Chemotherapie bei Erwachsenen angezeigt. Patienten mit EGFR- oder ALK-positiven Tumormutationen sollten vor der Therapie mit KEYTRUDA ebenfalls eine auf diese Mutationen zielgerichtete Therapie erhalten haben. • […]
Ramucirumab L01XC21 Cyramza	• Cyramza ist in Kombination mit Docetaxel indiziert zur Behandlung von erwachsenen Patienten mit einem lokal fortgeschrittenen oder metastasierten nicht-kleinzelligen Lungenkarzinom mit Tumorprogress nach platinhaltiger Chemotherapie. • […]
Amivantamab L01FX18 Rybrevant	Rybrevant als Monotherapie ist indiziert zur Behandlung erwachsener Patienten mit fortgeschrittenem nicht-kleinzelligem Lungenkarzinom (non-small cell lung cancer, NSCLC) und aktivierenden Exon-20-Insertionsmutationen des epidermalen Wachstumsfaktor-Rezeptors (EGFR) nach Versagen einer platinbasierten Therapie.

Quellen: AMIce-Datenbank, Fachinformationen

Gemeinsamer Bundesausschuss

Abteilung Fachberatung Medizin

Recherche und Synopse der Evidenz zur Bestimmung der zweckmäßigen Vergleichstherapie nach § 35a SGB V

Vorgang: 2022-B-223z (Capmatinib)

Auftrag von:	Abt. AM
Bearbeitet von:	Abt. FB Med
Datum:	14. November 2022

Inhaltsverzeichnis

Abkürzungsverzeichnis

AE	Adverse event
AFA	Afatinib
ALK	Anaplastic Lymphoma Kinase
ALT	Alanin-Aminotransferase
ASCO	American Society of Clinical Oncology
AST	Aspartat-Aminotransferase
ATEZO	Atezolizumab
AWMF	Arbeitsgemeinschaft der wissenschaftlichen medizinischen Fachgesellschaften
Bev	Bevacizumab
BSC	Best supportive care
CIS	Cisplatin
CNS	Zentrales Nervensystem/central nervous system
CTX	Cytotoxic Chemotherapy
DAHTA	DAHTA Datenbank
DCR	Disease Control Rate
DOC	Docetaxel
ECOG-PS	Eastern Cooperative Oncology Group Performance Status
EGFR	Epidermal Growth Factor Receptor
EORTC	European Organisation for QLQ Research and Treatment of Cancer Quality of Life Questionnaire
EPHPP	Effective Public Health Practice Project Tool
ERL	Erlotinib
ESMO	European Society for Medical Oncology
G-BA	Gemeinsamer Bundesausschuss
Gem	Gemcitabin
GIN	Guidelines International Network
GoR	Grade of Recommendations
GRADE	Grading of Recommendations Assessment, Development and Evaluation
HR	Hazard Ratio
ICI	Immune-Checkpoint Inhibitor
IQWiG	Institut für Qualität und Wirtschaftlichkeit im Gesundheitswesen
k.A.	Keine Angaben
KI	Konfidenzintervall
KRAS	Kirsten rat sarcoma oncogene Mutation

LoE	Level of Evidence
M+	mutation positive (EGFR)
NGC	National Guideline Clearinghouse
NICE	National Institute for Health and Care Excellence
NINTE	Nintedanib
NIVO	Nivolumab
NSCLC	non-small cell lung cancer
NSQ	Non-Squamous
OR	Odds Ratio
ORR	Objective response rate
OS	Overall Survival
PAX	Paclitaxel
PC	paclitaxel and carboplatin
PD-1	anti-programmed cell death receptor 1
PD-L1	antiprogrammed cell death ligand
PEM	Pemetrexed
PEMBRO	Pembrolizumab
PFS	Progression Free Survival
Pt+B	Platinum plus Bevacizumab
QoL	Quality of Life
RCT	Randomized Controlled Trial
RR	Relatives Risiko
SQ	Squamous
SIGN	Scottish Intercollegiate Guidelines Network
TA	Targeted Agent
TKI	Tyrosinkinsaseinhibitor
TPS	Tumor Proportion Score
TRAE	Treatment related adverse event
TRIP	Turn Research into Practice Database
TTP	Time to Progression
VEGFR	Vascular endothelial growth factor receptor
VTE	Venous Thromboembolism
WHO	World Health Organization
WMD	Weighted mean difference.
WT	Wild Type

1 Indikation

Indikation für die Synopse: Behandlung des lokal fortgeschrittenen oder metastasierten nicht-kleinzelligen Lungenkarzinoms (NSCLC) nach vorheriger Therapie.

2 Systematische Recherche

Es wurde eine systematische Literaturrecherche nach systematischen Reviews, Meta-Analysen und evidenzbasierten systematischen Leitlinien zur Indikation *NSCLC* durchgeführt und nach PRISMA-S dokumentiert [A]. Die Recherchestrategie wurde vor der Ausführung anhand der PRESS-Checkliste begutachtet [B]. Es erfolgte eine Datenbankrecherche ohne Sprachrestriktion in: The Cochrane Library (Cochrane Database of Systematic Reviews), MEDLINE (PubMed). Die Recherche nach grauer Literatur umfasste eine gezielte, iterative Handsuche auf den Internetseiten von Leitlinienorganisationen. Ergänzend wurde eine freie Internetsuche (https://www.startpage.com) unter Verwendung des privaten Modus, nach aktuellen deutsch- und englischsprachigen Leitlinien durchgeführt.

Die Erstrecherche wurde am 03.05.2021 durchgeführt, die folgende am 09.12.2021. Die Recherchestrategie der Erstrecherche wurde unverändert übernommen und der Suchzeitraum jeweils auf die letzten fünf Jahre eingeschränkt. Die letzte Suchstrategie inkl. Angabe zu verwendeter Suchfilter ist am Ende der Synopse detailliert dargestellt. Die Recherchen ergaben insgesamt 1839 Referenzen.

In einem zweistufigen Screening wurden die Ergebnisse der Literaturrecherche bewertet. Im ersten Screening wurden auf Basis von Titel und Abstract nach Population, Intervention, Komparator und Publikationstyp nicht relevante Publikationen ausgeschlossen. Zudem wurde eine Sprachrestriktion auf deutsche und englische Referenzen vorgenommen. Im zweiten Screening wurden die im ersten Screening eingeschlossenen Publikationen als Volltexte gesichtet und auf ihre Relevanz und methodische Qualität geprüft. Dafür wurden dieselben Kriterien wie im ersten Screening sowie Kriterien zur methodischen Qualität der Evidenzquellen verwendet. Basierend darauf, wurden insgesamt 86 Referenzen eingeschlossen. Es erfolgte eine synoptische Darstellung wesentlicher Inhalte der identifizierten Referenzen.

3 Ergebnisse

3.1 Cochrane Reviews

Vasconcellos VF et al., 2020 [64].

Cisplatin versus carboplatin in combination with third-generation drugs for advanced non-small cell lung cancer.

Fragestellung

To assess the effectiveness and safety of carboplatin-based chemotherapy compared with cisplatin-based chemotherapy, both in combination with a third-generation drug, in people with advanced NSCLC.

To compare the QoL of people with advanced NSCLC receiving chemotherapy with cisplatin and carboplatin combined with a third-generation drug.

Methodik

Population:

- People with pathologically confirmed NSCLC, with metastatic disease, or pleural or pericardial effusion (stage IIIB or IV)

Intervention/Komparator:

- Cisplatin plus gemcitabine versus carboplatin plus gemcitabine
- Cisplatin plus docetaxel versus carboplatin plus docetaxel
- Cisplatin plus paclitaxel versus carboplatin plus paclitaxel
- Cisplatin plus vinorelbine versus carboplatin plus vinorelbine
- Cisplatin plus irinotecan versus carboplatin plus irinotecan

Endpunkte:

- Overall survival, Health-related quality of life (HRQoL), One-year survival rate, Objective response rate, Drug toxicities

Recherche/Suchzeitraum:

- Bis Januar 2019

Qualitätsbewertung der Studien:

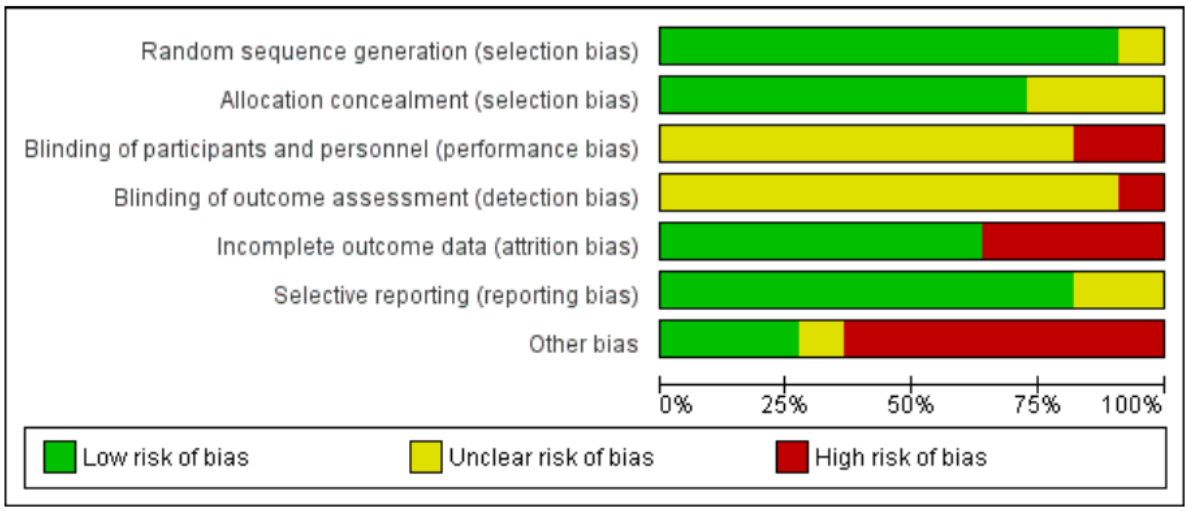
- Cochrane approach / GRADE

Ergebnisse

Anzahl eingeschlossener Studien:

- one additional RCT, for a total of 11 included RCTs (5088 participants, 4046 for metaanalysis)

Qualität der Studien:



Studienergebnisse:

- No difference in overall survival (hazard ratio (HR) 0.99, 95% confidence interval (CI) 0.82 to 1.20; 10 RCTs; 2515 participants; high-quality evidence); one-year survival rate (risk ratio (RR) 0.98, 95% CI 0.89 to 1.08; I2 = 17%; 4004 participants; all 11 RCTs; high-quality evidence); or response rate (RR 0.89, 95% CI 0.79 to 1.00; I2 = 12%; all 11 RCTs; 4020 participants; high-quality evidence).
- A subgroup analysis comparing carboplatin with different doses of cisplatin found an overall survival benefit in favour of carboplatin-based regimens when compared to cisplatin at lower doses (40 to 80 mg/m2) (HR 1.15, 95% CI 1.03 to 1.28; 6 RCTs; 2508 participants), although there was no overall survival benefit when carboplatin-based chemotherapy was compared to cisplatin at higher doses (80 to 100 mg/ m2) (HR 0.93, 95% CI 0.83 to 1.04; I2 = 0%; 4 RCTs; 1823 participants).
- Carboplatin caused more thrombocytopenia (RR 2.46, 95% CI 1.49 to 4.04; I2 = 68%; 10 RCTs; 3670 participants) and was associated with more neurotoxicity (RR 1.42, 95% CI 0.91 to 2.23; I2 = 0%, 5 RCTs; 1489 participants), although we believe this last finding is probably related to a confounding factor (higher dose of paclitaxel in the carboplatincontaining treatment arm of a large study included in the analysis).
- There was no statistically significant difference in renal toxicity (RR 0.52, 95% CI 0.19 to 1.45; I2 = 3%; 3 RCTs; 1272 participants); alopecia (RR 1.11, 95% CI 0.73 to 1.68; I2 = 0%; 2 RCTs; 300 participants); anaemia (RR 1.37, 95% CI 0.79 to 2.38; I2 = 77%; 10 RCTs; 3857 participants); and neutropenia (RR 1.18, 95% CI 0.85 to 1.63; I2 = 94%; 10 RCTs; 3857 participants) between cisplatin-based chemotherapy and carboplatin-based chemotherapy regimens.
- Two RCTs performed a healthrelated quality of life analysis; however, as they used different methods of measurement we were unable to perform a meta-analysis. One RCT reported comparative health-related quality of life data between cisplatin and carboplatin-containing arms but found no significant differences in global indices of quality of life, including global health status or functional scales.

Anmerkung/Fazit der Autoren

Advanced NSCL patients treated with carboplatin or cisplatin doublet with third-generation chemotherapy drugs showed equivalent overall survival, one-year survival, and response rate. Regarding adverse events, carboplatin caused more thrombocytopenia, and cisplatin

caused more nausea/vomiting. Therefore, in this palliative therapeutic intent, the choice of the platin compound should take into account the expected toxicity profile, patient's comorbidities and preferences.

Kommentare zum Review

- Gemischte Population; keine Subgruppenanalysen zu Therapielinie oder Stadium

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Sim EHA et al., 2018 [59].

Gefitinib for advanced non-small cell lung cancer.

Fragestellung

To determine the effectiveness and safety of gefitinib as first-line, second-line or maintenance treatment for advanced NSCLC.

Methodik

Population:

- Eligible trials included adult participants aged 18 years or older of either sex with histologically or cytologically confirmed NSCLC (stage IIIB/IV) not curable with surgery

Intervention:

- Any dosage of gefitinib as firstor second-line therapy or maintenance therapy

Komparator:

- placebo or best supportive care, chemotherapeutic agents, gefitinib combined with a chemotherapy regimen, Gefitinib at any dose in combination with chemotherapeutic agents versus the same chemotherapy agents alone, Gefitinib at any dose in combination with chemotherapeutic agents versus a different combination of chemotherapeutic agents

Endpunkte:

- OS, PFS, Toxicity, Ansprechen, QoL

Recherche/Suchzeitraum:

- CENTRAL, MEDLINE and Embase from inception to 17 February 2017

Qualitätsbewertung der Studien:

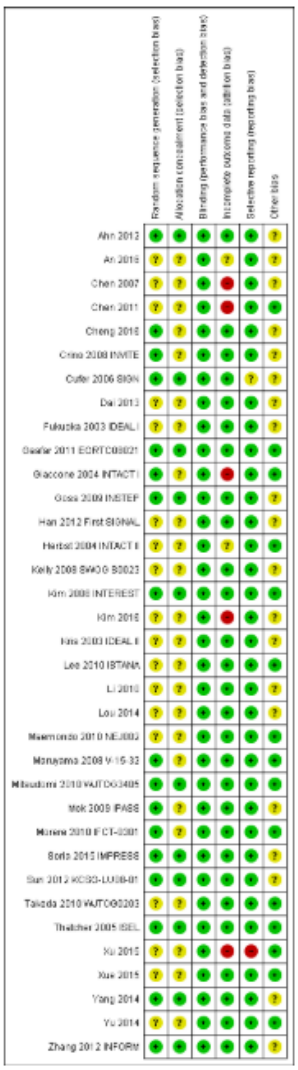
- Cochrane approach / GRADE

Ergebnisse

Anzahl eingeschlossener Studien:

- 35 eligible randomised controlled trials (RCTs), which examined 12,089 patients

Qualität der Studien:



Studienergebnisse:

- Gefitinib did not statistically improve overall survival when compared with placebo or chemotherapy in either first- or second-line settings.
  - Second-line gefitinib prolonged time to treatment failure (TTF) (hazard ratio (HR) 0.82, 95% confidence interval (CI) 0.75 to 0.90, P < 0.0001) when compared with placebo.
  - Maintenance gefitinib improved progression-free survival (HR 0.70, 95% CI 0.53 to 0.91, P = 0.007) after first-line therapy.
- Studies in patients of Asian ethnicity or that conducted subgroup analyses:
  - Second-line gefitinib prolonged overall survival over placebo (HR 0.66, 95% CI 0.48 to 0.91, P = 0.01). In the first-line setting, progression-free survival was improved with gefitinib over chemotherapy alone (HR 0.65, 95% CI 0.43 to 0.98, P = 0.04, moderate quality of evidence). Gefitinib given in combination with a chemotherapy regimen improved progression-free survival versus either gefitinib alone or chemotherapy alone (HR 0.69, 95% CI 0.49 to 0.96, P = 0.03; HR 0.69, 95% CI 0.62 to 0.77, P < 0.00001, respectively). In the second-line setting, progression-free survival was superior in patients given gefitinib over placebo or chemotherapy (HR 0.69, 95% CI

0.52 to 0.91, P = 0.009; HR 0.71, 95% CI 0.57 to 0.88, P = 0.002; moderate quality of evidence, respectively). Combining gefitinib with chemotherapy in the second-line setting was superior to gefitinib alone (HR 0.65, 95% CI 0.43 to 0.97, P = 0.04). As maintenance therapy, gefitinib improved progression-free survival when compared with placebo (HR 0.42, 95% CI 0.33 to 0.54, P < 0.00001).

- Patients with EGFR mutation-positive tumours:
  - Studies in patients with EGFR mutation-positive tumours showed an improvement in progression-free survival in favour of gefitinib over first-line and second-line chemotherapy (HR 0.47, 95% CI 0.36 to 0.61, P < 0.00001; HR 0.24, 95% CI 0.12 to 0.47, P < 0.0001, respectively). Gefitinib as maintenance therapy following chemotherapy improved overall and progression-free survival (HR 0.39, 95% CI 0.15 to 0.98, P = 0.05; HR 0.17, 95% CI 0.07 to 0.41, P < 0.0001, respectively) in one phase III study when compared to placebo. Toxicities from gefitinib included skin rash, diarrhoea and liver transaminase derangements. Toxicities from chemotherapy included anaemia, neutropenia and neurotoxicity. In terms ofquality oflife, gefitinib improved Functional Assessment ofCancer Therapy-Lung (FACT-L) (standardised mean difference (SMD) 10.50, 95% CI 9.55 to 11.45, P < 0.000001), lung cancer subscale (SMD 3.63, 95% CI 3.08 to 4.19, P < 0.00001) and Trial Outcome Index (SMD 9.87, 95% CI 1.26 to 18.48, P < 0.00001) scores when compared with chemotherapy.

Anmerkung/Fazit der Autoren

This systematic review shows that gefitinib, when compared with standard first- or second-line chemotherapy or maintenance therapy, probably has a beneficial effect on progression-free survival and quality of life in selected patient populations, particularly those with tumours bearing sensitising EGFR mutations.

Patients with EGFRmutations lived longer when given maintenance gefitinib than those given placebo.

One study conducted subgroup analysis and showed that gefitinib improved overall survival over placebo in the second-line setting in patients of Asian ethnicity. All other studies did not detect any benefit on overall survival. The data analysed in this review were very heterogenous. We were limited in the amount of data that could be pooled, largely due to variations in study design. The risk of bias in most studies was moderate, with some studies not adequately addressing potential selection, attrition and reporting bias. This heterogeneity may have an impact on the applicability of the results.

Combining gefitinib with chemotherapy appears to be superior in improving progression-free survival to either gefitinib or chemotherapy alone, however further data and phase III studies in these settings are required.

Gefitinib has a favourable toxicity profile when compared with current chemotherapy regimens. Although there is no improvement in overall survival, gefitinib compares favourably with cytotoxic chemotherapy in patients with EGFR mutations with a prolongation of progression-free survival and a lesser side effect profile.

Kommentar zum Review:

- Siehe auch: Zhao, Q. et al., 2020 [82]

3.2 Systematische Reviews

Ando K et al., 2020 [2].

Nivolumab plus Ipilimumab versus Existing Immunotherapies in Patients with PD-L1-Positive Advanced Non-Small Cell Lung Cancer: A Systematic Review and Network Meta-Analysis.

Fragestellung

a network meta-analysis of four relevant Phase III trials to compare the efficacy and safety of Niv+Ipi, pembrolizumab (Pem) plus platinum-based chemotherapy (PBC) (Pem+PBC), Pem, Niv, or PBC using Bayesian analysis.

Methodik

Population:

- patients with advanced NSCLC with PD-L1 expression ≥1%

Intervention/Komparator:

- Niv+Ipi vs. existing regimens with immunotherapies

Endpunkte:

- PFS, AEs

Recherche/Suchzeitraum:

- From 1946 to the present in PubMed, CENTRAL, EMBASE and SCOPUS

Qualitätsbewertung der Studien:

- Cochrane approach

Ergebnisse

Anzahl eingeschlossener Studien:

- four studies

Charakteristika der Population:

Study Name (Year of Publication)	Treatment Arms	N	Age—yrs. Median (range)	Female Sex No. (%)	ECOG PS No. (%)	Histologic Type No. (%)	PD-L1 Status
KEYNOTE-189 (2018)	Pembrolizumab 200 mg/body e3w plus platinum-based chemotherapy	410	65 (34–84)	156 (38.0)	PS0: 186 (45.4) PS1: 221 (53.9) PS2: 1 (0.2) Missing: 2 (0.5)	Adenocarcinoma 394 (96.1) Other 16 (3.9)	≥1% 260 (63.4) ≥50% 132 (32.2)
	Platinum-based chemotherapy	206	63.5 (34–84)	97 (47.1)	PS0: 80 (38.8) PS1: 125 (60.7) Missing: 1 (0.5)	Adenocarcinoma 198 (96.1) Other 8 (3.6)	≥1% 128 (62.1) ≥50% 70 (34.0)
	Total, 616						
KEYNOTE-407 (2018)	Pembrolizumab 200 mg/body e3w plus platinum-based chemotherapy	278	65 (29–87)	58 (20.9)	PS0: 73 (26.3) PS1: 205 (73.7)	Squamous: 272 (97.8) Adenosquamous: 6 (2.2)	≥1% 176 (63.3) ≥50% 73 (26.3)
	Platinum-based chemotherapy	281	65 (36–88)	46 (16.4)	PS0: 90 (32.0) PS1: 191 (68.0)	Squamous: 274 (97.5) Adenosquamous: 7 (2.5)	≥1% 177 (63.0) ≥50% 73 (26.0)
	Total, 559						
	Pembrolizumab 200 mg/body e3w	637	63.0 (57.0–69.0)	187 (29%)	PS0: 198 (31) PS1: 439 (69)	Squamous: 243 (38) Non-squamous: 394 (62)	≥1% 637 (100) ≥50% 299 (46.9)
	Platinum-based chemotherapy	637	63.0 (57.0–69.0)	185 (29%)	PS0: 192 (30) PS1: 445(70)	Squamous: 249 (39) Non-squamous: 388(61)	≥1% 637 (100.0) ≥50% 300 (47.1)
	Total, 1274						
CheckMate 227 (2019)	Nivolumab 3 mg/kg e2w plus ipilimumab 1 mg/kg e6w	583	64 (26–87)	190 (32.6)	PS0: 204 (35.0) PS1: 377 (64.7) Other or missing: 2 (0.3)	Squamous: 163 (28.0) Non-squamous: 419 (71.9) Missing data: 1 (0.2)	≥1% 396 (67.9) ≥50% 205 (35.2)
	Nivolumab 240 mg/body e2w	396	64 (27–85)	124 (31.3)	PS0: 142 (35.9) PS1: 252 (63.6) Other or missing: 2 (0.5)	Squamous: 117 (29.5) Non-squamous: 279 (70.5) Missing data: 0 (0)	≥1% 396 (100.0) ≥50% 214 (54.0)
	Platinum based chemotherapy	583	64 (29–87)	198 (34.0)	PS0: 191 (32.8) PS1: 386 (66.2) Other or missing: 6 (1.0)	Squamous: 162 (27.8) Non-squamous: 421 (72.2) Missing data: 0 (0)	≥1% 397 (68.1) ≥50% 192 (32.9)
	Total, 1562						

The intention-to-treat (ITT) population contains all participants who were randomized, irrespective of whether an intervention was performed. N, number of patients; yrs., years; ECOG, Eastern Cooperative Oncology Group; PS, performance status; PD-L1, programmed cell death ligand 1; e3w, every three weeks; e2w, every two weeks, e6w, every 6 weeks.

Qualität der Studien:

- low risk of bias was shown for all studies

Studienergebnisse:

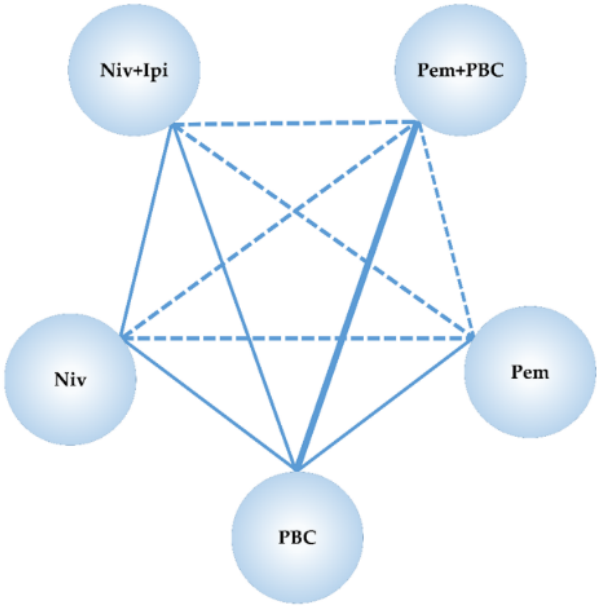


Figure 2. Network map of the network meta-analysis performed in this study. The randomized controlled trials (RCTs) included in this analysis are represented by solid lines, and the thickness of solid line indicates the number of included studies. The dashed line indicates a relationship where no RCT exists but an indirect comparison could be attempted. s.c., subcutaneous; RCT, randomized controlled trial; Niv, nivolumab; Ipi, ipilimumab; Pem, pembrolizumab; PBC, platinum-based chemotherapy.

- With regard to PFS, Niv+Ipi was inferior to Pem+PBC, and superior to Pem, Niv, or PBC alone.
- SUCRA ranking showed Pem+PBC had the highest efficacy for PFS, followed by Niv+Ipi, Niv, PBC, and Pem.
- The safety outcome analysis revealed Niv+Ipi was generally well tolerated compared to existing immunotherapy regimens.

Fazit der Autoren

In conclusion, we compared the efficacy and safety profiles of Niv+Ipi and existing immunotherapies in PD-L1-positive NSCLC, using PBC as a common comparator, via a Bayesian NMA. Our results revealed that, in terms of PFS, Niv+Ipi was inferior to Pem+PBC, and was superior to Pem, Niv, and PBC. No significant differences were observed in the frequency of G3–5AEs between Niv+Ipi and Pem+PBC, while the frequency of G3–5AEs was higher in the Niv+Ipi group than in the Pem- or Niv-treated groups. SUCRA results showed that Pem+PBC ranked highest in PFS, followed by Niv+Ipi, Niv, PBC, and Pem, and also revealed that Pem ranked highest in the G3–5AEs, followed by Niv, Niv+Ipi, PBC, and Pem+PBC. These results provide clinical information regarding the efficacy and safety of Niv+Ipi in PD-L1-positive advanced NSCLC, indicating the possibility of Niv+Ipi as a new therapeutic option as a first-line treatment for PD-L1-positive advanced NSCLC. Considering that this study is an NMA through direct and indirect comparison, verification by a direct head-to-head RCT is warranted to confirm the results obtained. Furthermore, identifying the characteristics of the patient populations where Niv+Ipi has particular benefit is an important future research topic.

Wu LG et al., 2021 [71].

The efficacy and safety of PD-1/PD-L1 inhibitors versus chemotherapy in patients with previously treated advanced non-small-cell lung cancer: A meta-analysis.

Fragestellung

To assess the effectiveness and safety of programmed death-1 (PD-1)/PD ligand 1 (PD-L1) inhibitors versus chemotherapy as second-line or late-line treatment for patients with advanced non-small-cell lung cancer (NSCLC) via a systematic review of published randomized controlled trials (RCTs).

Methodik

Population:

- Patients with advanced NSCLC

Intervention:

- PD-1 or PD-L1 inhibitors alone (e.g., durvalumab, nivolumab, atezolizumab, pembrolizumab, or avelumab)

Komparator:

- chemotherapy alone

Endpunkte:

- Overall survival (OS),progression-free survival (PFS) and the objective response rate (ORR)

Recherche/Suchzeitraum:

- PubMed, EMBASE, and Cochrane Library databases from inception to March 2020

Qualitätsbewertung der Studien:

- Cochrane Risk of Bias Tool

Ergebnisse

Anzahl eingeschlossener Studien:

- 4122 eligible patients from 8 RCTs

Charakteristika der Population:

- All intervention groups received PD-L1 inhibitor treatment, with those in 3, 3, 1, and 1 studies receiving atezolizumab, nivolumab,[15,16,20] avelumab, and pembrolizumab respectively. In all studies, PD-L1 inhibitors were used as second-line or later-line treatment. Apart from the studies by Hida and Wu, the remaining 6 studies described the TNM classification of tumors.

Qualität der Studien:

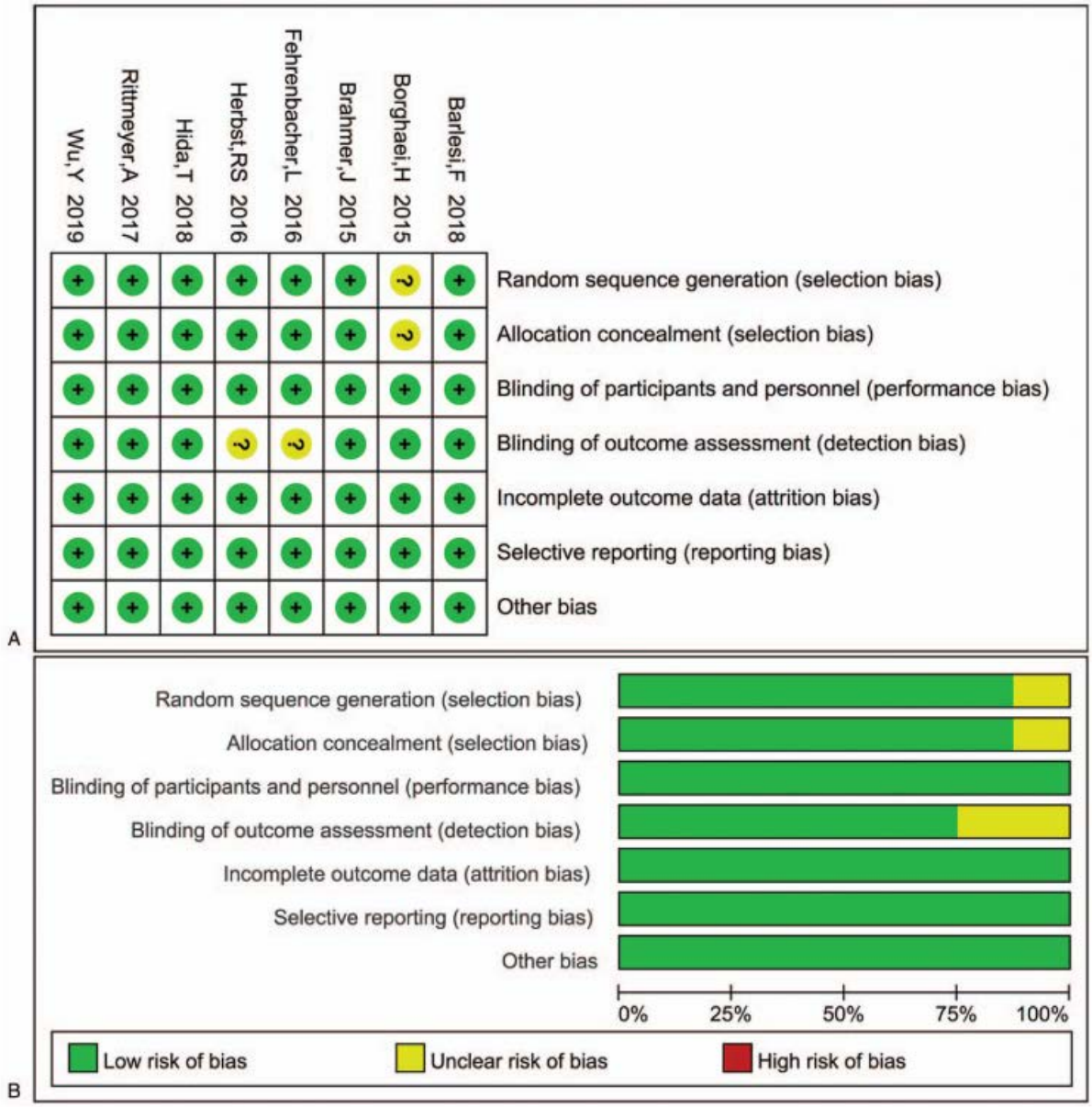


Figure 1. The risk of bias of included studies. A: Risk of bias summary. B: Risk of bias graph.

Studienergebnisse:

- The meta-analysis showed that PD-1/PD-L1 inhibitors could significantly improve overall survival (hazards ratio [HR] 0.71, 95% confidence interval [CI] 0.66–0.77, P<.001), progressionfree survival (HR 0.88, 95%CI 0.81–0.94, P=.01), and objective response rate (HR 2.03, 95%CI 1.66–2.49, P<.001) compared with chemotherapy drugs.
- The incidence of side effects of any grade (HR 0.34, 95%CI 0.29–0.39, P<.001) or grades 3 to 5 (HR 0.15, 95%CI 0.10–0.23, P<.001) consistently showed that PD-1/PD-L1 inhibitors were safer than chemotherapy.
- Subgroup analysis based on tumor proportion score or pathology classification revealed that PD-1/PD-L1 inhibitors significantly improved overall survival compared with chemotherapy.

Anmerkung/Fazit der Autoren

As a second-line or late-line treatment, PD-1/PD-L1 inhibitors are safer and more effective than chemotherapy in patients with advanced NSCLC.

Kommentare zum Review

- Siehe auch: García-González, J. et al., 2020 [21]; Shi, Y. et al., 2020 [58]; Li, Z. Q. et al., 2020 [42]; Li, X. et al., 2020 [39]; Bozcuk, H. et al., 2021 [6]

Wang DD et al., 2021 [67].

Comparative efficacy and safety of PD-1/PD-L1 immunotherapies for non-small cell lung cancer: a network meta-analysis.

Fragestellung

to conduct a network meta-analysis to compare the safety and efficacy of these immune checkpoint inhibitors (ICIs).

Methodik

Population:

- patients with advanced non-small cell lung cancer

Intervention:

- PD-1/PD-L1 inhibitors

Komparator:

- Chemotherapy

Endpunkte:

- OS and/or PFS

Recherche/Suchzeitraum:

- PubMed and Embase databases for English-language articles published up to December 20, 2020

Qualitätsbewertung der Studien:

- Cochrane Collaboration’s Risk of Bias tool

Ergebnisse

Anzahl eingeschlossener Studien:

- 19 RCTs, including 12,753 patients

Charakteristika der Population:

Table I. Details of all included trials.

Study	Study characteristics					D-L1 expression			Patient characteristics			
	Treatment details	Sample size	Line of treatment	Histology types	Median follow-up (months)	≥50% (n)	1%-49% (n)	<1% (n)	% Male	% of current or former smokers	% of non-squamous	Median age
KEYNOTE -010	Pem Chemo	690 343	Second or late	Mixed	42.6	290 152	400 191	0 0	62% 61%	82% 78%	70% 70%	63 62
KEYNOTE -024	Pem Chemo	154 151	First-line	Mixed	25.2	154 151	0 0	0 0	59.7% 62.9%	96.8% 87.4%	81.2% 82.1%	64.5 66
KEYNOTE -033	Pem Chemo	213 212	Second or later	Mixed	18.8	114 98	112 98	0 0	73.7% 77.4%	N/A N/A	N/A N/A	60.6† 61.0†
KEYNOTE -042	Pem Chemo	637 637	First-line	Mixed	14	299 300	338 337	0 0	71% 71%	78% 78%	62% 61%	63 63
KEYNOTE -189	Pem+Chemo Chemo	410 206	First-line	Non-SCC	23.1	132 70	128 58	127 63	62.0% 52.9%	88.3% 87.9%	100% 100%	65 63.5
KEYNOTE -407	Pem+Chemo Chemo	278 281	First-line	SCC	14.3	73 73	103 104	95 99	79.1% 83.6%	92.1% 93.2%	0% 0%	65 65
CheckMate 017	Niv Chemo	135 137	Second or later	SCC	36.6 (minimum)	17 12	NA NA	54 52	82% 71%	90% 94%	0% 0%	63 63
CheckMate 026	Niv Chemo	271 270	First-line	Mixed	13.5	88 126	NA NA	0 0	89% 88%	88% 87%	76% 76%	63 65
CheckMate 057	Niv Chemo	292 290	Second or later	Non-SCC	36.6 (minimum)	66 46	NA NA	108 101	53% 58%	79% 78%	100%	61 64
CheckMate 078	Niv Chemo	338 166	Second or late	Mixed	25.9 (minimum)	NA NA	NA NA	138 67	78% 81%	70% 71%	61% 60%	60 60
CheckMate 227 (Part 1)	Niv+Ipi Niv Niv+Chemo Chemo	583 396 177 583	First-line	Mixed	29.3 (minimum)	205 214 0 192	191 182 1 205	187 0 176 186	67.4% 68.7% 73.4% 66.0%	85.2% 86.4% 83.1% 85.6%	71.9% 70.5% 75.7% 72.2%	64 64 64 64
CheckMate 277 (Part 2)	Niv+Chemo Chemo	377 378	First-line	Mixed	19.5 (minimum)	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA
OAK	Ate Chemo	425 425	Second or later	Mixed	26 (minimum)	72 65	173 161	180 199	61% 61%	80% 83%	74% 74%	63 64
IMpower110	Ate Chemo	277 277	First-line	Mixed	13.4	107 98	170 179	0 0	70.8% 69.7%	86.6% 87.4%	69.3% 69.7%	64 65
IMpower130	Ate+Chemo Chemo	451 228	First-line	Non-SCC	18.5 19.2	88 42	128 65	235 121	59% 59%	89% 92%	100% 100%	64 65
IMpower131	Ate+Chemo Chemo	343 340	First-line	SCC	26.8 24.8	48 44	134 126	161 170	80% 80%	77.20% 77.20%	0% 0%	65 63
IMpower132	Ate+Chemo Chemo	292 286	First-line	Non-SCC	28.4	25 20	63 72	88 75	66.4% 66.4%	87% 90%	100% 100%	64 63
MYSTIC	Dur Chemo	374 372	First-Line	Mixed	30.2	118 107	161 182	95 83	68.4% 67.2%	84.8% 86.0%	71.4% 71.5%	65 64
ARCTIC (Study B)	Dur Chemo	117 118	Third-line or later	Mixed	9.1	0 0	N/A N/A	52 58	62.4% 68.6%	76.1% 81.4%	75.2% 76.3%	63 65

Abbreviations: NA: not available; Ate: atezolizumab; Pem: pembrolizumab; Ipi: ipilimumab; Niv: nivolumab; Dur: durvalumab; Chemo: chemotherapy; SCC: Squamous Cell Carcinoma.
Notes: † Mean age

Qualität der Studien:

- Overall, 18 trials were considered to have low risk of bias for the overall survival outcome. One trial (CM 227 Part 2) was considered to have an unclear risk of bias as three domains were assessed as having an unclear risk.
- In the selection bias domain, 18 trials were considered low risk, and one (CM 227 Part 2) was considered unclear risk. In the reporting bias domain, 18 trials were considered low risk, and one (CM 227 Part 2) was considered unclear risk. In the performance bias domain, all trials were considered to be low risk for the overall survival outcome as this is unlikely to be affected by the lack of blinding in the open trial design. Only two trials

(KN-189 and KN-407) had a low risk of bias for PFS, as these were the only double-blind trials.

- In the detection bias domain, all trials were considered low risk for the overall survival outcome as this is unlikely to be affected by lack of blinding. Ten trials (KN-010, KN-024, KN-033, KN-042, KN-189, KN-407, CM 017, CM 026, CM 227 Part 1, MYSTIC) were also considered low risk for the PFS outcome, as they used blinded independent central reviewers for radiographic assessment of progression.
- All trials were considered low risk for attrition bias. Most trials allowed crossover, and this was considered to be a source of other potential bias.

Studienergebnisse:

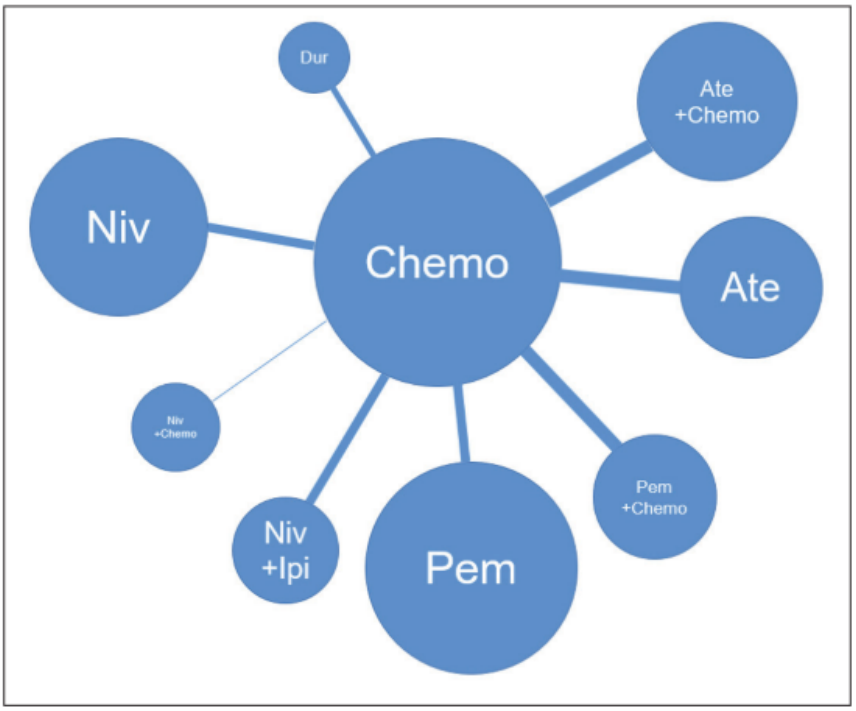


Figure 1. Network of eligible comparisons. The size of the nodes is proportional to the number of patients randomized to receive the treatment. The width of the lines is proportional to the number of trials comparing the connected treatments. Abbreviations: Pem, pembrolizumab; Ate, atezolizumab; Dur, durvalumab; Ipi, ipilimumab; Niv, nivolumab; Chemo, chemotherapy.

- In the analysis of all-comers, the pembrolizumab/chemotherapy combination ranked best for overall survival (OS) and progression-free survival (PFS).
- Durvalumab was the only ICI treatment that showed no benefit over chemotherapy.
- In the first-line setting only, in terms of OS, atezolizumab, pembrolizumab/chemotherapy, and nivolumab/ipilimumab ranked as the best treatments for patients with PD-L1 expression levels of ≥50%, 1-49%, and <1%, respectively.
- Nivolumab, atezolizumab, pembrolizumab, and durvalumab all had lower odds of grade 3 or greater treatment-related adverse events (TRAEs) compared to chemotherapy.
- With the addition of chemotherapy to any ICI regimen, the odds of TRAEs increased in a considerable and statistically significant way.

Anmerkung/Fazit der Autoren

While the pembrolizumab/chemotherapy combination was the most effective therapy in the overall cohort of all-comers, treatment preferences varied by treatment-line setting, tumor characteristics, and outcome of interest. In the first-line setting, the most effective

treatments for patients with PD-L1 expressions of ≥50%, 1-49%, and <1% were atezolizumab, pembrolizumab/chemotherapy, and nivolumab/ipilimumab, respectively.

Kommentare zum Review

- Siehe auch: Liang, J.et al., 2020 [43]

Yang Y et al., 2021 [74].

The optimal immune checkpoint inhibitors combined with chemotherapy for advanced non-small-cell lung cancer: a systematic review and meta-analysis.

Fragestellung

Metaanalysis that compared the efficacy and safety of PD-1 inhibitor + CT with PD-L1 inhibitor + CT.

Methodik

Population:

- advanced patients with NSCLC patients

Intervention/Komparator:

- PD-1 + CT vs PD-L1 + CT

Endpunkte:

- progression-free survival (PFS), overall survival (OS), objective response rate (ORR) and treatmentrelated adverse events (TRAEs)

Recherche/Suchzeitraum:

- PubMed, Embase, Web of Science, Cochrane Library, and major international scientific meetings were searched from inception dates to March 2020

Qualitätsbewertung der Studien:

- Cochrane risk of bias tool

Ergebnisse

Anzahl eingeschlossener Studien:

- 8 phase III RCTs with 4253 patients

Charakteristika der Population:

Table 1 Characteristics of patients comparing PD-1/PD-L1 inhibitors plus chemotherapy or PD-1/PD-L1 inhibitors alone with chemotherapy in 8 randomized controlled trials included in the meta-analysis

Study	Author	Year	Trial phase	Study group (regime and no. of Pts.)		Control group (regime and no. of Pts.)		Inclusion criteria
CheckMate 227	Hellmann	2018	III	NIV plus PBC	177	PBC alone	160	Stage IV or recurrent NSCLC without targetable genetic aberration, with a high tumor mutational burden (≥ 10 mutations per megabase)
KEYNOTE-021	Langer	2016	III	PEM plus PBC	60	PBC alone	63	Stage IIIB or IV, non-squamous NSCLC without targetable genetic aberration
KEYNOTE-189	Gandhi	2018	III	PEM plus PBC	410	PBC alone	206	Stage IV non-squamous NSCLC without targetable genetic aberration
KEYNOTE-407	Paz-Ares	2018	III	PEM plus PBC	278	PBC alone	281	Stage IV, squamous NSCLC
Impower 130	West	2019	III	ATE plus PBC	447	PBC alone	226	Stage IV, non-squamous NSCLC without targetable genetic aberration
Impower 131	Jotte	2018	III	ATE plus PBC	343	PBC alone	340	Stage IV, squamous NSCLC
Impower 132	Papadimitra-kopoulou	2018	III	ATE plus PBC	292	PBC alone	286	Stage IV non-squamous NSCLC without targetable genetic aberration
Impower 150	Socinski	2018	III	ATE plus PBC	353	PBC alone	331	Stage IIIB or IV, non-squamous NSCLC without targetable genetic aberration

NIV nivolumab, *PBC* platinum-based chemotherapy, *PEM* pembrolizumab, *ATE* atezolizumab

Qualität der Studien:

- All of the studies were of high quality.

Studienergebnisse:

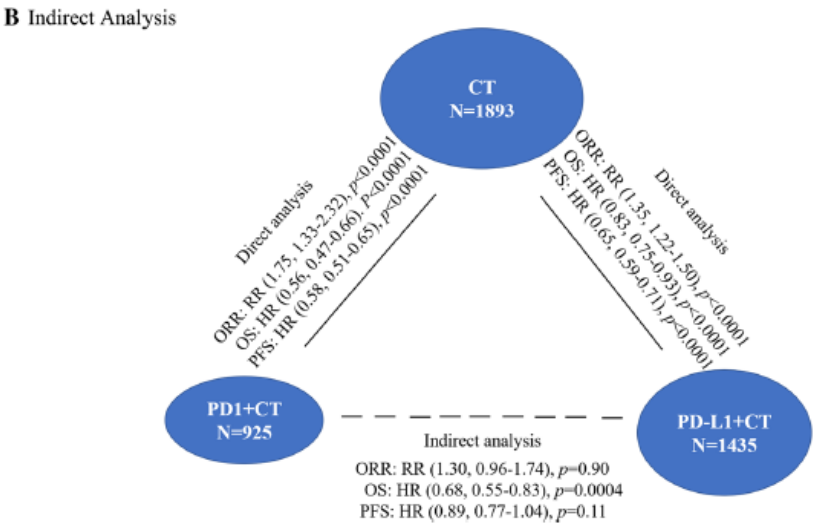


Fig. 3 Forest plots of progression-free survival (PFS) comparing PD-1+CT or PD-L1+CT versus chemotherapy alone and indirect comparison between PD-1+CT versus PD-L1+CT. In B, solid lines represented the existence of direct comparisons between treatment regimens, and dashed line represented the indirect comparison between PD-1+CT versus PD-L1+CT. The size of the circle corresponds to the enrolled patient number. *PD-1* anti-PD-1 immune checkpoint inhibitor, *PD-L1* anti-PD-L1 immune checkpoint inhibitor, *CT* chemotherapy, *ORR* objective response rate, *OS* overall survival, *PFS* progression-free survival

- PD-1 + CT led to notably longer OS most in low/negative expression of PD-L1 for NSCLC patients compared with PD-L1 + CT.
- In terms of Grade 3–5 TRAEs, the results showed that PD-1 + CT and PD-L1 + CT exclusively increased the risk of adverse incidence than CT alone, especially for PD-L1 + CT ($p < 0.00001$).

- For subgroups including female, young patients, patients with nonsmoker, and EGFR/ALK wild-type, PD-1 + CT was associated with prolonged OS ($p < 0.05$).
- For no liver metastasis of NSCLC patients, obviously OS advantage for patients treated with PD-1 + CT compared to PD-L1 + CT was found.

Anmerkung/Fazit der Autoren

This exploratory analysis from our meta-analysis demonstrated ICIs + CT provides a survival advantage over CT alone in a large proportion of metastatic NSCLC patients, and it is worth noting that in terms of tumor response, OS and PFS, the superiority of combined PD-1 + CT over PD-L1 + CT as a first-line treatment strategy for advanced NSCLC patients according to indirect analysis.

Kommentare zum Review

- Siehe auch: Li, L. et al., 2020 [37]

Wu S et al., 2021 [72].

Comparison between the first-line and second-line immunotherapy drugs in the progression-free survival and overall survival in advanced non-small cell lung cancer: a systematic review and meta-analysis of randomized controlled trials.

Fragestellung

The meta-analysis compares different clinical effects of them by overall survival (OS) and progression-free survival (PFS) because it is important to detect the best time of immunotherapy for NSCLC patients.

Methodik

Population:

- NSCLC patients

Intervention/Komparator:

- firstline and second-line immunotherapy drugs

Endpunkte:

- PFS, OS

Recherche/Suchzeitraum:

- Cochrane Library, Embase, PubMed and Web of science up to November 2019

Qualitätsbewertung der Studien:

- Cochrane approach

Ergebnisse

Anzahl eingeschlossener Studien:

- Ten RCTs

Charakteristika der Population:

Table 1 Characteristics of the randomized controlled trials selected

Study name	Trial design	Experimental drug	Treatment line	Phase	No. of patients	No. of patients (using experimental drug)	Primary endpoint	Secondary endpoints	Study period	NCT number	Year	Reference
Reck M 2016 (KEYNOTE-024)	Pembrolizumab *vs.* chemotherapy	Pembrolizumab	First line	III	305	154	PFS	OS, ORR, safety	From September 2014 to May 2016	NCT02142738	2016	(29)
Tony S K Mok 2019 (KEYNOTE-042)	Pembrolizumab *vs.* Chemotherapy	Pembrolizumab	First line	III	1,274	637	OS	OS, PFS	From December 2014 to March 2017	NCT02220894	2019	(19)
Herbst RS 2016 (KEYNOTE-010)	Pembrolizumab 2 mg/kg *vs.* Pembrolizumab 10 mg/kg *vs.* docetaxel	Pembrolizumab	Second line	II/III	1,034	691	OS, PFS	Safety, DOR	From August 2013 to September 2015	NCT01905657	2016	(30)
Hui R 2017 (KEYNOTE-001)	Pembrolizumab	Pembrolizumab	First line	Ib	101	101	ORR	DOR, PFS, OS	From March 2013 to September 2015	NCT01295827	2017	(31)
Fehrenbacher L 2016 (POPLAR)	Atezolizumab *vs.* docetaxel	Atezolizumab	Second line	II	287	144	OS	ORR, PFS	From August 2013 to May 2015	NCT01903993	2016	(32)
Rittmeyer A 2017 (OAK)	Atezolizumab *vs.* docetaxel	Atezolizumab	Second line	III	1,225	425	OS	PFS, safety, DOR	From March 2014 to April 2015	NCT02008227	2017	(33)
Vokes EE 2018 (CheckMate 017 and CheckMate 057)	Nivolumab *vs.* docetaxel	Nivolumab	Second line	III	874	427	OS	ORR, PFS	From October 2012 to June 2017; from November 2012 to June 2017	NCT01642004; NCT01673867	2018	(23,25,26)
Carbone DP 2017 (CheckMate 026)	Nivolumab *vs.* docetaxel	Nivolumab	First line	III	541	271	PFS	PFS, OS	From March 2014 to August 2016	NCT02041533	2017	(18)
Antonia SJ 2018 (PACIFIC)	Durvalumab *vs.* placebo	Durvalumab	Second line	III	713	476	PFS, OS	ORR, DOR	From May 2014 to March 2018	NCT02125461	2018	(34)

ORR, objective response rate; DOR, duration of response.

Qualität der Studien:

Table 3 Outcomes of the randomized controlled trials selected

Study	A*	B*	C*	D*	E*	F*	Total
Hui R 2017 (KEYNOTE-001)	Y*	Y*	–	Y*	–	Y*	4
Herbst RS 2016 (KEYNOTE-010)	Y*	Y*	–	–	Y*	Y*	4
Reck M 2016 (KEYNOTE-024)	Y*	Y*	Y*	–	Y*	Y*	5
Tony S K Mok 2019 (KEYNOTE-042)	Y*	–	Y*	Y*	Y*	Y*	5
Carbone DP 2017 (CheckMate 026)	Y*	Y*	Y*	–	–	–	3
Vokes EE 2018 (CheckMate 017 and CheckMate 057)	Y*	Y*	–	Y*	Y*	Y*	5
Fehrenbacher L 2016 (POPLAR)	Y*	Y*	–	–	Y*	–	3
Rittmeyer A 2017 (OAK)	Y*	–	Y*	–	Y*	Y*	4
Antonia SJ 2018 (PACIFIC)	Y*	–	Y*	–	–	Y*	3

The outcomes of KEYNOTE-024, KEYNOTE-042, KEYNOTE-010, KEYNOTE-001, POPLAR, OAK, CheckMate 017/CheckMate 057, CheckMate 026 and PACIFIC clinical trials based on Cochrane Handbook. A*: sequence generation; B*: allocation concealment; C*: blinding; D*: incomplete outcome data; E*: no selective outcome reporting; F*: other sources of bias; Y*: low risk.

Studienergebnisse:

- The pooled results indicated that first-line and second-line single immunotherapy drug treatment seems to have a tiny difference in PFS, with HR 0.79, 95% confidence interval (CI): 0.51–1.21, I2 CI: 0.62–0.89, I2=89% in first-line single immunotherapy drug treatment and HR 0.74, 95% =84% in second-line single immunotherapy drug treatment.

- When it comes to OS, first-line immunotherapy drug treatment still has better effects than the second-line. In first-line single immunotherapy drug treatment, HR 0.78, 95% CI: 0.55–1.11, I2 CI: 0.64–0.76, I2 =83%, but in second-line, HR 0.70, 95% =53%.

Anmerkung/Fazit der Autoren

In sum, our meta-analysis still has deficiencies, but it is still the first one trying to make a comparison between the results of first-line and second-line single immunotherapy drug treatment in NSCLC and give us some suggestion for the time of immunotherapy in NSCLC.

Yang YL et al., 2020 [76].

Effect of alectinib versus crizotinib on progression-free survival, central nervous system efficacy and adverse events in ALK-positive non-small cell lung cancer: a systematic review and meta-analysis.

Fragestellung

to evaluate the different efficacies of alectinib and crizotinib on progression-free survival (PFS), central nervous system (CNS) progression and adverse events (AEs) in NSCLC patients with ALK-positive.

Methodik

Population:

- patients with NSCLC

Intervention:

- alectinib

Komparator:

- crizotinib or without control

Endpunkte:

- PFS, cumulative incidence of CNS progression, incidence of adverse events (AEs)

Recherche/Suchzeitraum:

- PubMed, EMBASE, Cochrane Library, and Web of Science. The cut-off date of the search was 30 April 2019.

Qualitätsbewertung der Studien:

- Cochrane Risk of Bias tool

Ergebnisse

Anzahl eingeschlossener Studien:

- Ten studies were included with in total 2,377 patients

Charakteristika der Population:

Table 1 Characteristics of included studies

First author	Year	Registration number	Treatment	Study design	Number of patients	Outcomes	Country	Age median [range]	Male
Gadgeel *et al*. (19)	2014	AF002-JG NCT01588028	Alectinib 300–900 mg twice a day	Prospective cohort, single arm	47	Establish the recommended phase 2 dose	USA	56 [40–83]	57.0%
Hida *et al*. (12)	2017	J-ALEX	Alectinib 300 mg twice daily, crizotinib 250 mg twice daily	Randomized controlled trial	207	PFS, OS, adverse events	Japan	61 [27–85]	40.0%
Ito *et al*. (20)	2017	–	Alectinib 300 mg twice daily, crizotinib 250 mg twice daily	Retrospective cohort	61	ORR, TTF, PFS	Japan	64 [28–89]	42.6%
Masuda *et al*. (16)	2019	UMIN000014989	300 mg twice-daily alectinib	Prospective cohort, single arm	1221	Incidence of adverse, drug reactions, overall survival	Japan	62 [22–91]	46.1%
Nishio *et al*. (21)	2018	J-ALEX	Alectinib 300 mg twice daily, crizotinib 250 mg twice daily	Randomized controlled trial	207	CNS progression	Japan	62 [27–85]	42.0%
Novello *et al*. (22)	2018	NCT02604342	Alectinib 600mg twice daily chemotherapy (pemetrexed 500 mg/m2 or docetaxel 75 mg/m2, every 3 weeks)	Randomized controlled trial	107	PFS, adverse events	Germany	55.5 [21–82]	56.9%
Ou *et al*. (17)	2016	NP28673 (NCT01801111)	Alectinib 600 mg twice daily within 30 minutes after eating	Prospective cohort, single arm	138	ORR adverse events	16 countries	52 [22–79]	44.0%
Peters *et al*. (11)	2017	ALEX	Alectinib 600 mg twice daily, crizotinib 250 mg twice daily	Randomized controlled trial	303	PFS, CNS progression, ORR, OS, adverse events	n countries	58 [25–88]	45.0%
Shaw *et al*. (15)	2016	NP28761 (NCT01871805)	Alectinib 600 mg orally twice daily in 21-day cycles	Prospective cohort, single arm	87	ORR PFS; ORR, DCR in the CNS, adverse events	USA	54 [29–79]	45.0%
Tamura *et al*. (14)	2017	AF-001JP	Oral alectinib 300 mg twice per day	Prospective cohort, single arm	46	ORR, disease control rate, PFS, overall survival, pharmacokinetics, and safety	Japan	48 [26–75]	47.8%
Total	10 studies				2,377				

CNS, central nervous system; DCR, disease control rate; ORR, objective response rate; OS, overall survival; PFS, progression free survival; TTF, time to treatment failure.

Qualität der Studien:

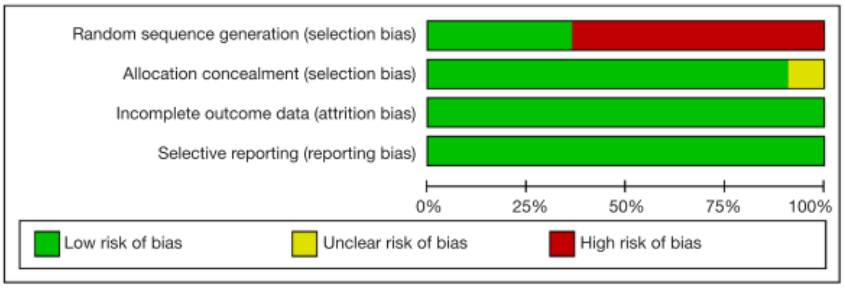


Figure 3 Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.

Studienergebnisse:

- Alectinib showed significant PFS superiority over crizotinib. The pooled HR =0.41 (95% CI: 0.29–0.53) indicated that the alectinib therapy group did have significantly longer PFS than that of the crizotinib group.
- Based on 5 clinical trials, the cumulative incidence of CNS progression for patients treated with alectinib at 6 months (10%, 95% CI: 5–16%) and 12 months (16%, 95% CI: 9–24%) was calculated.
- Based on 7 clinical studies, the risk of AEs related to treatment with alectinib was determined: alectinib was associated with 28 cases of AE grade ≤2 and 9 cases of AE

grade ≥3; among the top 4 incidences of AE grade ≥3, were blood creatine phosphokinase increased 5.6%, ALT increased 2.5%, AST increased 2.4% and anemia 1.8%.

Anmerkung/Fazit der Autoren

Taken together, the results indicate that alectinib significantly prolongs PFS, and it better controls CNS metastases than crizotinib; however, there is insufficient evidence that alectinib could completely replace crizotinib. Although alectinib has a smaller gastrointestinal response than crizotinib, it still is associated with prominent liver damage and myalgia, which is worthy of attention. This systematic review and meta-analysis can provide some references for the clinical use of alectinib.

Zhou K et al., 2020 [85].

Efficacy and safety of erlotinib combined with bevacizumab in the treatment of non-small cell lung cancer: A systematic review and meta-analysis.

Fragestellung

To determine the efficacy and safety of erlotinib and bevacizumab for NSCLC, we conducted a meta-analysis and systematic review of randomized controlled trials.

Methodik

Population:

- patients aged 18 years or older; histologically or cytologically confirmed NSCLC

Intervention/Komparator:

- Erlotinib vs erlotinib combined with bevacizumab, or bevacizumab vs erlotinib combined with bevacizumab

Endpunkte:

- OS, PFS, or ORR, and incidence of adverse events

Recherche/Suchzeitraum:

- PubMed, Embase, Web of Science, and Cochrane databases On June 2, 2019

Qualitätsbewertung der Studien:

- Cochrane approach

Ergebnisse

Anzahl eingeschlossener Studien:

- 6 included studies involved 1960 participants

Charakteristika der Population:

Table 1

Summary of studies included in the final meta-analysis.

Author	Year	Group	Number	Male/ Female	Race (White/ Asian or Pacific Island/Other)	Smoking history (Never/previous/ current)	ECOGPS (0/1/2)	Histology (large-cell carcinoma/ adeno-carcinoma/ squamous/other)	Clinical stage (IIIB/IV/Other)	Region	Line of treatment
Herbst et al[26]	2007	B+E	39	17/22	29/3/7	NR	19/20/0	0/32/0/7	NR	USA	Second
		B+chemo	40	23/17	34/2/4	NR	19/21/0	9/30/0/1	NR		
Herbst et al[21]	2011	B+E	319	171/148	264/23/32	34/237/48	129/166/23	23/242/11/43/38	NR	USA	Second
		E+placebo	317	170/147	257/18/42	33/212/72	121/176/20	25/235/14/40	NR		
Ciuleanu et al[25]	2013	B+E	63	37/26	NR	21/20/11	28/35/0	NR	NR	Romania	First
		B+gem	61	36/25	NR	23/14/24	20/41/0	NR	NR		
Johnson et al[22]	2013	B+E	370	193/177	293/43/34	61/180/129	180/190/0	30/301/11/28	32/317/21	USA	Second
		B+placebo	373	196/177	290/45/38	66/178/129	173/198/1	26/309/6/32	37/310/25		
Seto et al[23]	2014	B+E	75	30/45	NR	42/9/24	43/32/0	0/74/1/0	1/60/14	Japan	First
		E	77	26/51	NR	45/6/26	41/36/0	1/76/0/0	0/62/15		
Saito et al[24]	2019	B+E	112	41/71	NR	65/6/41	64/48/0	1/110/0/1	8/82/22	Japan	First
		E	112	39/73	NR	64/7/41	68/42/2	0/112/0/0	8/84/20		

B = bevacizumab; chemo = chemotherapy; E = erlotinib; gem = gemcitabine; NR = not reported.

Table 2

Number of patients with different epidermal growth factor receptor mutation status.

			EGFR mutation status				EGFR FISH status		EGFR IHC status	
Study	Year	Grouping	Mutant	Wild type	Exon 19 deletion	Exon21 Leu858Arg mutation	Positive	Negative	Positive	Negative
Herbst et al	2007	B+E	1	8						
		B or E	0	13						
Herbst et al	2011	B+E	12	173			33	69	135	49
		B or E	18	152			43	59	119	42
Ciuleanu et al	2013	B+E	2	19			12	7	15	4
		B or E	0	11			6	5	5	5
Seto et al	2014	B+E			40	35				
		B or E			40	37				
Saito et al	2019	B+E			28	24				
		B or E			32	33				

B = bevacizumab; E = erlotinib; EGFR = epidermal growth factor receptor; FISH = fluorescent in situ hybridization; IHC = immunohistochemistry.

Qualität der Studien:

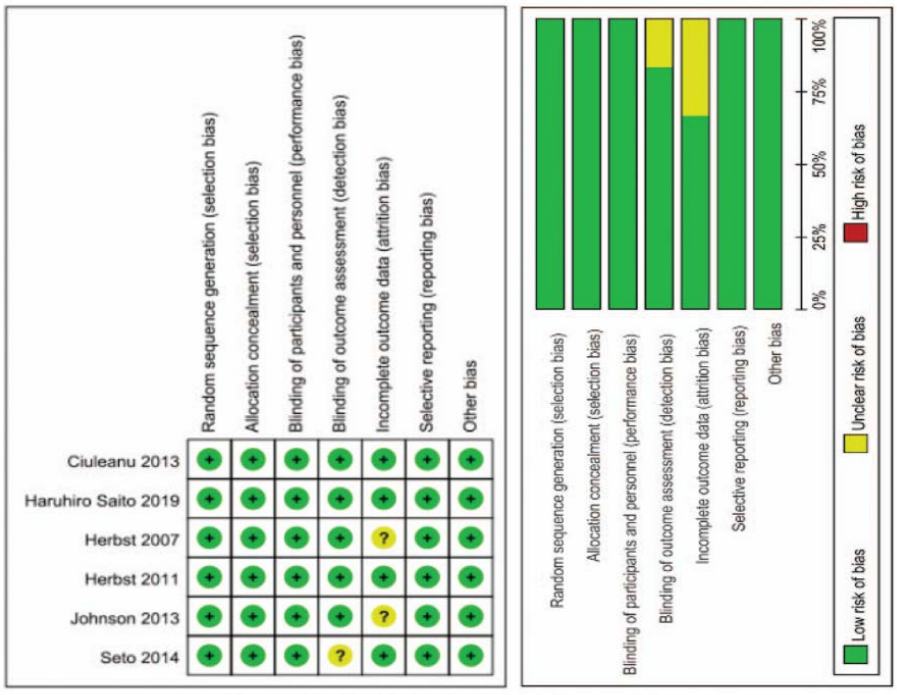


Figure 2. Methodological quality of studies included in meta-analysis.

Studienergebnisse:

- Compared with erlotinib or bevacizumab alone, the combined treatment did not significantly prolong OS (95% confidence interval [CI]=0.84–1.11; P=.62) or increase the ORR (95% CI=0.91–1.20; P=.52), but significantly improved PFS (95% CI=0.58– 0.73; P<.001).
- This improvement was especially notable in patients with the following characteristics: Eastern Cooperative Oncology Group Performance Status score of 0 or 1, female, no smoking history, adenocarcinoma, and EGFR Exon19 deletion or Exon21 Leu858Arg mutation.
- Combination therapy significantly increased incidence of grade 1–2 hypertension (20.3% vs 6.3%, 95% CI 1.73–5.88; P<.01) and severe diarrhea (10% vs 3.2%, 95% CI 1.36–6.60; P=.01).

Anmerkung/Fazit der Autoren

Combining erlotinib and bevacizumab did not improve OS and ORR of patients with NSCLC but did prolong PFS. Subgroup analysis confirmed that combination therapy prolonged PFS without causing severe incurable complications in female patients, as well as those with ECOG-PS0 or ECOG-PS1, no smoking history, adenocarcinoma, and an EGFR Exon19 deletion or Exon21 Leu858Arg mutation. Therefore, we particularly recommend combination therapy for these patients. Our findings can help resolve existing controversies surrounding the benefits of erlotinib+bevacizumab therapy, thus further improving and personalizing patient selection for this treatment.

Kommentar zum Review:

Siehe auch: Chen, F. et al., 2020 [8] & Chen, Z. et al., 2020 [13] & Yang, Y. et al., 2021 [75]

Elliott J et al., 2020 [16].

ALK inhibitors for non-small cell lung cancer: a systematic review and network meta-analysis.

Fragestellung

to assess the relative effects of individual anaplastic lymphoma kinase (ALK) inhibitors for the treatment of non-small cell lung cancer (NSCLC).

Methodik

Population:

- Treatment-naïve or experienced participants with phase III or IV ALK-positive and/or ROS1-positive NSCLC

Intervention:

- ALK inhibitors (e.g, crizotinib, ceritinib, alectinib, brigatinib, loratinib, ensartinib, and entrectinib)

Komparator:

- Placebo, chemotherapy, radiotherapy, another ALK inhibitor, or the same ALK inhibitor at a different dose

Endpunkte:

- treatment-related death, overall survival, progression-free survival, and SAEs

Recherche/Suchzeitraum:

- MEDLINE, Embase, Cochrane CENTRAL, and grey literature (July 23, 2019)

Qualitätsbewertung der Studien:

- Cochrane Collaboration's ROB tool

Ergebnisse

Anzahl eingeschlossener Studien:

- 13 RCTs

Charakteristika der Population:

Table 1. Study characteristics of included randomized controlled trials.

Author, yr, page (study name; NCT no.) (companion publications)	Population	Groups (no. randomized)	Duration of treatment, median (IQR), months	Cross-over between treatment groups allowed?	Reported outcomes of interest to this review	Funding source
Chemotherapy-controlled						
Wu 2018, p. 1549 (PROFILE 1029; NCT01639001)[28, 30]	18–70 years, ALK-positive NSCLC, with ECOG score of 0–2, with no prior systemic treatment	Crizotinib 250 mg BID (104) Chemotherapy (103)	NR	Not reported	TR death; OS; PFS (independent review)*;	Pharma
Shaw 2013, p. 2385 (PROFILE 1007; NCT00932893)[16, 31] (Blackhall 2014[32])	≥ 18 yr, ALK-positive NSCLC, with ECOG score of 0–2, with progressive disease after one prior platinum-based chemotherapy regimen	Crizotinib, 250 mg BID (173) Chemotherapy (174)	NR	Not during study period; participants from the chemotherapy arm could enroll in NCT00932451	TR death; OS; PFS (independent radiologic review*)	Pharma
Solomon 2014, p. 2167[25] (PROFILE 1014; NCT01154140) (Thorne-Nuzzo 2017,[33] Solomon 2016[34], Solomon 2018 [35])	≥ 18 yr, ALK-positive NSCLC, with ECOG score of 0–2, with no prior systemic treatment	Crizotinib 250 mg BID (172) Chemotherapy (171)	10.9 (range 0.4 to 34.3) 4.1 (range 0.7 to 6.2)	Yes; participants in the chemotherapy arm with disease progression could cross to the crizotinib arm provided safety criteria were met	TR death; OS; PFS (independent review)*	Pharma
Zhao 2015, p. 616[18]	≥ 18 yr, ALK-positive NSCLC, Karnofsky performance status (KPS) score ≥ 70, following first- or second-line chemotherapy	Crizotinib, 250 mg BID (14) Chemotherapy (14)	NR	Not reported	TR death; SAEs	Non-pharma
Novello 2018, p. 1409 (ALUR; NCT02604342) [26]	ALK-positive NSCLC, with ECOG score of 0–2; two prior lines of systemic therapy including one line of chemotherapy and one of crizotinib	Alectinib 600 mg BID (72) Chemotherapy (35)	20.1 wk (range 0.4–62.1) 6.0 wk (range 1.9–47.1)	Yes; cross-over from chemotherapy to alectinib was permitted following progression	OS; PFS (investigator-assessed)*	Pharma
Soria 2017, p. 917[24, 36] (ASCEND-4; NCT01828099)	≥ 18 yr, ALK-positive NSCLC, ECOG score of 0–2, previously untreated	Ceritinib 750 mg QD (189) Chemotherapy (187)	66.4 (30.8 to 83.7) 29.9 (13.0 to 62.3)	Yes, participants in the chemotherapy arm could crossover to ceritinib after disease progression	TR death; OS; PFS (independent review)*; SAEs	Pharma
Shaw 2017, p. 874 (ASCEND-5, NCT01828112)[23, 37] (Kiura 2018[38])	≥ 18 yr, ALK-positive NSCLC, with WHO performance status of 0–2, one or two previous chemotherapy regimens and previous crizotinib for at least 21 d	Ceritinib 750 mg QD (115) Chemotherapy (116)	30.3 (13.3 to 54.1) 6.3 (6.0 to 15.1)	Yes, participants in the chemotherapy arm could cross over to the ceritinib group after disease progression	TR death; OS; PFS (independent review)*	Pharma
Head-to-head comparisons of ALK inhibitors						
Zhou 2019, p. 437 (ALESIA; NCT02838420)[29]	≥ 18 yr, ALK-positive NSCLC, ECOG score of 0–2, life expectancy of >12wk, no prior systemic therapy	Crizotinib 250 mg BID (62) Alectinib 600 mg BID (125)	12.6 14.7	No	TR death; OS; PFS (investigator assessed)*; SAEs	Pharma
Camidge 2018, p. 1 (ALTA-1L; NCT02737501)[25]	≥ 18 yr, ALK-positive locally advanced or metastatic NSCLC, with at least one measurable lesion, and no prior ALK-targeted therapy	Crizotinib 250 mg BID (138) Brigatinib 180 mg QD (137)	7.4 (range 0.1 to 19.2) 9.2 (range 0.1 to 18.4)	Yes: patients in the crizotinib group could cross over to brigatinib after disease progression	TR death; OS; PFS (independent review)*	Pharma
Peters 2017, p. 829 (ALEX; NCT02075840)[5, 39] (Camidge 2019[40]; Gadgeel 2018[41])	≥ 18 yr, ALK-positive NSCLC, with ECOG score of 0–2, with no prior systemic treatment	Crizotinib 250 mg BID (151) Alectinib 600 mg BID (152)	17.6 (0.3 to 27.0) 18.6 (0.5 to 29.0)	No	TR death; OS; PFS (investigator assessed)*	Phama

Hida 2017, p. 29[21] (J-ALEX; JAPICcti-132316)	≥ 20 yr, ALK-positive NSCLC, with ECOG score of 0–2, ALK-inhibitor naive, chemotherapy-naïve or had received 1 regimen of chemotherapy	Crizotinib 250 mg BID (104) Alectinib 300 mg BID (103)	NR	Not during study period; Treatment crossover after study withdrawal was allowed in both groups	TR death; PFS (independent review)*	Pharma
Hida 2016, p. 1642 (JP28927; JapicCTI-132186)[19] (Nishio 2018[42])	≥ 20 yr, ALK-positive NSCLC, with ECOG score of 0–1; prior treatment, including other ALK inhibitors, was allowed	Cross-over (300 mg BID total for all groups; 35 participants): Alectinib 20/40 mg capsules Alectinib 150 mg capsules Extension: Alectanib 300 mg BID (150 mg capsules)	13.1 (range 11.1 to 15.0)	Yes by design during cross-over phase	TR death	Pharma
Kim 2017 (ALTA, NCT02094573)[22, 43] (Kawata 2019[44])	≥ 18 yr, ALK-positive NSCLC, with ECOG performance status of 0–2, disease progression while receiving crizotinib	Brigatinib 90 mg QD (109) Brigatinib 180 mg QD (110)	NR	Yes, participants in the 90 mg/d group could cross to the 180 mg/d group after disease progression	PFS (independent review), SAEs	Pharma

BID = twice daily, ECOG = Eastern Cooperative Oncology Group, NSCLC = non-small cell lung cancer, OS = overall survival, PFS = progression-free survival, QD = once daily, RCT = randomized controlled trial, SAE = serious adverse event, TR = treatment-related, WHO = World Health Organization.

*Primary outcome.

Table 2. Participants characteristics of included randomized controlled trials.

Author, yr, page (study name; NCT no.)	Group	Age, yr, median (range)*	Male, %	Current smoking,%	Never smoked,%	Brain or CNS metastases, %	ECOG0, %	ECOG 1, %	ECOG2, %	Adenocarcinoma, %
Treatment naive										
Zhou 2019[29] (ALESIA; NCT02838420)	Crizotinib	49 (IQR 41–59)	55	5	73	37	98**		2	97
	Alectinib	51 (IQR 43–59)	51	3	67	35	97**		3	94
Wu 2018[28] (PROFILE 1029; NCT01639001)	Chemotherapy	50 (23–69)	42	9	70	31	96**		4	98
	Crizotinib	48 (24–67)	48	7	75	20	96**		4	96
Camidge 2018[25] (ALTA-1L; NCT02737501)	Crizotinib	60 (29–89)	41	5	54	30	96**		4	99
	Brigatinib	58 (27–86)	50	3	61	29	96**		4	92
Soria 2017, p. 917 (ASCEND-4; NCT01828099)	Chemotherapy	54.0 (22–80)	39	8	65	33	37†	56†	6†	98
	Ceritinib	55.0 (22–81)	46	8	57	31	37	57	7	95
Peters 2017[5] (ALEX; NCT02075840)	Crizotinib	54.0 (18–91)	42	3	65	38	93**		7	94
	Alectinib	58.0 (25–88)	45	8	61	42	93**		7	90
Solomon 2014[17] (PROFILE 1014; NCT01154140)	Chemotherapy	54 (19–78)	37	3	65	27	95**		5	94
	Crizotinib	52 (22–76)	40	6	62	26	94**		6	94
Treatment experienced										
Novello 2018[26] (ALUR; NCT02604342)	Chemotherapy	59 (37–80)	49	6	46	74	31	54	14	100
	Alectinib	55.5 (21, 82)	57	3	49	65	40	51	8	100
Hida 2017[21] (J-ALEX; JAPICcti-132316)	Crizotinib	59.5 (25–84)	39	3	59	28	46	52	2	99
	Alectinib	61.0 (27–85)	40	2	54	14	52	46	2	97
Kim 2017[22] (ALTA; NCT02094573)	BRI 90 QD	50.5 (18–82)	45	NR	63	71	30	63	6	96
	BRI 180 QD	56.5 (20–81)	42	NR	57	67	41	51	8	98
Shaw 2017[23] (ASCEND-5; NCT01828112)	Chemotherapy	54.0 (47.0–64.0)¶	47	1	53	59	44†	52†	4†	97
	Ceritinib	54.0 (44.0–63.0)¶	41	3	62	57	49	43	8	97
Hida 2016[19] (JP28927; JapicCTI-132186)	Alectinib (cross-over)	45.0 (21–78)	46	3	60	NR	43	57	NR	100
Zhao 2015[18]	Chemotherapy	58.1 (13.2)‡	64	NR	NR	NR	NR	NR	NR	29
	Crizotinib	55.3 (12.7)‡	57	NR	NR	NR	NR	NR	NR	43
Shaw 2013[16] (PROFILE 1007; NCT00932893)	Chemotherapy	49 (24–85)	45	5	64	34	37	55	8	94
	Crizotinib	51 (22–81)	43	3	62	35	42	49	9	95

BRI = brigatinib, CNS = central nervous system, ECOG = Eastern Cooperative Oncology Group, IQR = interquartile range, NR = not reported, QD = once daily, SD = standard deviation.

*Unless otherwise stated.

†WHO performance score.

‡Mean (SD).

¶Median (IQR).

**ECOG0 or ECOG1.

Qualität der Studien:

- Most RCTs were at low ROB for randomization (62%) and allocation concealment (54%), although 38% and 46% ofstudies did not report details ofrandomization and allocation concealment, respectively. Performance and detection bias were ofconcern for all RCTs because ofthe open-label design. All RCTs that reported progression-free survival employed an independent review committee to ascertain disease progression; however, the primary outcome in three RCTs was based on unblinded assessment ofprogressionfree survival by trial investigators. The ROB owing to selective reporting was unclear for 23% ofRCTs, primarily owing to a lack ofavailable protocol or registration record; two RCTs (15%) were at high ROB owing to differences between the protocol and published manuscript. Other concerns included the potential for participant cross-over between study groups with unclear reporting of outcome data by group allocation.

Studienergebnisse:

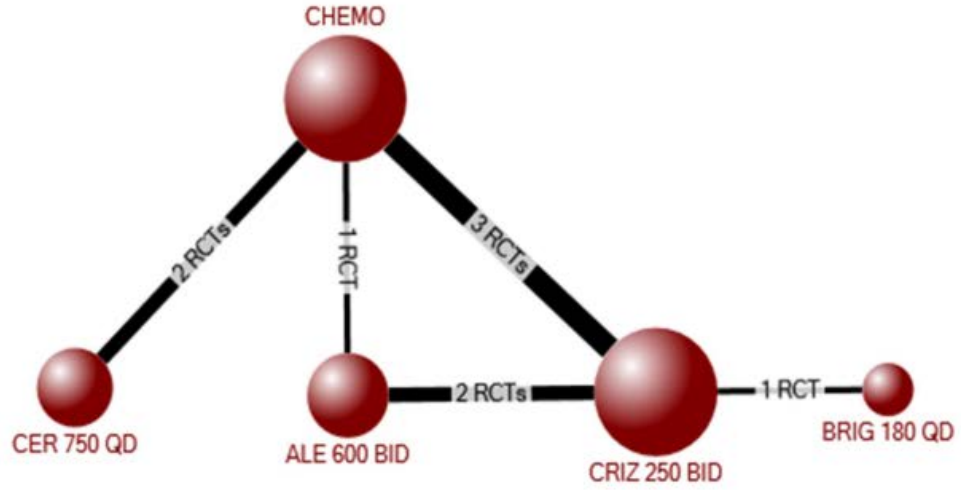


Fig 2. Evidence network for the network meta-analysis of overall survival among all participants (treatment experienced and naïve).

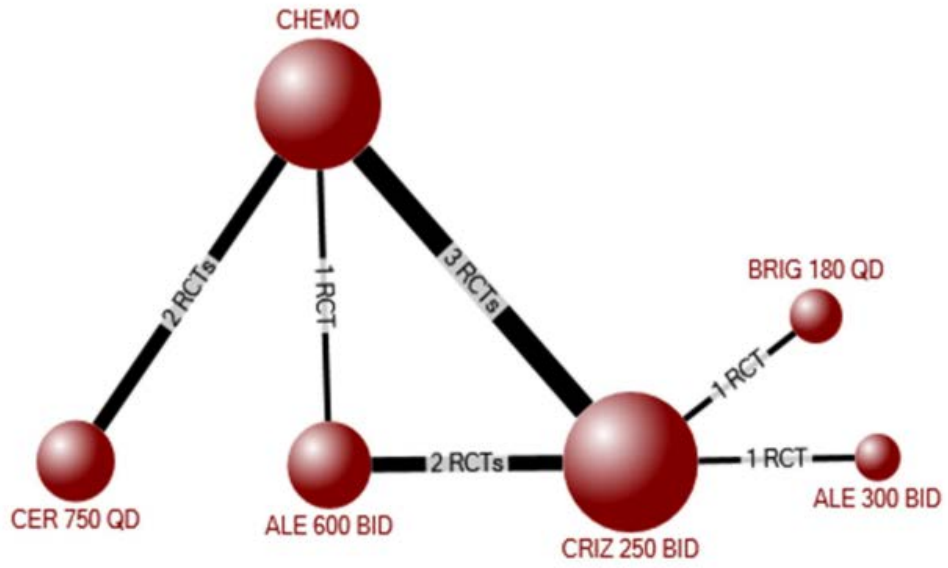


Fig 3. Evidence network for the network meta-analysis of progression-free survival among all participants (treatment experienced and naïve).

- Treatment-related deaths were rare, with 10 deaths attributed to crizotinib (risk difference v. chemotherapy: 0.49, 95% credible interval [CrI] –0.16 to 1.46; odds ratio 2.58 (0.76–11.37).

- All ALK inhibitors improved PSF relative to chemotherapy (hazard ratio [95% CrI]: crizotinib 0.46 [0.39–0.54]; ceritinib 0.52 [0.42–0.64]; alectinib 300 BID 0.16 [0.08–0.33]; alectinib 600 BID 0.23 [0.17–0.30]; brigatinib 0.23 [0.15–0.35]), while alectinib and brigatinib improved PFS over crizotinib and ceritinib (alectinib v. crizotinib 0.34 [0.17–0.70]; alectinib v. ceritinib 0.30 [0.14–0.64]; brigatinib v. crizotinib 0.49 [0.33–0.73]; brigatinib v. ceritinib 0.43 [0.27–0.70]).
- OS was improved with alectinib compared with chemotherapy (HR 0.57 [95% CrI 0.39–0.83]) and crizotinib (0.68 [0.48–0.96]).
- Use of crizotinib (odds ratio 2.08 [95% CrI 1.56–2.79]) and alectinib (1.60 [1.00–2.58]) but not ceritinib (1.25 [0.90– 1.74), increased the risk of serious adverse events compared with chemotherapy.
- Results were generally consistent among treatment-experienced or naïve participants.

Anmerkung/Fazit der Autoren

Treatment-related deaths were infrequent among ALK-positive NSCLC. Among patients with ALK-positive NSCLC, progression-free survival was improved by crizotinib, ceritinib, alectinib, and brigatinib compared with chemotherapy, while alectinib and brigatinib were significantly better than crizotinib and ceritinib. Overall survival was improved only by alectinib; however, the findings are likely confounded by crossover between treatment groups and should be interpreted with caution. Few studies have enrolled participants with ROS1 mutations, and additional research is need in this area.

Kommentar zum Review:

- Siehe auch: Fan, J. et al., 2018 [20] & Breadner, D. et al., 2020 [7]

Xu Z et al., 2019 [73].

Nivolumab provides improved effectiveness and safety compared with docetaxel as a second-line treatment for advanced non-small cell lung cancer: A systematic review and meta-analysis.

Fragestellung

goal of identifying a better second-line therapeutic regimen for patients with advanced NSCLC, we conducted a meta-analysis to compare the anti-tumor efficacy and adverse effects (AEs) between nivolumab and docetaxel.

Methodik

Population:

- patients with stage III/IV NSCLC

Intervention:

- nivolumab

Komparator:

- docetaxel

Endpunkte:

- OS, PFS, objective response rate (ORR), complete response (CR), partial response (PR), stable disease (SD), progressive disease (PD), disease control rate (DCR), and AEs.

Recherche/Suchzeitraum:

- PubMed, EMBASE, Ovid MEDLINE, Scopus, Web of Science, Cochrane Library, ScienceDirect, Ovid MEDLINE, and Google Scholar from their inception to 5 June 2018

Qualitätsbewertung der Studien:

- Cochrane Risk of Bias Tool

Ergebnisse

Anzahl eingeschlossener Studien:

- six studies (949 patients)
- our were RCTs (studies 11 and 12 were the two-year and three-year outcomes of studies 9 and 10), and two were retrospective studies.

Qualität der Studien:

- According to the Cochrane Risk of Bias Tool, all the included studies were of high quality

Studienergebnisse:

- Nivolumab showed better efficacy in terms of the PFS (hazard ratios [HR]: 0.70, P = 0.03), OS (HR: 0.70, P < 0.00001), objective response rate (ORR) (risk ratios [RR]: 1.73, P = 0.0008), total AEs (RR: 0.77, P = 0.006), and grade 3-5 AEs (RR: 0.18, P < 0.00001) than docetaxel.
- The subgroup analysis suggested that the anti-tumor efficacy of nivolumab was superior for squamous NSCLC than for nonsquamous NSCLC in terms of both PFS and OS, and no changes in these endpoints were found among the groups with different ECOG statuses, histological features, and study designs. The anti-tumor efficacy of nivolumab for NSCLC in terms of both PFS and OS was positively correlated with the level of PD-L1 expression.
- In the nivolumab treatment arm, the 10 most-reported AEs were fatigue (15.7%), nausea (10.8%), decreased appetite (10.3%), asthenia (9.8%), diarrhea (7.5%), rash (7.5%), arthralgia (5.4%), vomiting (4.4%), constipation (3.5%), and pyrexia (3.3%).

Anmerkung/Fazit der Autoren

Our results suggested that nivolumab is a better choice than docetaxel-based chemotherapy for advanced NSCLC due to its improved anti-tumor efficacy (PFS, OS, and ORR) and decreased toxicity. The anti-tumor efficacy of nivolumab for NSCLC in terms of both PFS and OS showed a positive correlation with the level of PD-L1 expression. However, due to the inherent limitations of the study, more largescale and high-quality RCTs are needed to support this conclusion. Moreover, the use of a drug combination for lung cancer is also a promising research direction and deserves attention.

Li YX et al., 2019 [40].

A meta-analysis of the comparing of the first-generation and next-generation TKIs in the treatment of NSCLC.

Fragestellung

to address this question, and identify the most efficacious drug, by assessing the efficacy and safety of first generation EGFR TKIs and next generation EGFR-TKIs in patients with EGFR-mutant NSCLC.

Methodik

Population:

- NSCLC patients harboring activating mutations in EGFR

Intervention/Komparator:

- Comparing second/third -generation EGFR-TKIs and first -generation EGFR-TKIs

Endpunkte:

- survival, tumor response, toxicity

Recherche/Suchzeitraum:

- PubMed and Embase databases were searched to identify studies. Two investigators independently performed the literature search up to September 2018.

Qualitätsbewertung der Studien:

- Jadad scale

Ergebnisse

Anzahl eingeschlossener Studien:

- 5 RCTs including 3 clinical trials

Charakteristika der Population:

Study	Year	Clinical Trials	Treatment regimen		Patients number		Age(years)	
			Study arm	Comparative arm	Study arm	Comparative arm	Study arm	Comparative arm
J.-C. Soria	2017	FLAURA	osimertinib	gefitinib/erlotinib	279	277	64	64
Keunchil Park	2016	LUX-Lung 7	afatinib	gefitinib	160	159	63	63
L. Paz-Ares	2017	LUX-Lung 7	afatinib	gefitinib	146	151	/	/
Yi-Long Wu	2017	ARCHER 1050	dacomitinib	gefitinib	227	225	62	61
Tony S. Mok	2018	ARCHER 1050	dacomitinib	gefitinib	227	225	62	61

Qualität der Studien:

- All included studies in this study were based on moderate to high quality evidence.

Studienergebnisse:

- Pooling the PFS data from three trials showed that next-generation EGFR-TKIs did prolong the PFS compared with the first-generation EGFR-TKIs
- While, subgroup analyses with EGFR mutations, there are also significant differences with exon 19 deletion (OR = 0.56, 95%CI = 0.41–0.77, P = 0.0003) and exon 21 (L858R) mutation (OR = 0.60, 95%CI = 0.49–0.75, P＜0.00001)
- Pooled data showed that the next-generation EGFR-TKIs had significantly better OS rate than first-generation group, with the pooled OR being 0.76 (95 % CI 0.65–0.90, P = 0.001)

- The pooling ORR data achieved advantage in the next-generation EGFR-TKIs agents (OR = 1.27, 95%CI = 1.01–1.61, P = 0.04)
- Pooling the SAE data show that there is no statistical difference between the two groups

Anmerkung/Fazit der Autoren

In summary, our meta-analysis indicates that next-generation EGFR-TKIs are superior to the first-generation EGFR-TKIs with respect to survival and objective response in the treatment of NSCLC patients with EGFR activating mutations and the efficacy benefits are found both in exon 19 deletion and exon 21 (L858R) mutation when comparing the next-generation EGFR-TKIs over first -generation EGFR-TKIs. We believe that these results provide additional evidence to help to inform decision-making when choosing the standard treatment option for patients with EGFR mutation- positive NSCLC.

Kommentare zum Review

- Linie unklar

Lv WW et al., 2019 [46].

Safety of combining vascular endothelial growth factor receptor tyrosine-kinase inhibitors with chemotherapy in patients with advanced non-small-cell lung cancer: A PRISMA-compliant meta-analysis.

Fragestellung

to definite the incidence and the risk of grade ≥3 adverse events (AEs), serious and fatal AEs (SAEs and FAEs), with VEGFR-TKIs in advanced/metastatic NSCLC patients was performed.

Methodik

Population:

- advanced/metastatic NSCLC

Intervention/Komparator:

- either chemotherapy alone or in combination with VEGFR-TKIs

Endpunkte:

- incidence and relative risk of FAEs, included grade ≥3 AEs and SAEs

Recherche/Suchzeitraum:

- published up to December 2017

Qualitätsbewertung der Studien:

- Cochrane approach

Ergebnisse

Anzahl eingeschlossener Studien:

- 18 RCTs of VEGFR-TKIs plus chemotherapy, involving 8461 advanced NSCLC patients

Charakteristika der Population:

Characteristics of included randomized controlled trials.

First author, year (ref)	Study design	Treatment line	Treatment arms	Number for analysis	Median age, y	Median PFS, mo	Median OS, mo
Heymach et al, 2007[18]	Phase II	Second line	Vandetanib 100 mg + docetaxel	42	61 (30–76)	4.7	13.1
			Vandetanib 300 mg + docetaxel	44	60 (29–82)	4.2	7.9
			Placebo + docetaxel	41	58 (41–78)	4.0	13.4
Heymach et al, 2008[19]	Phase II	First line	Vandetanib 300 mg + carboplatin/ paclitaxel Placebo + carboplatin/paclitaxel	56	60 (36–79)	6.0	10.2
				52	59 (42–83)	5.8	12.6
Goss et al, 2010[20]	Phase II	First line	Cediranib 30 mg/day + paclitaxel/carboplatin	126	60 (36–77)	5.6	NM
			Placebo + paclitaxel/carboplatin	123	58 (39–81)	5.0	
Herbst et al, 2010[21]	Phase II	Second line	Vandetanib 100 mg/day + docetaxel	689	59 (28–82)	4.0	10.6
			Placebo + docetaxel	690	59 (20–82)	3.2	10.0
Scagliotti et al, 2010[22]	Phase III	First line	Sorafenib 400 mg twice a day + carboplatin/paclitaxel	463	62 (34–86)	4.6	10.7
			Placebo + carboplatin/paclitaxel	459	63 (34–82)	5.4	10.6
de Boer et al, 2011[23]	Phase III	Second line	Vandetanib 100 mg/day + pemetrexed	260	60 (28–82)	4.4	10.5
			Placebo + pemetrexed	273	60 (35–83)	3.0	9.2
Paz-Ares et al, 2012[24]	Phase III	First line	Sorafenib 400 mg twice a day + gemcitabine/cisplatin	385	59 (28–81)	6.0	12.4
			Placebo + gemcitabine/cisplatin	384	58 (22–77)	5.5	12.5
Scagliotti et al, 2012[25]	Phase III	First line	Motesanib 125 mg/day + paclitaxel/carboplatin	533	60 (23–87)	5.6	13.0
			Placebo + paclitaxel/carboplatin	539	60 (21–84)	5.4	11.0
Dy et al, 2013[26]	Phase II	First line	Cediranib 30 mg/day + gemcitabine/carboplatin	58	65 (46–81)	6.3	12
			Gemcitabine/carboplatin	29	64 (45–82)	4.5	9.9
Scagliotti et al, 2013[27]	Phase II	First line	Pazopanib 800 mg/day + pemetrexed	61	62 (40–75)	6.2	NM
			Cisplatin + pemetrexed	34	64 (36–74)	5.7	
Belani et al, 2014[28]	Phase II	First line	Axitinib 5 mg bid + pemetrexed/cisplatin	55	62 (30–77)	8.0	17.0
			Pemetrexed/cisplatin	55	59 (42–76)	7.1	15.9
Gridelli et al, 2014[29]	Phase II	First line	Vandetanib 100 mg/day + gemcitabine	61	75 (70–82)	6.1	8.7
			Placebo + gemcitabine	63	75 (70–84)	5.6	10.2
Laurie et al, 2014[30]	Phase III	First line	Cediranib 20 mg/day + paclitaxel/carboplatin	151	63 (23–85)	5.5	12.2
			Placebo + carboplatin/paclitaxel	153	62 (36–77)	5.5	12.1
Novello et al, 2014[31]	Phase III	First line	Motesanib 125 mg/day + carboplatin/paclitaxel	181	62 (31–79)	4.9	11.1
			Placebo + carboplatin/paclitaxel	173	59.5 (32–81)	5.1	10.7
Heist et al, 2014[32]	Phase II	Second line	Pemetrexed + sunitinib 37.5 mg daily	39	63 (38–84)	3.7	6.7
			Pemetrexed	42		4.9	10.5
Reck et al, 2014[33]	Phase III	Second line	Nintedanib 200 mg twice daily + docetaxel Placebo + docetaxel	652	60 (53–67)	3.4 2.7	10.9
				655	60 (54–66)		7.9
Ramalingam et al, 2015[34]	Phase II	First line	Linifanib 7.5 mg + carboplatin/paclitaxel	42	61.5 (35–79)	8.3	11.4
			Linifanib 12.5 mg carboplatin/paclitaxel	47	60 (43–79)	7.3	13.0
			Placebo + carboplatin/paclitaxel	47	61 (44–79)	5.4	11.3
Hanna et al, 2016[35]	Phase III	Second-line	Nintedanib 200 mg twice daily + pemetrexed	347	60 (21–84)	4.4	12.0
			Placebo + pemetrexed	357	59 (26–86)	3.6	12.7

NM = not mentioned, OS = overall survival, PFS = progression-free survival.

Qualität der Studien:

- The quality of the trial was generally good and the risk of bias was low. Of the studies enrolled, 7 trials were considered to be with an excellent quality without bias. The most common problem is that there is no expression of randomization process and allocation concealment (selection bias), and the lack of blinding in the studies by Bellani et al, Dy et al, Heist et al, and Scagliotti et al (performance bias and detection bias).

Studienergebnisse:

- The proportion of patients with grade ≥3 AEs was increased with the addition of VEGFR-TKIs (relative risk, 1.35; 95% confidence interval [CI] 1.19–1.52; incidence, 68.1% vs 50.1%; P<.001).
- The most common grade ≥3 AEs was neutropenia (24.9% vs 15.4%, P<.001). Addition of VEGFR-TKIs was also related to the increased risk of SAEs (relative risk, 1.34; 95% CI 1.14–1.56; incidence, 37.8% vs 27.9%; P<.001) and FAEs (relative risk, 2.16, 95% CI 1.47–3.19; incidence, 3.4% vs 1.8%).
- Subgroup analysis suggested there was no difference in the rates of SAEs and FAEs in the second-line settings.

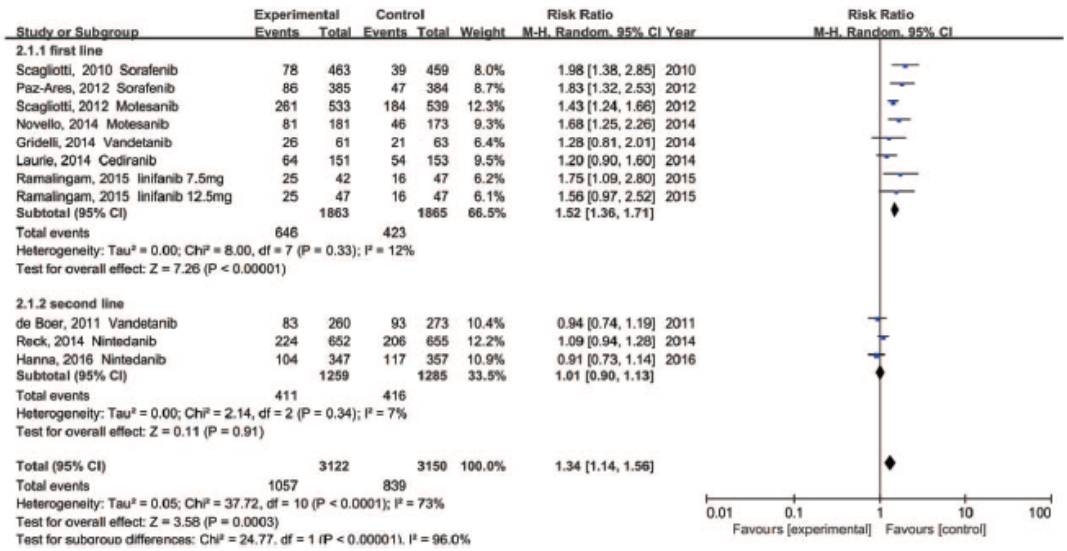


Figure 4. Forest plot and pooled risk ratio for serious adverse events.

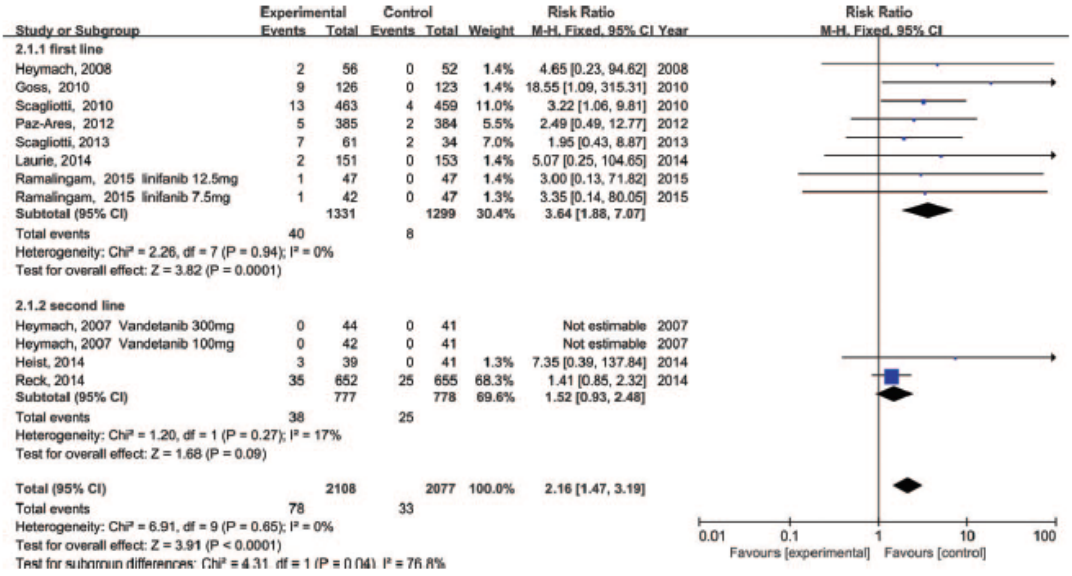


Figure 5. Forest plot and pooled risk ratio for fatal adverse events.

Anmerkung/Fazit der Autoren

This is a comprehensive meta-analysis that specifically evaluated the grade ≥3, serious and fatal toxicities of adding VEGFR-TKIs to chemotherapies in advanced NSCLC patients, and also the most reported specific grade ≥3 AEs. Our results show that the addition of VEGFR-TKIs to chemotherapies in NSCLC significantly increases grade ≥3 toxicity, SAEs, and FAEs compared with traditional chemotherapy alone, especially in the first treatment line. Monitoring AEs, especially haematologic AEs during VEGFR-TKIs therapy, is recommended.

Chen JH et al., 2018 [9].

Indirect comparison of efficacy and safety between immune checkpoint inhibitors and antiangiogenic therapy in advanced non–small-cell lung cancer

Fragestellung

(…) indirect comparison to compare the safety and efficacy of immune checkpoint inhibitors, antiangiogenic therapy, and conventional chemotherapy.

Methodik

Population:

- patients with unresectable locally advanced or metastatic NSCLC either treatment-naive or first-line chemotherapy failure

Intervention/Komparator:

- anti-angiogenesis inhibitors, immunotherapy or chemotherapy as first-line therapy or subsequent therapy

Endpunkte:

- overall survival, progression free survival and all grade 3 to 5 adverse events

Recherche/Suchzeitraum:

- up to July 2017

Qualitätsbewertung der Studien:

- Cochrane risk of bias tool

Ergebnisse

Anzahl eingeschlossener Studien:

- 37 RCTs involving 16810 patients were included to conduct meta-analysis and indirect comparisons
- Eighteen trials were conducted as first line setting and nineteen trials were designed as subsequent therapy. Among the trials of first line setting, eighteen trials compared anti-angiogenetic agents or immune checkpoint inhibitors with doublet platinum-based treatment. In terms of the trials of subsequent therapy, seventeen trials compared anti-angiogenic agents or immune checkpoint inhibitors with docetaxel and two trials compared these newer treatments with pemetrexed.
- Nineteen anticancer agents were analyzed, including anti-angiogenetic agents (bevacizumab, aflibercept, ramucirumab, nintedanib, axitinib, sorafenib, vandetanib, and sunitinib), immune checkpoint inhibitors (ipilimumab, pembrolizumab, nivolumab and atezolizumab) and traditional chemotherapy (cisplatin, carboplatin, oxaliplatin, gemcitabine, paclitaxel, docetaxel and pemetrexed)

Qualität der Studien:

- The quality of the included RCTs were generally good with low risk of bias. The most common bias was the lack of blinding in about 38% of included trials with open-label designed. In the domain of other risk of bias, one trial by Wang Y. et al. was at high risk of bias due to single center design.

Studienergebnisse:

- Overall survival (OS):
  - The results of pairwise meta-analysis of direct comparisons of OS: In the first line setting, use of pembrolizumab significantly prolonged OS (HR: 0.60; 95%CI: 0.41–0.88; p = 0.010; heterogeneity: single trial). In the subsequent setting, the use of nivolumab (HR: 0.67; 95%CI: 0.55–0.82; p = 0.0001; heterogeneity: p = 0.24; I_2 = 27%), pembrolizumab (HR: 0.71; 95%CI: 0.58–0.87; p = 0.001; heterogeneity: single trial), atezolizumab (HR: 0.73; 95%CI: 0.63–0.84; p < 0.0001; heterogeneity: p = 1.00; I_2 = 0%) and ramucirumab plus docetaxel (HR: 0.86; 95%CI: 0.75–0.98; p = 0.02; heterogeneity: p = 1.00; I_2 = 0%) showed significant OS benefit versus standard chemotherapy.
  - Indirect comparison of OS: For the first line setting, both use of pembrolizumab alone (HR: 0.6; 95%CI: 0.4–0.91) and the combination of bevacizumab and doublet platinum-base therapy (HR: 0.86; 95%CI: 0.75–0.99) showed significant survival benefit as compared to doublet platinum therapy. Overall, anti-PD1 monoclonal antibodies appears superior to anti-angiogenic therapies in terms of OS. The use of pembrolizumab alone was associated with statistically significant survival benefit as compared to the combination of axitinib and doublet platinum-based therapy (HR: 0.41; 95%CI: 0.22–0.78), the combination of sorafenib and doublet platinum-based therapy (HR: 0.57; 95%CI: 0.36–0.89), and the combination of vandetanib and doublet platinum-based therapy (HR: 0.52; 95%CI: 0.28–0.96); it was also superior to the combination of ramucirumab and doublet platinum-based therapy (HR: 0.58; 95%CI: 0.32–1.05) and the combination of bevacizumab and doublet platinum-based therapy, although these difference did not reach statistical significance. In addition, the use of pembrolizumab alone resulted in significant survival advantage when compared to nivolumab alone, regardless of PD-1/PD-L1 expression level (HR: 0.59; 95%CI: 0.36–0.97). In the subsequent setting, the single use of anti-PD1/PD-L1 monoclonal antibodies (atezolizumab alone, pembrolizumab alone and nivolumab alone) showed significant survival benefit as compared to docetaxel or pemetrexed. The combination of ramucirumab and docetaxel also resulted in survival advantage when compared to docetaxel (HR: 0.79; 95% CI: 0.64–0.98).

    → Overall, in the subsequent setting, the single use of anti-PD1/PD-L1 monoclonal antibodies appears superior to anti-angiogenic therapies in terms of OS. The use of nivolumab alone was associated with statistically significant survival benefit as compared to the combination of ramucirumab and docetaxel (HR: 0.79; 95%CI: 0.64–0.98), the combination of sunitinib and pemetrexed (HR: 0.49; 95%CI: 0.31–0.78), and the combination of vandetanib and docetaxel (HR: 0.72; 95%CI: 0.58–0.88); the use of pembrolizumab alone (HR: 0.83; 95%CI: 0.65–1.05) and atezolizumab alone (HR: 0.85; 95%CI: 0.7–1.03) were both superior the combination of ramucirumab and docetaxel, although the difference were not statistically significant.
- PFS:
  - In the first line setting, statistically significant improvement of PFS were shown in the combination of bevacizumab and doublet platinum-based therapy (HR: 0.62; 95%CI: 0.47–0.82; p = 0.0009; heterogeneity: p = 0.0002; I2 = 84%), the combination of pembrolizumab and doublet platinum-based therapy (HR: 0.53; 95%CI: 0.31–0.91; p = 0.02; heterogeneity: single trial), and pembrolizumab alone (HR: 0.50; 95%CI: 0.37–0.68; p < 0.00001; heterogeneity: single trial) versus standard doublet platinum-based therapy. In the subsequent setting, statistically significant benefit of PFS were shown in the combination of ramucirumab and docetaxel (HR: 0.75; 95%CI: 0.67–0.84; p < 0.00001; heterogeneity: p = 0.65; I2 = 0%), the combination of nintedanib

and docetaxel (HR: 0.79; 95%CI: 0.68–0.92; p = 0.002; heterogeneity: single trial), the combination of aflibercept and docetaxel (HR: 0.82; 95%CI:0.72–0.94; p = 0.004; heterogeneity: single trial), and the combination of vandetanib and docetaxel (HR: 0.78; 95%CI: 0.70–0.87; p < 0.00001; heterogeneity: p = 0.44; I2 = 0%) versus docetaxel.

- Indirect comparison: In the first line setting, pembrolizumab alone (HR: 0.5; 95%CI: 0.32–0.79) and combination of bevacizumab and doublet platinum-based therapy (HR: 0.64; 95%CI: 0.52–0.78) showed significantly increased efficacy compared with doublet platinum-based therapy.

  → Overall, pembrolizumab showed increased efficacy compared with anti-angiogenic therapies, although statistical significance did not reach in some comparisons: pembrolizumab vs combination of bevacizumab and doublet platinum-based therapy, pembrolizumab vs combination of ramucirumab and doublet platinum-based therapy, pembrolizumab vs combination of sorafenib and doublet platinum-based therapy (HR: 0.54; 95%CI: 0.32–0.91), and pembrolizumab vs combination of vandetanib and doublet platinum-based therapy. In the subsequent setting, combination of ramucirumab and docetaxel showed significant increased efficacy compared with docetaxel alone in terms of PFS (HR: 0.74; 95%CI: 0.56–0.98). Although the HR appears to be in favor of pembrolizumab alone and nivolumab alone compared with docetaxel alone, the difference were not statistically significant.

- Toxicity:

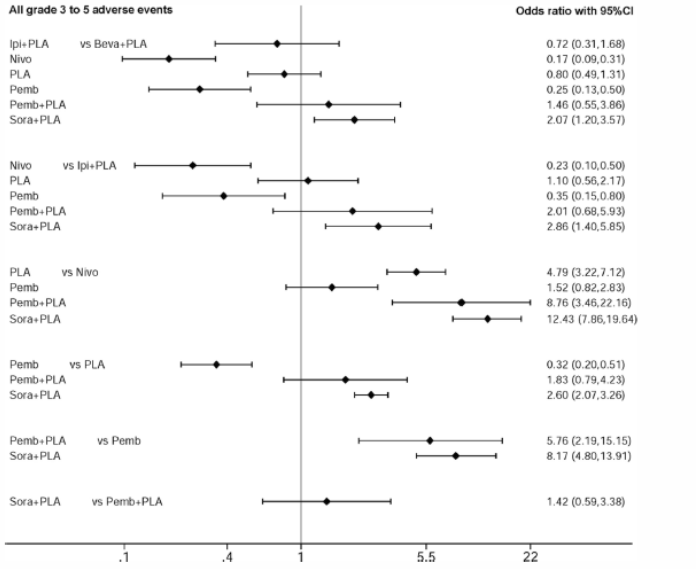


Figure 2. Forest plot of indirect comparison: all grade 3 to 5 adverse events in first line therapy. All individual regimens compared with reference treatment. Odds ratios (OR) and 95% confidence intervals were given. Beva: bevacizumab; Ipi: ipilimumab; Nivo: nivolumab; Pemb: pembrolizumab; Sora: sorafenib; PLA: doublet platinum-based treatment.

Anmerkung/Fazit der Autoren

In conclusion, based on current evidence, our results revealed that pembrolizumab and nivolumab may be preferable first-line and subsequent treatment options, respectively, for patients with advanced NSCLC without target gene mutations. These findings enhance our understanding of the efficacy and safety of immune checkpoint inhibitors and antiangiogenic therapy in advanced NSCLC.

Kommentare zum Review

- Gemischte Population: Keine seperaten Analysen/Ergebnisse zum Stadium oder Status (z.B. fortgeschritten vs. metastasierte Patienten) bzw. EGFR Status.
- Siehe auch: Shao, J. et al., 2020 [56]

Han S et al., 2018 [22].

The efficacy and safety of paclitaxel and carboplatin with versus without bevacizumab in patients with non-small-cell lung cancer: a systematic review and meta-analysis

Fragestellung

To investigate the efficacy and safety of Bevacizumab (Bev) used in combination with paclitaxel and carboplatin (PC), compared with PC alone in patients with advanced non-small-cell lung cancer (NSCLC).

Methodik

Population:

- patients with untreated locally advanced, recurrent or previously metastatic NSCLC

Intervention/Komparator:

- PC with or without Bev as a first-line therapy for patients with untreated locally advanced, recurrent or previously metastatic NSCLC

Endpunkte:

- PFS, OS, ORR, toxicity, treatment related mortality

Recherche/Suchzeitraum:

- up to May 2017

Qualitätsbewertung der Studien:

- Cochrane Collaboration tool

Ergebnisse

Anzahl eingeschlossener Studien:

- five RCTs (1486 patients) that compared PC with or without Bev (dose: 15 mg/kg) for locally advanced (stage IIIB), recurrent or metastatic (stage IV) NSCLC

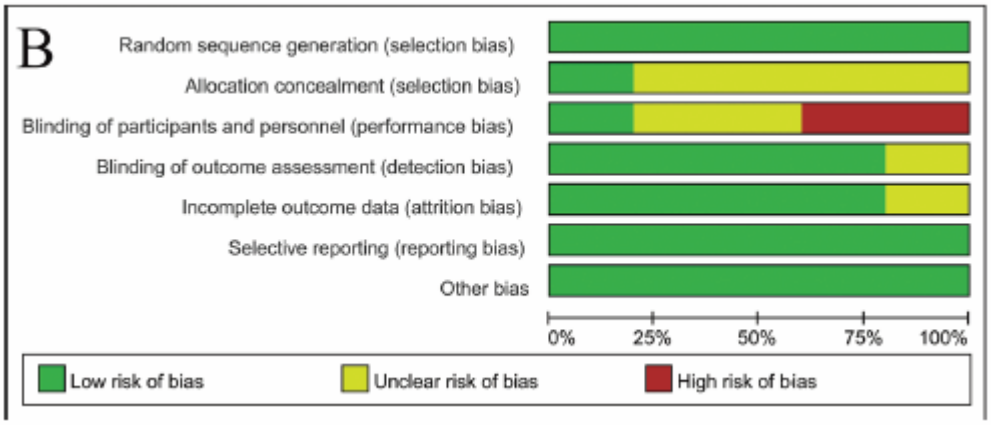
Charakteristika der Population:

Table 1: Characteristics of RCTs included in the meta-analysis

study	year	region	trial phase	participants	intervention and comparisons	patients enrolled	Histology	primary endpoint
Johnson	2004	USA	II	99	C:CP T:CP+BEV(7.5 mg/kg) T:CP+BEV(15 mg/kg)	32 32 35	adenocarcinoma, large cell carcinoma, squamous cell carcinoma, other	time to disease progression and tumor response rate
Sandler	2006	USA	III	878	C:CP T:CP+BEV(15 mg/kg)	444 434	adenocarcinoma, large cell carcinoma, bronchoalveolar carcinoma, other	overall survival
Soria	2011	Europe	II	85	C:CP T:CP+BEV(15 mg/kg)	41 44	adenocarcinoma, bronchoalveolar carcinoma, large cell carcinoma, other	objective response rate
Niho	2012	Japan	II	180	C:CP T:CP+BEV(15 mg/kg)	59 121	adenocarcinoma, large cell carcinoma, other	progression-free survival
Zhou	2015	China	III	276	C:CP T:CP+BEV(15 mg/kg)	138 138	adenocarcinoma, large cell carcinoma, mixed cell carcinoma	progression-free survival

Qualität der Studien:

- low risk of bias in most domains except for the allocation concealment and binding. Because the outcomes (such as PFS and OS) in cancer trials are objective and are not influenced by a lack of blinding, the risk of bias was considered acceptable.



Studienergebnisse:

- Progression-free survival
  - PFS was prolonged in patients treated who were with PC plus Bev, compared with PC, with an estimated HR of 0.57 (random effects: 95% CI = 0.46–0.71, $p < 0.01$; I2 = 56%, $p = 0.06$).
- Overall survival:
  - The five included trials all reported OS. The HR for the OS favored Bev combined with PC (fixed effect: HR = 0.81; 95% CI = 0.71–0.92; $p < 0.01$), without significant heterogeneity (I2 = 0%; $p = 0.48$) among the trials, and HR was calculated using a fixed effects model. There was also no significant heterogeneity ($I^2 = 15\%$, $P = 0.32$) with regarding the effect of Bev on the OS after excluding the study published by Johnson et al., which was the only study that included patients with squamous cell histology.
- Overall response rates:

- The fixed-effects model evaluation ($\chi 2 = 4.67$; $p = 0.32$, $I^2 = 14\%$), including 1,486 patients, showed an increased response rate in the Bev plus PC versus the PC along group (RR = 2.06, 95% CI = 1.73–2.44).

- Toxicities and safety:
  - Bev showed a significant increase in treatment-related deaths in patients with NLCLC (fixed effect: RR = 2.96; 95% CI = 1.46–5.99; $p = 0.003$).
  - According to the haematological toxicities (grade 3/4), the group that received PC plus Bev had higher rates of neutropenia (fixed effect: RR = 1.29; 95% CI = 1.12– 1.49; $p = 0.0006$). The proportions of febrile anemia, febrile neutropenia and thrombocytopenia were similar.
  - The non-haematologic toxicities were also more frequent for patients receiving PC plus Bev. These toxicities included haemoptysis (fixed effect: RR = 4.87; 95%CI = 1.13–20.90; p = 0.03), hypertension (fixed effect: RR = 6.89; 95% CI = 3.21–14.79; p < 0.00001), proteinuria (fixed effect: RR = 12.58; 95% CI = 2.61–60.57; p = 0.002) and bleeding events (fixed effect: RR = 4.59; 95% CI = 1.78–11.80; p = 0.002). There was no difference in the proportion of patients with thrombocytopenia.

Anmerkung/Fazit der Autoren

Our meta-analysis demonstrated that Bev significantly prolonged the PFS, OS and RR when combined with PC as first-line therapy in patients with non-squamous advanced NSCLC. This combination caused more adverse events and slightly increased the risk of treatment-related death. Thus, Bev plus PC can be considered a good option for reasonably selected target patients. Importantly, the patient's own value, complicated diseases and expected toxicity profile should be considered before making a treatment decision.

Kommentare zum Review

- Gemischte Population: Keine separaten Angaben zum Stadium oder Status (z.B. fortgeschritten vs. metastasierte Patienten bzw. EGFR Status.

Li Z. et al., 2018 [41].

Chemotherapy with or without pemetrexed as second-line regimens for advanced non-small-cell lung cancer patients who have progressed after first-line EGFR TKIs: a systematic review and meta-analysis.

Fragestellung

to evaluate the chemotherapeutic regimens "with-pemetrexed" versus "non-pemetrexed" in advanced NSCLC patients who had progressed after first-line EGFR-TKIs.

Methodik

Population:

- patients were pathologically confirmed of advanced NSCLC/ patients using EGFR-TKIs as first-line therapy and developed acquired resistance or progression of disease

Intervention/Komparator:

- pemetrexed singlet or pemetrexed-based combination chemotherapy with non-pemetrexed chemotherapy as secondline chemotherapy (with-pemetrexed vs non-pemetrexed)

Endpunkte:

- Response rate (RR), disease control rate (DCR), 1-year survival rate (1-year SR), progression-free survival (PFS), and overall survival (OS)

Recherche/Suchzeitraum:

- PubMed, Embase, Cochrane Library, and the Web of science up to March 2017.

Qualitätsbewertung der Studien:

- Jadad score / modified Newcastle-Ottawa scale

Ergebnisse

Anzahl eingeschlossener Studien:

- One randomized controlled trial (RCT) and three retrospective studies were included in this meta-analysis, covering a total of 354 patients
- 202 in the chemotherapy with-pemetrexed arm and 152 in the chemotherapy non-pemetrexed arm

Charakteristika der Population:

- In these 354 patients, mostly metastatic and stage IV adenocarcinoma, except for 11 patients with stage IIIb in the RCT.
- All of these 354 patients were treated using EGFR-TKIs as first-line therapy, and none of them were treated with any radiation therapy before. After the first-line EGFR-TKIs treatment, the patients presented local progress and distant metastasis, and hence changed to second-line chemotherapy regimens.
- The regimens included in the with-pemetrexed arm are pemetrexed singlet or pemetrexedbased combination chemotherapy. The regimens of the non-pemetrexed arm comprised conventional cytotoxic chemotherapy singlet (eg, docetaxel singlet) or doublet (eg, platinum doublet, navelbine/platinum doublet and platinum+gemcitabine/navelbine/taxotere doublet).

Table 1 Characteristics and data extracted from the studies included in this meta-analysis

Authors/ year	Type	EGFR mutation	Second-line regimens (per arm)	Patients enrolled	RR (%)	DCR (%)	1-year SR (%)	PFS	OS	Jadad/ Ottawa score
Dong et al 2014[15]	RCT	Yes	Pem,	54	22.2	51.9	25.9	NA	NA	3
			docetaxel	55	25.5	52.7	25.5			
Park et al 2015[16]	Retrospective	Yes	Pem,	34	24	91	NA	HR: 0.47	HR: 0.50	6
			platinum doublet	26	12	88		95% CI: 0.26–0.84	95% CI: 0.22–1.13	
Tseng et al 2016[17]	Retrospective	Yes	Pem ± platinum ± beva,	37	32.4	78.4	NA	HR: 0.54	HR: 0.92	6
			NVB/platinum doublet	46	17.4	50.0		95% CI: 0.34–0.86	95% CI: 0.50–1.68	
Yang et al 2016[14]	Retrospective	Yes	Pem + platinum,	77	26	54.6	60.3	HR: 0.78	HR: 0.47	6
			platinum + GEM/NVB/TXT	25	20	48	40.9	95% CI: 0.51–1.2	95% CI: 0.26–0.83	

Abbreviations: EGFR, epidermal growth factor receptor; RR, response rate; PFS, progression-free survival; OS, overall survival; DCR, disease control rate; 1-year SR, 1-year survival rate; RCT, randomized controlled trial; HR, hazard ratio; Pem, pemetrexed; Beva, bevacizumab; GEM, gemcitabine; NVB, navelbine; TXT, taxotere; NA, no assessment.

Qualität der Studien:

- Jadad score obtained was 3. Three retrospective studies were used to assess Newcastle-Ottawa scale and the score obtained was 6. All these articles were considered to be of high quality.

Studienergebnisse:

- The results showed that there was no significant difference between with-pemetrexed arm and non-pemetrexed arm in RR, DCR, and 1-year SR.
- But the with-pemetrexed chemotherapeutic regimens significantly improved the PFS (HR 0.61, 95% CI 0.46–0.81, P=0.0005) and OS (HR 0.62, 95% CI 0.42–0.90, P=0.01).

Anmerkung/Fazit der Autoren

Our meta-analysis showed that compared with nonpemetrexed regimens, the second-line with-pemetrexed chemotherapeutic regimens provided significantly longer PFS and OS in the advanced NSCLC patients who had progressed after first-line treatment with EGFR TKIs. This indicates that the with-pemetrexed chemotherapeutic regimen may be an optimal second-line chemotherapeutic regimen for patients with advanced NSCLC after EGFR-TKI failure.

Yi L et al., 2019 [77].

Efficacy and safety of osimertinib in treating EGFR-mutated advanced NSCLC: A meta-analysis.

Fragestellung

synthesized the results of different studies, including the overall response rate (ORR), disease control rate (DCR), PFS, and AEs, to provide more objective data for the optimal clinical use of osimertinib.

Methodik

Population:

- histologically diagnosed with advanced NSCLC

Intervention:

- osimertinib

Komparator:

- siehe Ergebnisteil

Endpunkte:

- response rate, PFS, and toxicity

Recherche/Suchzeitraum:

- PubMed, Web of Science, and the Cochrane Library on May 4, 2018

Qualitätsbewertung der Studien:

- The Newcastle–Ottawa Scale (NOS) / Cochrane Approach

Ergebnisse

Anzahl eingeschlossener Studien:

- A total of 11 clinical trials (three RCTs, eight single-arm trials) involving 3,086 patients with advanced NSCLC (632 in the three RCTs, 2,454 in the eight single-arm trials)

Charakteristika der Population & Qualität der Studien:

- The eligible studies were published from 2015 to 2017, and the sample size of each study ranged from 60 to 1,217.
- The proportion of female patients varied from 62 to 69% in each study, apart from three studies for which this information was not available.
- In the two studies involving first-line treatment, patients with EGFR-TKIsensitizing mutations accounted for 98.5% (334/339).
- All patients in eight of the nine studies involving secondline treatment or beyond were EGFR T790M-positive. The 80 mg dose of osimertinib was used in 8 of 11 studies.

Table 1. Characteristics of the 11 trials included in the meta-analysis

Study (year)	Country	Trial design	Sub-category	EGFR mutant (%)	Treatment line	Age (years)	Sample size (female %)	Dosage and length of osimertinib	Quality assessment
Mok *et al.* (2017)	China, America, United Kingdom, Korea, Italy	RCT Phase III	AURA3	T790M (100%)	Second	20–90	279 (62%)	80 mg qd, to PD	Cochrane ROB tool: low risk
Soria *et al.* (2018)	America	RCT Phase III	FLAURA	Ex19del/L858R (100%)[2]	First	26–93	279 (64%)	80 mg qd, to PD	Cochrane ROB tool: low risk
Nie *et al.* (2017)	China	RCT Phase III	NR	T790M (100%)	Third	18–80	74 (NR)	80 mg qd, to PD	Cochrane ROB tool: medium risk
Janne *et al.* (2015)	America, China	Single-arm Phase I	AURA	T790M (NR)	≥Second	28–88	163 (NR)	20–240 mg qd, to PD	NOS: 7
Goss *et al.* (2016)	America	Single-arm Phase II	AURA2	T790M (100%)	≥Second	35–88	210 (69%)	80 mg qd, to PD	NOS: 8
Planchard *et al.* (2016)	France	NR	NR	T790M (100%)	≥Second	28–92	350 (67%)	NR	NOS: 6
Marinis *et al.* (2017)	America	Single-arm Phase III b	ASTRIS	T790M (100%)	Second	27–92	1,217 (67%)	80 mg qd, to PD	NOS: 6
Ramalingam *et al.* (2018)	America	Single-arm Phase I	AURA	Ex19del/L858R (92%)[2]	First	38–91	60 (64%)	80 or 160 mg qd, to PD	NOS: 7
Yang *et al.* (2017)	China	Single-arm Phase II (extension)	AURA	T790M (100%)	≥Second	37–89	201 (61%)	80 mg qd, to PD	NOS: 7
Zhou *et al.* (2017)	China	Single-arm Phase II	AURA17	T790M (100%)	≥Second	26–82	171 (69%)	80 mg qd, to PD	NOS: 5
Hochmair *et al.* (2017)	Austria	NR	NR	T790M (100%)	Second	NR	82 (NR)	80 mg qd, to PD	NOS: 4

Abbreviations: EGFR, epidermal growth factor receptor; Ex19del, exon 19 deletion; NOS, Newcastle–Ottawa Scale; NR, not reported; PD, progression disease; RCT, randomized controlled trial; ROB, risk of bias.
[1]T790M (NR)
[2]T790M (8%).

Studienergebnisse:

- Tumor response
  - About 9 of the 11 studies provided data on second-line treatment or beyond, and the combined ORR on EGFR T790M-positive NSCLC patients treated with osimertinib was 58% (95% CI 46–71%), with obvious heterogeneity (I2 = 98%, p < 0.00001).
  - Nine studies included usable data on DCR, and the pooled DCR was 84% (95% CI 71–97%). The combined DCR of the first-line treatment group was 97% (95% CI 95–99%), (I2 =0%, p = 0.85), while the pooled DCR for second-line treatment or beyond was 80% (95% CI 63–98%), (I2 =99%, p < 0.00001).
  - The data on CR, PR, and SD were given by six studies. The pooled CR was 3% (95% CI 1–4%). Subgroup analysis showed that the pooled CR values of the first-line group and the second-line or beyond group were 3% (95% CI 1–4%) (I2 = 0%, P = 0.74) and 3% (95% CI 1–5%), (I2 = 79%, P = 0.003), respectively.
  - The pooled PR was 62% (95% CI 39–84%). Subgroup analysis showed that the pooled PR of the first-line group was 77% (95% CI 72–81%), (I2 =0%, p = 0.51), while that of the second-line or beyond group was 55% (95% CI 27–84%), (I2 = 99%, p < 0.00001)
  - The pooled SD was 15% (95% CI 9–21%). Subgroup analysis showed that the pooled SD of the first-line group was 17% (95% CI 13–21%), (I2 =0%, p = 0.58), while the

pooled SD of the second-line or beyond group was 14% (95% CI 5–22%), (I2 = 94%, p < 0.00001)

- Progression-free survival
  - The pooled median PFS was 13.06 months (95% CI 10.19– 15.93 months). Subgroup analysis suggested that the pooled median PFS of patients with EGFR-TKI-sensitizing mutations treated with osimertinib was 19.17 months (95% CI 16.88– 21.45 months), (I2 =0%, p = 0.61). The pooled median PFS of EGFR T790M-positive patients treated with osimertinib was 10.58months (95% CI 9.20–11.97months), (I2 =57%, p =0.07). The PFS-6 and PFS-12 were analyzed separately based on the available data from five studies. The pooled PFS-6 was 71% (95% CI 60–82%).
  - Subgroup analysis indicated that the pooled PFS-6 of the first-line group was 83% (95% CI 80–87%), with small heterogeneity (I2 =0%, p = 0.97). The combined PFS-6 of the second-line or beyond group was 63% (95% CI 58–69%), with significant heterogeneity (I2 = 55%, p = 0.11).
  - The combined PFS-12 was 45% (95% CI 26–64%). The pooled PFS-12 of the second-line or beyond group was 32% (95% CI 17–47%), with significant heterogeneity (I2 = 95%, p <0.00001).
- Toxicities
  - The highest-incidence AE among AEs of all grades was diarrhea, and the combined rate from a total of six studies (579/1,303) was 44% (95% CI 36–52%). The second was rash, and the pooled rate from a total of six studies (556/1,303) was 42% (95% CI 33–51%). Aggregated analysis based on AEs of grade ≥III indicated that the highest incidence was a prolonged QT interval on ECG, and the combined rate was 2% (95% CI 1–3%), with two studies included in the analysis (10/489). The second was neutropenia, and the combined rate was 2% (95% CI 1–3%), with two studies (9/489) included in the analysis. Furthermore, the pooled rate of diarrhea with grade ≥III was 1% (95% CI 0–1%). Five studies (12/1,132) provided data on rash with grade ≥III, and the pooled rate was 1% (95% CI 0–1%).

Anmerkung/Fazit der Autoren

The results of our study indicate that most patients with advanced NSCLC harboring T790M mutations after earlier- generation EGFR-TKI therapy would respond to osimertinib treatment or exhibit disease control. Osimertinib has impressive antitumor activity in treatment-naïve advanced NSCLC harboring EGFR-TKI-sensitizing mutations. Additionally, the incidences of AEs such as diarrhea and rash were lower than earlier-generation EGFR-TKIs, and there were no prominent serious AEs. Thus, osimertinib is a drug with favorable efficacy as well as tolerable AEs. Further clinical trials comparing firstline osimertinib treatment with the sequential use of earliergeneration EGFR-TKIs and osimertinib are warranted to update this meta-analysis and provide insight for optimizing the clinical use of osimertinib.

Almutairi AR et al., 2019 [1].

Comparative efficacy and safety of immunotherapies targeting the PD-1/PD-L1 pathway for previously treated advanced non-small cell lung cancer: A Bayesian network meta-analysis.

Fragestellung

A network meta-analysis was conducted to compare efficacy/safety of PD-1/PD-L1 inhibitors.

Methodik

Population:

- Previously treated advanced NSCLC

Intervention/Komparator:

- Netwerkmetaanalyse: immune checkpoint inhibitors that target PD-1 (nivolumab, pembrolizumab) and its ligand PD-L1 (atezolizumab) in previously treated advanced NSCLC

Endpunkte:

- overall survival (OS), progression- free survival (PFS), objective response rate (ORR), adverse events

Recherche/Suchzeitraum:

- Medline/PubMed, Cochrane Library, and Embase from inception through 31 May 2018

Qualitätsbewertung der Studien:

- Cochrane Collaboration Risk of Bias Assessment tool

Ergebnisse

Anzahl eingeschlossener Studien:

- five trials
- all had docetaxel as the comparator arm and included 3024 patients with advanced NSCLC previously treated with chemotherapy
- The majority of patients had non-squamous NSCLC type, wild type of EGFR, no anaplastic lymphoma kinase (ALK) translocation, PD-L1 expression measured by tumor proportion score (TPS) less than 50%, ECOG performance status score of 1, and one prior line of systemic treatment. Three additional articles provided 2-year and 3-year updates for two nivolumab trials (Checkmate-017, Checkmate-057) (Horn et al., 2017; Vokes et al., 2018) and a 2-year update for an atezolizumab trial (OAK) (Fehrenbacher et al., 2018).

Qualität der Studien:

- All five trials being open-label, they were all considered at high risk of bias in performance and detection. Two studies were rated at high risk of selection bias because they utilized unmasked allocation methods

Studienergebnisse:

- with docetaxel as common comparator there were no differences in OS and PFS between PD-1/PD-L1 inhibitors.
- Pembrolizumab (odds ratio (OR)=2.22, 95%CrI=1.28–3.70) and nivolumab (OR=1.92, 95%CrI=1.15–3.23) had higher ORRs than atezolizumab and at PD-L1 expression ≥50% and ≥1%.
- Probabilistically, pembrolizumab ranked first in OS and ORR, and in OS sub-analyses for adenocarcinoma, EGFR-mutant, ECOG-score-1, male, and age<65 years.
- Nivolumab ranked first in PFS, and in OS sub-analyses for squamous-cell disease, EGFR-wild-type, and ECOG-score-0.
- Pembrolizumab and nivolumab ranked the best option for most of adverse events.

Anmerkung/Fazit der Autoren

In conclusion, pembrolizumab and nivolumab prevailed in overall OS and ORR benefits over atezolizumab in our overall network metaanalysis. However, our analyses also suggest that clinical (NSCLC type, ECOG status), genomic (EGFR, PD-L1 expression), and demographic (gender, age) patient characteristics, as well as safety and tolerance, should be considered in treatment decision-making about PD-1 and PDL1 checkpoint inhibitors in previously-treated patients with advanced NSCLC. Real-world evidence is necessary to complement trial evidence under conditions of greater heterogeneity in patients and treatment settings.

Kommentar zum Review:

- Siehe auch: Ando, K. et al., 2020 [3]

Connock M et al., 2019 [14].

Comparative survival benefit of currently licensed second or third line treatments for epidermal growth factor receptor (EGFR) and anaplastic lymphoma kinase (ALK) negative advanced or metastatic non-small cell lung cancer: a systematic review and secondary analysis of trials.

Fragestellung

With the aim of gauging patient survival benefit, we conducted a systematic review of randomised controlled trials (RCT) and compared survival outcomes from available licensed treatments for patients with advanced/metastatic NSCLC.

Methodik

Population:

- adult patients with advanced or metastatic (IIIB and/or IV) NSCLC with non-squamous (adenocarcinoma, large cell) or squamous histology who had experienced failure to prior first line chemotherapy (i.e., those receiving second line treatment and beyond); had either predominantly negative or 100% negative expression of anaplastic lymphoma kinase (ALK); had either predominantly negative or 100% negative expression of epidermal growth factor receptor (EGFR).

Intervention/Komparator:

- Docetaxel (DOC), Pemetrexed (PEM), Ramucirumab plus docetaxel (RAM + DOC), Erlotinib (ERL), Nintedanib plus docetaxel (NIN +DOC), Afatinib (AFA), Nivolumab (NIVO), and Pembrolizumab (PEMBRO), Atezolizumab (ATEZO)

Endpunkte:

- overall survival or progression-free survival

Recherche/Suchzeitraum:

- MEDLINE; EMBASE; Web of Science) from January, 2000 up to July, 2017

Qualitätsbewertung der Studien:

- Cochrane approach

Ergebnisse

Anzahl eingeschlossener Studien:

- 11 primary RCT studies with 7581 participants
- The 11 RCTs compared nine different drugs with the majority of comparisons were against DOC

Charakteristika der Population:

- Study sample size ranged from 208 to 1314 patients; studies included predominantly people with stage IV NSCLC and performance status 1

Qualität der Studien:

- Nine studies were considered as high-risk of bias due to the lack of blinding of participants and personnel. The five RCTs evaluating checkpoint inhibitors versus DOC were open-label and were considered as high-risk due to performance bias. LUME-LUNG-1 was rated at low risk of bias for all the key domains. Only HORG and TAILOR [18, 22] had public funding, so the remaining studies were rated as high-risk due to “other source bias”.

Studienergebnisse:

- patients regardless of histology groups, targeted drugs (ramucirumab and nintedanib) yielded small overall survival gains of < 2.5 months over docetaxel, erlotinib provided no benefit, while immunotherapies (atezolizumab and pembrolizumab) delivered 5 to 6 months gain.
- Studies with patients stratified by histology confirmed the apparent superiority of immunotherapy (nivolumab and atezolizumab) over targeted treatments (ramucirumab, nintedanib, afatinib) providing between about 4 to 8 months OS gain over docetaxel.
- In network analysis immunotherapies consistently ranked higher than alternatives irrespective of population histology and outcome measure.

Table 2 Mean survival (months) estimates from studies of patients with mixed histologies

TRIAL	Outcome	Intervention (*n*)	Control (*n*)	Intervention minus control
REVEL		Ram + Doc (628)	Plac + Doc (625)	
RMS [95% CI]	to 19 mos	11.00 [10.47–11.52]	10.01 [9.48–10.55]	0.99 [0.24–1.73]
Mean total OS	*R_mSext*	15.02	14.31	0.71
Mean total OS	Weibull [95% CI]	14.87 [13.40–16.57]	12.99 [11.71–14.46]	1.88 [−0.22–3.98]
Mean total OS	Weibull formula	14.87	12.98	1.89
LUME LUNG-1		Nin + Doc (655)	Plac + Doc (659)	
RMS [95% CI]	to 19 mos	10.85 [10.35–11.36]	10.38 [9.88–10.87]	0.48 [−0.23–1.18]
Mean total OS	*R_mSext*	14.38	13.57	0.82
Mean total OS	Weibull [95% CI]	14.08 [12.97–15.31]	13.21 [12.17–14.35]	0.87 [−0.73–2.47]
Mean total OS	Weibull formula	14.08	13.20	0.88
POPLAR		Atezolizumab (144)	Docetaxel (143)	
RMS [95% CI]	to 19 mos	11.84 [10.71–12.97]	10.39 [9.33–11.46]	1.45 [−0.11–3.00]
Mean total OS	*R_mSext*	20.76	13.00	7.76
Mean total OS	Weibull [95% CI]	17.89 [13.69–24.31]	12.15 [10.02–15.05]	5.74 [−0.135–11.61]
Mean total OS	Weibull formula	17.93	12.15	5.78
OAK		Atezolizumab (425)	Docetaxel (425)	
RMS [95% CI]	to 19 mos	12.31 [11.65–12.96]	10.68 [10.03–11.33]	1.62 [0.70–2.55]
Mean total OS	*R_mSext*	20.76	12.24	8.52
Mean total OS	Weibull [95% CI]	18.93 [16.54–21.81]	13.59 [12.11–15.32]	5.34 [2.25–8.43]
Mean total OS	Weibull formula	18.98	13.34	5.64
KEYNOTE-010		Pembrolizumab (344)	Docetaxel (343)	
RMS [95% CI]	to 19 mos	11.40 [10.62–12.19]	9.82 [9.05–10.59]	1.58 [0.48–2.68]
Mean total OS	*R_mSext*	20.64	12.74	7.89
Mean total OS	Weibull [95% CI]	16.14 [13.51–19.68]	11.10 [9.68–12.88]	5.04 [1.57–8.52]
Mean total OS	Weibull formula	16.43	10.42	6.01
TAILOR		Erlotinib (109)	Docetaxel (110)	
RMS [95% CI]	to 19 mos	7.66 [6.15–8.81]	9.30 [8.02–10.57]	−1.64 [−3.36–0.08]
Mean total OS	*R_mSext*	8.90	11.16	−2.26
Mean total OS	Weibull [95% CI]	8.67 [6.99–10.86]	11.11 [8.80–14.25]	−2.44 [−5.78–0.90]
Mean total OS	Weibull formula	8.67	11.10	−2.43
HORG		Erlotinib (166)	Pemetrexed (166)	
RMS [95% CI]	to 19 mos	10.18 [9.10–11.26]	9.85 [8.73–10.97]	0.33 [−1.23–1.88]
Mean total OS	*R_mSext*	15.33	14.42	0.91
Mean total OS	Weibull [95% CI]	15.02 [11.94–18.94]	13.86 [11.21–17.35]	1.16 [−3.5–5.82]
Mean total OS	Weibull formula	15.12	13.86	1.25
Hanna		Pemetrexed (283)	Docetaxel (288)	
RMS [95% CI]	to 19 mos	8.80 [8.10–9.50]	8.70 [7.96–9.44]	0.10 [−0.92–1.12]
Mean total OS	*R_mSext*	9.64	8.83	0.81
Mean total OS	Weibull [95% CI]	9.34 [8.30–10.57]	9.35 [8.20–10.74]	−0.01 [−1.71–1.69]
Mean total OS	Weibull formula	9.34	9.34	−0.01

OS overall survival, *RMS* restricted mean survival; *R_mSext* restricted mean survival exponentially extended from the end of the KM plot, *Mean total OS Weibull formula* mean OS estimated from Weibull model parameters using the formula published by Davies et al. [13]

Table 3 Estimates of mean survival (months) based on studies of patients with squamous histology

TRIAL	Outcome	Intervention (n)	Control (n)	Intervention minus control
REVEL		Ram + Doc (157)	Plac + Doc (171)	
RMS [95% CI]	to 24 mos	10.89 [9.65–12.13]	9.92 [8.75–11.10]	0.96 [−0.75–2.67]
Mean total OS	*R_mSext*	12.04	11.87	0.17
Mean total OS	Weibull [95% CI]	11.91 [10.01–14.29]	11.08 [9.31–13.29]	0.83 [−2.09–3.75]
Mean total OS	Weibull formula	11.90	11.07	0.83
Lux-lung 8		Afatanib (398)	Erlotinib (397)	
RMS [95% CI]	to 24 mos	10.48 [9.67–11.28]	8.95 [8.23–9.67]	1.52 [0.44–2.61]
Mean total OS	*R_mSext*	10.98	9.87	1.11
Mean total OS	Weibull [95% CI]	11.46 [10.19–12.94]	9.32 [8.39–10.37]	2.14 [0.45–3.83]
Mean total OS	Weibull formula	11.35	9.41	1.94
LUME LUNG-1		Nin + Doc (276)	Docetaxel (279)	
RMS [95% CI]	to 24 mos	10.65 [9.79–11.52]	10.14 [9.26–11.02]	0.51 [−0.72–1.75]
Mean total OS	*R_mSext*	11.76	12.19	−0.43
Mean total OS	Weibull [95% CI]	11.67 [10.42–13.07]	11.73 [10.31–13.38]	−0.06 [−2.09–1.97]
Mean total OS	Weibull formula	11.67	11.72	−0.06
Checkmate_017		Nivolumab (135)	Docetaxel (137)	
RMS [95% CI]	to 24 mos	11.94 [10.48–13.39]	8.33 [7.15–9.52]	3.61 [1.73–5.48]
Mean total OS	*R_mSext*	17.14	9.76	7.37
Mean total OS	Weibull [95% CI]	15.92 [12.79–19.94]	9.41 [7.78–11.41]	6.51 [2.50–10.52]
Mean total OS	Weibull formula	15.95	9.40	6.55
OAK		Atezolizumab (112)	Docetaxel (110)	
RMS [95% CI]	to 24 mos	11.99 [10.37–13.62]	9.73 [8.31–11.14]	2.27 [0.11–4.42]
Mean total OS	*R_mSext*	14.80	10.41	4.40
Mean total OS	Weibull [95% CI]	14.34 [11.31–18.58]	10.26 [8.45–12.52]	4.08 [−0.09–8.25]
Mean total OS	Weibull formula	14.34	10.25	4.09
Hanna		Pemetrexed (78)	Docetaxel (94)	
RMS [95% CI]	to 24 mos	NOT REACHED		
Mean total OS	*R_mSext*	7.40	8.83	−1.43 [−0.75–2.67]
Mean total OS	Weibull [95% CI]	7.22 [5.95–8.75]	8.83 [7.32–10.59]	− 1.61 [−5.84–2.62]
Mean total OS	Weibull formula	7.22	8.82	−1.61

OS overall survival, *RMS* restricted mean survival, *R_mSext* restricted mean survival exponentially extended from the end of the KM plot, *Mean total OS Weibull formula* mean OS estimated from Weibull model parameters using the formula published by Davies et al. [13]

Table 4 Estimates of mean survival (months) based on studies of patients with non- squamous histology

TRIAL	Outcome	Intervention (n)	Control (n)	Intervention minus control
REVEL		Ram + Doc (465)	Plac + Doc (447)	
RMS [95% CI]	to 27 mos	13.50 [12.60–14.40]	12.10 [11.20–13.00]	1.39 [0.12–2.67]
Mean total OS	*R_mSext*	18.18	14.88	3.31
Mean total OS	Weibull [95% CI]	15.98 [14.16–18.15]	13.56 [12.00–15.41]	2.42 [−0.20–5.04]
Mean total OS	Weibull formula	16.98	13.56	2.43
LUME LUNG-1		Nin + Doc (322)	Plac + Doc (336)	
RMS [95% CI]	to 27 mos	14.18 [13.14–15.21]	12.62 [11.65–13.59]	1.55 [0.14–2.97]
Mean total OS	*R_mSext*	17.84	14.90	2.94
Mean total OS	Weibull [95% CI]	17.29 [15.24–19.68]	14.45 [12.88–16.26]	2.84 [0.05–5.63]
Mean total OS	Weibull formula	17.30	14.45	2.85
Checkmate_057		Nivolumab (292)	Docetaxel (290)	
RMS [95% CI]	to 27 mos	13.93 [12.77–15.09]	11.79 [10.78–12.80]	2.14 [0.61–3.68]
Mean total OS	*R_mSext*	18.29	14.72	3.57
Mean total OS	Weibull [95% CI]	18.04 [15.48–21.07]	13.32 [11.73–15.18]	4.72 [1.44–8.00]
Mean total OS	Weibull formula	18.13	13.31	4.82
OAK		Atezolizumab (313)	Docetaxel (315)	
RMS [95% CI]	to 27 mos	15.62 [14.5–16.72]	13.07 [11.99–14.15]	2.55 [1.00–4.09]
Mean total OS	*R_mSext*	23.76	13.09	10.67
Mean total OS	Weibull [95% CI]	20.70 [17.64–24.51]	15.02 [13.05–17.43]	5.68 [1.61–9.75]
Mean total OS	Weibull formula	20.79	15.01	5.77
Hanna		Pemetrexed (205)	Docetaxel (194)	
RMS [95% CI]	to 27 mos	na	na	na
Mean total OS	*R_mSext*	12.54	10.72	1.82
Mean total OS	Weibull [95% CI]	11.88 [10.27–13.82]	10.53 [9.11–12.20]	1.35 [−1.00–3.70]
Mean total OS	Weibull formula	11.87	10.52	1.35

OS overall survival, *RMS* restricted mean survival, *R_mSext* restricted mean survival exponentially extended from the end of the KM plot, *Mean total OS Weibull formula* mean OS estimated from Weibull model parameters using the formula published by Davies et al. [13]

Anmerkung/Fazit der Autoren

Based on our review, NIVO, PEMBRO and ATEZO exhibit superior benefit compared to other licensed drugs indicated for people with non-specific late stage NSCLC. The patient survival gains over chemotherapy from these drugs appear to be fairly substantial in the context of an expected average survival with DOC of less than 1 year for people with squamous histology and a little over a year for those with non-squamous histology.

Tartarone A et al., 2019 [62].

Anti-PD-1 versus anti-PD-L1 therapy in patients with pretreated advanced non-small-cell lung cancer: a meta-analysis.

Fragestellung

The aim of this meta-analysis is an indirect comparison between anti-PD-1 and anti-PD-L1 inhibitors in terms of efficacy and tolerability in pretreated patients with advanced NSCLC.

Methodik

Population:

- patients with NSCLC who progress after a first-line therapy

Intervention:

- immune checkpoint agent (anti-PD-1 or anti-PD-L1)

Komparator:

- docetaxel

Endpunkte:

- OS, PFS, AEs

Recherche/Suchzeitraum:

- PubMed, Embase and Web of Sciences up to 30 September 2018

Qualitätsbewertung der Studien:

- Jadad Scale

Ergebnisse

Anzahl eingeschlossener Studien:

- Seven studies were included in the analysis
- A total of 4664 patients were analyzed, among these 2735 cases in the experimental group and 1929 cases in the control group.
- All the studies were Phase III (6/7) or Phase II RCTs (1/7).

Charakteristika der Population:

Table 1. Main characteristics of the included studies.

Clinical trials	Experimental arm	Control arm	Primary end points	Number of patients (experimental/docetaxel)	Patient selection based on PD-L1 status	Ref.
Javelin	Avelumab	Docetaxel	OS	396/396	No	[12]
OAK	Atezolizumab	Docetaxel	OS	425/425	No	[7]
POPLAR	Atezolizumab	Docetaxel	OS	144/143	No	[11]
CheckMate 017	Nivolumab	Docetaxel	OS	135/137	No	[4]
CheckMate 057	Nivolumab	Docetaxel	OS	292/290	No	[5]
KEYNOTE 010	Pembrolizumab	Docetaxel	OS, PFS	345; 346/343	TPS ≥1%	[6]
CheckMate 078	Nivolumab	Docetaxel	OS	338/166	No	[25]

OS: Overall survival; PFS: Progression-free survival; TPS: Tumor proportion score.

Qualität der Studien:

- The median Jadad score was five, confirming a high level of quality.

Studienergebnisse:

- Considering the overall survival ICIs showed very robust efficacy over docetaxel, while in terms of progression-free survival the therapy with ICIs is slightly favored.
- Anti-PD-1 gives a more significant benefit than anti-PD-L1; however, excluding the KEYNOTE 010 trial that enrolled only PD-L1-positive patients, the subgroup difference remains only in terms of progression-free survival.

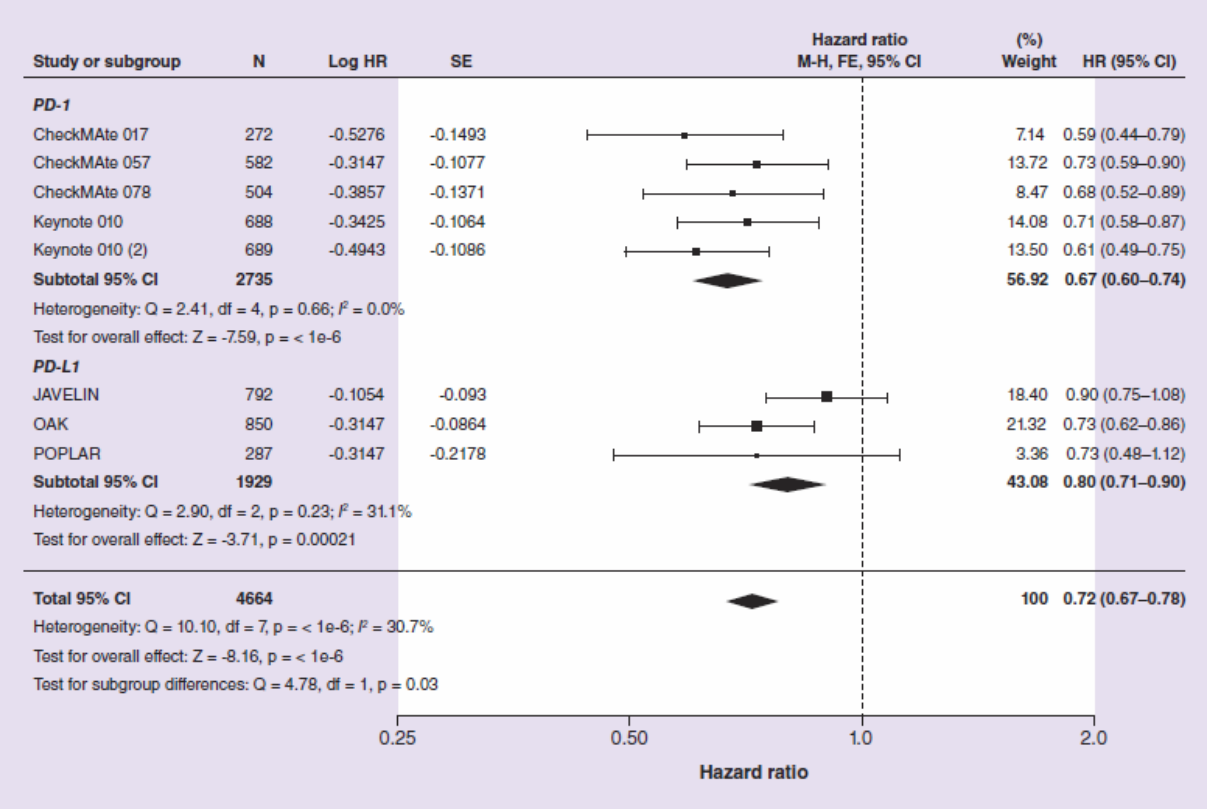


Figure 2. Forest plots of hazard ratios for overall survival comparing anti PD-1 and anti PD-L1 to docetaxel in all the collected non-small-cell lung cancer trials.
HR: Hazard ratio; SE: Standard error.

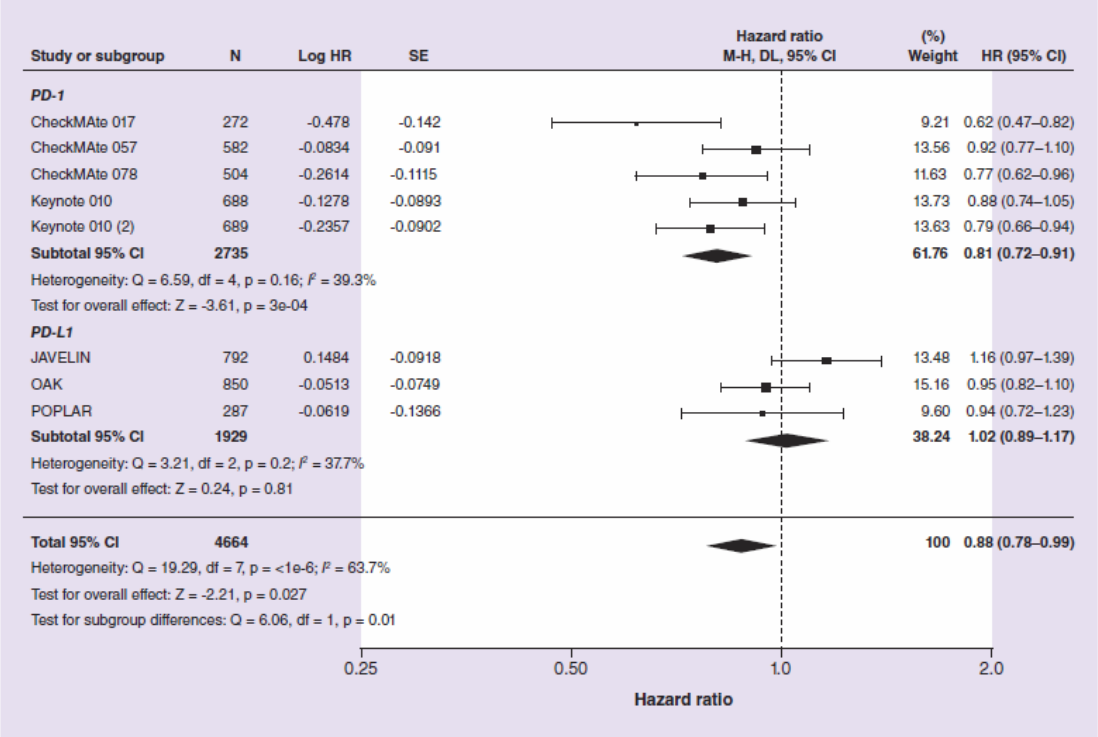


Figure 3. Forest plots of hazard ratios for progression free survival comparing anti PD-1 and anti PD-L1 to docetaxel in all the collected non-small-cell lung cancer trials.
HR: Hazard ratio; SE: Standard error.

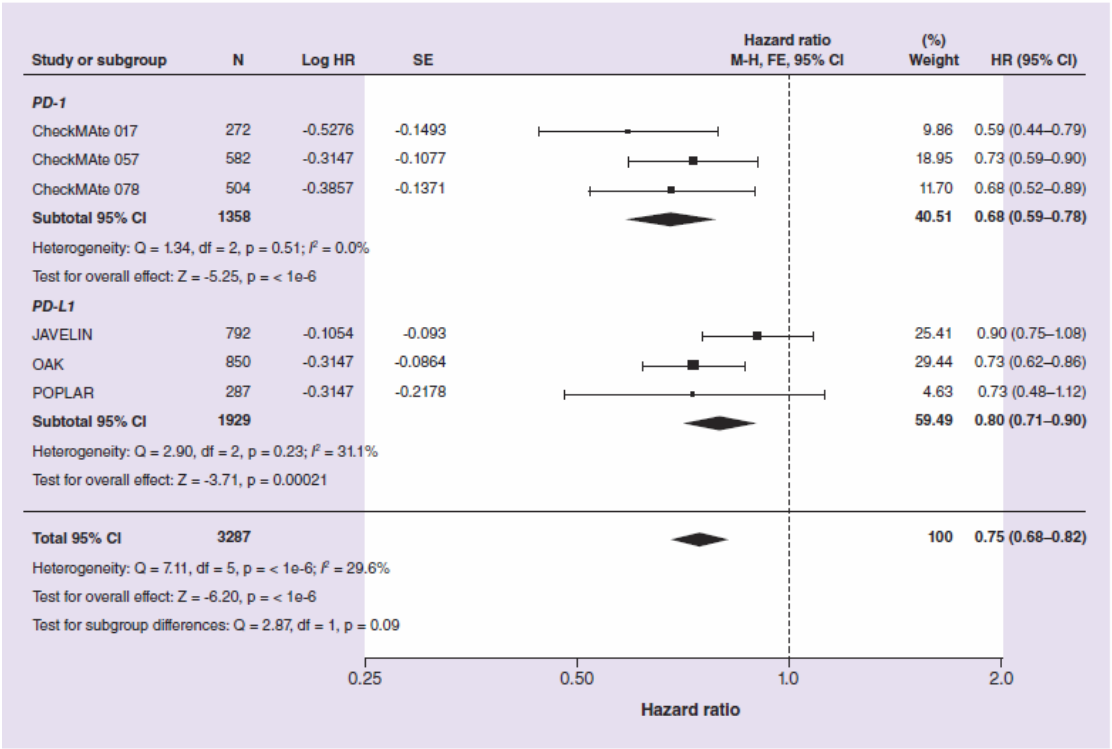


Figure 4. Forest plots of hazard ratios for overall survival comparing anti PD-1 and anti PD-L1 to docetaxel in NSCLC in all trials but without the KEY010 trial that enrolled only PD-L1-positive patients.
HR: Hazard ratio; SE: Standard error.

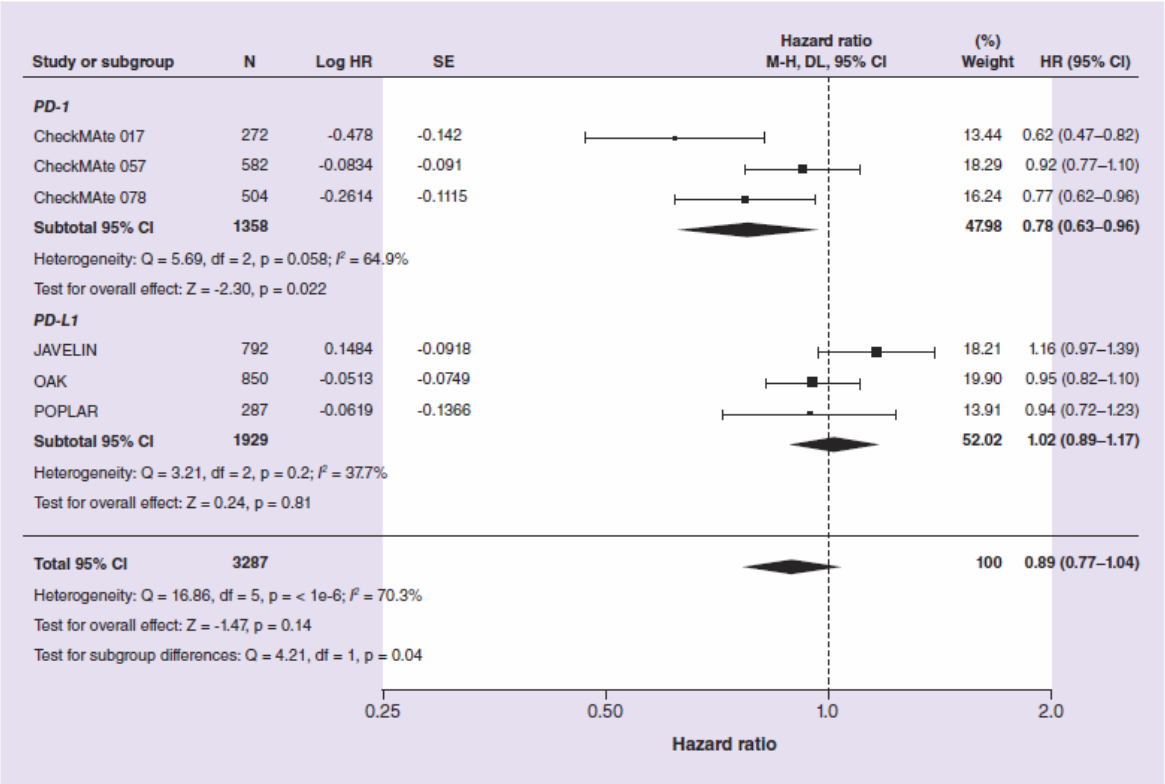


Figure 5. Forest plots of hazard ratios for progression free survival comparing anti PD-1 and anti PD-L1 to docetaxel in non-small-cell lung cancer in all trials but without the KEY010 trial that enrolled only PD-L1-positive patients.
HR: Hazard ratio; SE: Standard error.

Anmerkung/Fazit der Autoren

The advent in clinical practice of ICIs determined a major breakthrough in the battle against solid tumors, including NSCLC. At present, in view of the results obtained in large Phase III studies, two anti-PD-1 (nivolumab and pembrolizumab) and one anti-PD-L1 (atezolizumab) can be used interchangeably in pretreated NSCLC patients. Considering that so far, no published trials have compared anti-PD-1 to anti-PD-L1 therapies, some differences between these agents could emerge from the analysis of the data available in the literature. Our meta-analysis, based on seven studies including more than 4000 patients, as well as confirming the superiority in terms of efficacy and tolerability of ICIs versus docetaxel, would indicate a slight benefit from anti-PD-1 than from anti-PD-L1 inhibitors, always keeping in mind the possible biases of this indirect comparison.

Kommentar zum Review:

- Siehe auch: Khunger, M. et al., 2018 [31] & Tan, P. S. et al., 2018 [61]

Wan N et al., 2019 [65].

A pooled meta-analysis of PD-1/L1 inhibitors incorporation therapy for advanced non-small cell lung cancer.

Fragestellung

This meta-analysis summarized recent developments in four combination regimens of PD-1/L1 inhibitors.

Methodik

Population:

- advanced NSCLC patients

Intervention/Komparator:

- anti-PD1/L1 antibody with CTLA-4 inhibitors/chemotherapy/EGFR-TKIs/IDO inhibitors

Endpunkte:

- ORR, PFS, OS and safety

Recherche/Suchzeitraum:

- PubMed, the Cochrane Library and the Embase database up to July 2018

Qualitätsbewertung der Studien:

- Risks of bias within studies without comparable arms were assessed using the methodological item for non-randomized studies (MINORS) / Cochrane approach

Ergebnisse

Anzahl eingeschlossener Studien:

- Seventeen trials / 1,222 NSCLC patients
- Six studies involved research into the combination therapy of anti-PD-1/L1 antibody and chemotherapy involving 700 patients. Four studies reported the combination therapy of anti-PD-1/L1 antibody with EGFR-TKIs, and 95 patients were enrolled. One study reported the combination of pembrolizumab with epacadostat involving 43 patients.

Qualität der Studien:

Table S1 Bias risk evaluation of the studies without comparable arms in the meta-analysis

Reference	A clearly stated aim	Inclusion of consecutive patients	Prospective collection of data	Endpoints appropriate to the aim of the study	Unbiased assessment of the study endpoint	Follow-up period appropriate to the aim of the study	Loss to follow up less than 5%	Prospective calculation of the study size	Score
Patnaik [2015][1]	1	2	0	2	0	0	1	1	7
Gubens [2016][2]	1	2	0	2	0	2	2	1	10
Antonia [2014][3]	1	2	0	2	0	2	2	1	10
Hellmann [2017][4]	2	2	2	2	0	2	2	2	14
Antonia [2016][5]	2	2	1	2	0	2	2	2	13
Gadgeel [2016][6]	1	2	0	2	0	2	2	1	10
Kanda [2016][7]	2	2	2	2	0	2	2	1	13
Liu [2015][8]	1	2	0	2	0	0	2	1	8
Rizvi [2016][9]	2	2	2	2	0	2	2	2	14
Gettinger [2014][10]	1	2	0	2	0	2	2	1	10
Gibbons [2016][11]	1	2	0	2	0	0	2	1	8
Ma [2016][12]	1	2	0	2	0	2	2	2	11
Ahn [2016][13]	2	2	0	2	0	0	2	1	9
Gangadhar [2017][14]	1	1	0	2	0	0	2	1	7

Table S2 Bias risk evaluation of the randomized controlled trials included in the meta-analysis

Reference	Random sequence generation	Allocation concealment	Blinding of partici-pants and personnel	Blinding of out-come assessment	Incomplete outcome data	Selective reporting	Other sources of bias
Hellmann [2018][15]	Unclear risk	Unclear risk	Low risk	Low risk	Low risk	High risk	Unclear risk
Langer [2016][16]	Low risk	High risk	High risk	Low risk	Low risk	Low risk	Unclear risk
Gandhi [2018][17]	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	unclear risk

Studienergebnisse:

- Pooled ORR of combination therapy for first/second or more line therapy

- Second-Line Therapy: A total of 5 eligible trials24,27,28,34,39 involving 125 patients were included to evaluate the efficacy of anti-PD -1/L1 antibody combination therapy in the second or more line setting for NSCLC patients, and the ORR ranged from 17% to 55%. The combined ORR was 32.0% (95% CI: 23–42%) (Figure 4B). The pooled ORR of anti-PD-1/L1 antibody combination therapy with anti-CTLA-4 antibody/chemotherapy/EGFR-TKIs/IDO inhibitors in the second or more line setting for NSCLC patients was 36% (95% CI: 8–65%), 17% (95% CI: −13–46%), 39% (95% CI:19–59%) and 35% (95% CI:20–50%), respectively.

- The pooled 6-month progression-free survival rate (6m PFSr) and 1-year overall survival rate (1y OSr) for combination therapy of PD-1/L1 inhibitors with CTLA-4 inhibitors or chemotherapy were 35% or 65% (6m PFSr) and 31% or 70% (1y OSr) respectively. Anti-PD-1/L1 drugs combined with anti-CTLA-4 drugs exhibited a more potent efficacy on PD-L1 positive patients (OR=0.33, 95%CI: 0.12–0.88). This trend was not observed in patients receiving combination therapy of PD-1/L1 inhibitors with chemotherapy (OR=0.96, 95%CI: 0.51–1.78).

Anmerkung/Fazit der Autoren

In summary, the four combination regimens involving PD-1/L1 inhibitors with CTLA-4 inhibitors, chemotherapy, EGFR-TKIs and IDO inhibitors were potential treatment strategies and well tolerated for NSCLC patients. Further, the therapy lines and PD-L1 expression status were correlated with treatment efficacy.

Kommentare zum Review

- Gemischte Population u.a. hinsichtlich Linie und advanced/metastasiert
- Siehe auch Shen, K. et al., 2018 [57] & Zhang, H. et al., 2018 [79]

Zhang L et al., 2020 [80].

The Effect of Next-Generation TKI in Non-Small Cell Lung Cancer after Failure of First-Line Treatment: a Meta-Analysis.

Fragestellung

We performed this meta-analysis by including relevant trials which have been designed to determine its efficacy and toxicity with EGFR TKIs and focus primarily on whether next-generation EGFR-TKIs was superior in pre-treated NSCLC with first-line EGFR-TKI therapy.

Methodik

Population:

- Patient with treatment-refractory advanced NSCLC after failure of first-generation EGFR-TKIs

Intervention/Komparator:

- next-generation EGFR-TKIs vs. chemotherapy

Endpunkte:

- overall survival, progression-free survival, tumor response, toxicity

Recherche/Suchzeitraum:

- Pubmed, Embase, and Cochrane Database of Systematic Reviews from their inception to September, 2018

Qualitätsbewertung der Studien:

- Cochrane approach

Ergebnisse

Anzahl eingeschlossener Studien:

- three RCTs

Charakteristika der Population:

The Effect of Next-Generation TKI in Non-Small Cell Lung Cancer after Failure of First-Line Treatment: a...

Table 1 Detailed description of included trails

Study	Year	Treatment regimen		Patients number		Age(years)	
		Study arm	Comparative arm	Study arm	Comparative arm	Study arm	Comparative arm
V.A. Miller	2012	afatinib plus best supportive care	Placebo plus best supportive care	390	195	58	59
T.S. Mok	2016	osimertinib	intravenous pemetrexed plus either carboplatin or cisplatin	279	140	62	63
Keke Nie	2018	osimertinib	docetaxel plus bevacizumab	74	73	49.4	48.6

Qualität der Studien:

- keine weiteren Angaben über Studiendesign hinaus

Studienergebnisse:

- PFS: benefit was found between next-generation EGFR-TKIs and chemotherapy (OR = 0.34,95%CI = 0.29–0.40, P < 0.00001).
- OS: no significant statistical difference of OS when comparing the two groups
- ORR: there is advantage between two groups (OR = 10.48,95%CI = 3.87–28.34, P < 0.00001)
- AEs: diarrhoea, rash/acne, nausea, vomiting, and anemia were included → data did not reach a statistically significant level (P>0.05).
- DCR: data did show advantage in the next generation EGFR-TKIs groups (OR = 6.03,95%CI = 4.41–8.25, P < 0.00001)

Anmerkung/Fazit der Autoren

Acquired resistance refers to disease progression after response to first-generation EGFR-TKI is complicated; and the survival result is gloomy if resistance occurs. Our data showed that, next-generation EGFR-TKI could prolong PFS and better response rate in NSCLC patients after failed to firstgeneration EGFR-TKI.

Relevant clinical studies have been developed to study the paradigm of ''personalized'' medicine in the treatment of NSCLC, at least in a subset of patients with oncogenic driven; examples include mutations in the EGFR gene. From an efficacy standpoint, further trials into bio- markers that will benefit patients by subtype, which can be instructive in driving treatment decisions, while conferring with manageable adverse events. It is important to consider the risk of AEs when choosing treatment, particularly in patients with underlying immune disfunction.

Kommentar zum Review:

Siehe auch: Qi, Y. T. et al., 2020 [53] & Lee, H. J. et al., 2021 [34]

Armoiry X et al., 2018 [4].

Comparative efficacy and safety of licensed treatments for previously treated non-small cell lung cancer: A systematic review and network meta-analysis

Fragestellung

This systematic review with network meta-analysis compared the efficacy and safety of currently licensed second-line treatments in patients with late stage non-small cell lung cancer (NSCLC).

Methodik

Population:

- advanced/metastatic NSCLC (IIIB or IV) NSCLC of squamous, non-squamous, or mixed histology who experienced failure to prior first-line chemotherapy → Hinweis: Study populations had to have negative or predominantly negative expressions of ALK and EGFR

Intervention/Komparator:

- Docetaxel (DOC), Pemetrexed (PEM), Ramucirumab plus docetaxel (RAM + DOC), Erlotinib (ERL), Nintedanib plus docetaxel (NINTE + DOC), Afatinib (AFA), Nivolumab (NIVO), Pembrolizumab (PEMBRO), and Atezolizumab (ATEZO)

Endpunkte:

- overall survival (OS), progression-free survival (PFS), and drug-related grade 3±5 adverse-events (AEs)

Recherche/Suchzeitraum:

- from January, 2000 to July, 2017

Qualitätsbewertung der Studien:

- Cochrane RoB tool

Ergebnisse

Anzahl eingeschlossener Studien:

- 11 RCTs (7,581 participants) comparing nine drugs
- Six RCTs included only people receiving second-line treatment, while four others included those receiving both second- and third-lines

Charakteristika der Population:

- All studies included predominantly people with stage IV NSCLC and performance status 1.

Qualität der Studien:

- Nine studies were considered at high risk of bias for PFS and OS (due to the lack of blinding of participants and personnel). The five RCTs evaluating immunotherapies were

open-label and therefore were rated as high-risk on the domain of performance bias. The only study at low RoB for all the domains was LUME-LUNG 1. The majority of studies were rated as high-risk on `other domains of bias' due to being funded by industry.

Studienergebnisse:

- Overall survival:
  - Four drugs (NIVO, ATEZO, PEMBRO, and RAMU+DOC) showed a significant improvement on OS compared to DOC in head-to-head comparisons.

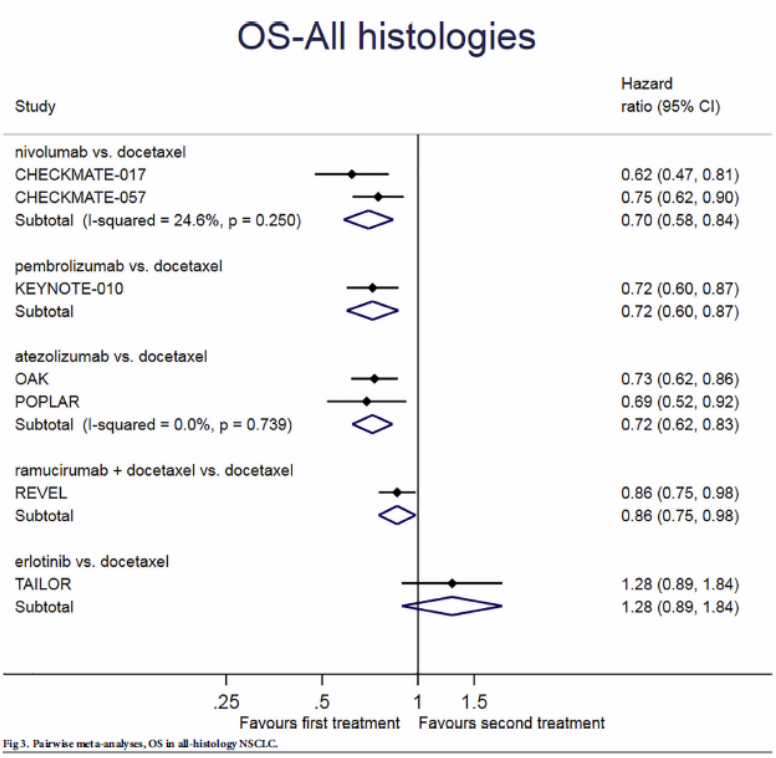


Fig 3. Pairwise meta-analyses, OS in all-histology NSCLC.

  - Indirect comparisons of drugs superior to DOC showed greater SUCRA values for the checkpoint inhibitors NIVO (0.82), ATEZO (0.77), PEMBRO (0.77) than for RAMU+DOC (0.42). There was no significant difference in OS across three highest ranking drugs (HR = 0.98, 95% CI 0.79, 1.21 for NIVO vs ATEZO; HR = 0.98, 95% CI 0.77, 1.25 for NIVO vs PEMBRO).
- Progression-free survival:
  - In head-to-head comparisons, only RAMU+DOC showed a significant improvement in PFS compared to DOC. Only the RAMU+DOC vs ERLO and NIVO vs ERLO indirect comparisons reached statistical significance. The SUCRA rankings suggested RAMU+DOC (0.84) as the best intervention followed by NIVO (0.81), PEMBRO (0.57), ATEZO (0.45), DOC (0.31) and ERLO (0.02) which ranked last.
- Drug-related grade 3±5 adverse events:
  - Direct comparisons showed significantly reduced risk of drug-related grade 3±5 AE with NIVO, ATEZO, PEMBRO, and ERLO compared to DOC alone. The same drugs were associated with reduced risk of these AEs compared to RAMU+DOC in indirect comparisons.
  - The SUCRA values for the checkpoint inhibitors were higher (range: 0.63±1.00) than for ERLO (0.49). Of the three highest ranking drugs (NIVO, ATEZO, PEMBRO), the safety profile of NIVO was significantly better than that of ATEZO (RR = 0.55, 95% CI 0.38, 0.79) and PEMBRO (0.52, 95% CI 0.34, 0.81).

- Discontinuation due to drug-related AE:
  - o No NMA could be conducted for this outcome, because unlike for the previous outcome the RR estimates from direct comparisons were not stable across different points of study follow-up.
- Overall results (cluster rank analysis):
  - o Overall, NIVO, ATEZO and PEMBRO exhibited dominance in efficacy and safety over alternative therapies. According to the cluster rank analysis, NIVO was the drug with both the highest probability of being the most effective (overall survival) and the safest (drug-related grade 3±5 AEs) followed by ATEZO and PEMBRO.
- Efficacy outcomes by histology subgroups:
  - → The NMA for safety outcomes could not be performed due to sparse data.
  - o Non-squamous histology:

    Based on the SUCRA rankings for OS), checkpoint inhibitors (PEMBRO, ATEZO, and NIVO) were the best interventions (0.94, 0.75, and 0.67, respectively) followed by PEM (0.59), NINTE + DOC (0.46), RAMU+DOC (0.46), and DOC (0.15), with ERLO (0.0) ranking the last.

    Among the four drugs with the highest rankings on OS, no significant difference was observed.

    For PFS, the network plot included one closed loop allowing a mixed treatment comparison between DOC, ERLO, and PEME. There was no evidence of inconsistency for the mixed treatment comparison (DOC, ERLO, PEME comparisons) within this loop (p = 0.07).

    The SUCRA rankings from the NMA suggested that RAMU+DOC (0.85) and NINTE+DOC (0.83) were the best interventions followed by PEMBRO (0.58) and NIVO (0.49), PEME (0.49), and DOC (0.16), with ERLO (0.10) ranking the last. Among the four drugs with the highest rankings on PFS, no significant difference was observed.

Anmerkung/Fazit der Autoren

In this review, we advanced the existing knowledge by comparing drugs approved in people with non-specific late-stage NSCLC. Our results indicate that the use of immunotherapies in people diagnosed with non-specific late stage NSCLC should be promoted. Amongst our included studies, more than 3,500 patients received licensed dosing of DOC, which proved relatively unsuccessful on both survival and safety. The use of DOC may now be judged irrelevant as a comparator intervention for approval of new drugs for second line treatment of NSCLC.

Wu D et al., 2017 [69].

Which treatment is preferred for advanced non-small-cell lung cancer with wild-type epidermal growth factor receptor in second-line therapy? A meta-analysis comparing immune checkpoint inhibitor, tyrosine kinase inhibitor and chemotherapy

Fragestellung

We compared the efficacy of PD-1/PD-L1 antibody, first-generation EGFR-TKI and chemotherapy in second- or third-line setting with Bayesian indirect method that allowed for combining direct and indirect evidence, aiming to identify the optimum treatment that could provide best survival benefit for advanced NSCLC patients with WT EGFR tumors.

Methodik

Population:

- pre-treated patients with advanced NSCLC, defined as unresectable locally advanced, metastatic or recurred disease (stage IIIB or IV).

Intervention + Komparator:

- two or more treatments among standard chemotherapy, first-generation EGFR-TKI and PD-1/PD-L1

Endpunkt:

- hazard ratios (HRs) with 95% confidence intervals (CIs) for OS and/or PFS

Recherche/Suchzeitraum:

- PubMed, Cochrane databases and EMBASE January 2017, with no date and language restriction

Qualitätsbewertung der Studien:

- Cochrane collaboration method

Ergebnisse

Anzahl eingeschlossener Studien:

- 12 open-labeled, randomized Phase II/III trials accruing 6462 patients with advanced NSCLC were finally included in this meta-analysis. 3341 patients bearing WT EGFR tumors

Charakteristika der Population:

- Eastern Cooperative Oncology Group or World Health Organization performance status of 0 to 2
- All the four trials containing PD-1/PD-L1 antibody arm used FDA-approved dose. Three of them were performed in second- or third-line setting, the other one were second-setting [26].
- All 12 trials containing chemotherapy arm used recommended drugs (single-agent docetaxel or pemetrexed is standard second- or higher- line treatment) with standard dosing schedule.
- All the 8 trials containing EGFR-TKI arm used standard dosing schedule (erlotinib, 150 mg orally daily; gefitinib, 250 mg orally daily). Among these trials, five were second-line setting, and three were second- or third-line setting.
- Five trials majorly comprised of white patients, while the other three majorly included Asian patients.

Qualität der Studien:

- The included trials were overall low risk
- Sequence was adequately generated in all trials.
- Allocation concealment was adequately performed in nine trials, not detailed in one trials and undone in two trials.
- Though all trials were designed as open-labeled, six of them blinded assessment of outcome by independent, central radiologic reviews or independent review committee.

- The reasons for excluding patients in all trials were sufficient and ITT principle was followed. No evidence of selective reporting was found.
- Additionally, other source of bias was found in two trials: one were halted prematurely, two had biased baseline characteristics, and the other one had imbalanced number of patients underwent crossover.

Studienergebnisse:

Overall survival

- no evidence of significant inter-study heterogeneity for OS or PFS was identified (I2 = 0% and 27%, respectively).
- The pooled fixed-effect models showed that treatment of PD-1/PDL1 antibody was more effective in improving OS and PFS than chemotherapy in WT EGFR patients, with an estimated HR of 0.67 (95% CI 0.60-0.75, p < 0.001)
- no significant difference for OS was identified between chemotherapy and EGFR-TKI.

Progression-free survival

- 9 out of 12 trials accruing 2454 patients.[17-19, 24, 26, 28-30, 32, 33]
- Treatment of PD-1 antibody significantly improved PFS compared with chemotherapy (HR 0.83 95% CI 0.73-0.95, p = 0.007)
- treatment of chemotherapy significantly improved PFS compared with TKI (HR 0.75 95% CI 0.66-0.84, p < 0.001).

Subgroup analysis

- there was a trend to favor chemotherapy than TKI in second-line setting, though the p value did not reach a significance threshold (HR 0.85, 95% CI 0.71-1.01, p = 0.06).

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Anmerkung/Fazit der Autoren

For pretreated WT EGFR patients, PD-1/PD-L1 antibody can be a preferable option. For the ones who are not candidates for PD-1/PD-L1 antibody therapy, chemotherapy is preferred. TKI may be only considered for the ones who have bad performance status.

Kommentare zum Review

- Gemischte Population: Keine seperaten Analysen/Ergebnisse zum Stadium oder Status (z.B. fortgeschritten vs. metastasierte Patienten).
- Siehe auch: Wu, F. Z. et al., 2019 [70] & Wang, C. et al., 2019 [66]

Créquit P et al., 2017 [15].

Comparative efficacy and safety of secondline treatments for advanced non-small cell lung cancer with wild-type or unknown status for epidermal growth factor receptor: a systematic review and network metaanalysis.

Fragestellung

to assess the comparative effectiveness and tolerability of all second-line treatments for advanced NSCLC with wild-type or unknown status for EGFR by a systematic review and network meta-analysis.

Methodik

Population:

- patients with advanced NSCLC (stage IIIB unsuitable for radical radiotherapy or surgery and stage IV) with wild-type or unknown status for EGFR

Intervention/Komparator:

- Indirect comparison to assess second-line treatments

- Trials in which patients in the control arm received chemotherapy (e.g., docetaxel or pemetrexed) at the investigators' discretion were included for the secondary analysis considering treatment categories. We also considered trials including both second- and third-line therapy, because there is no clinical reason to presume that these minority patients in third-line could not be randomized to any of the treatments. If a multi-arm trial compared one drug to two different dosages of another drug, we retained the usual treatment dosage or that corresponding to the 3-week scheme of administration.

Endpunkte:

- OS, PFS, objective response (ObR), SAEs, QoL

Recherche/Suchzeitraum:

- MEDLINE, EMBASE, CENTRAL, ClinicalTrials.gov, and the US Food and Drug Administration website, as well as other sources, were searched for available reports up to June 6, 2017

Qualitätsbewertung der Studien:

- Cochrane approach

Ergebnisse

Anzahl eingeschlossener Studien:

- 102 RCTs involving 36,058 patients

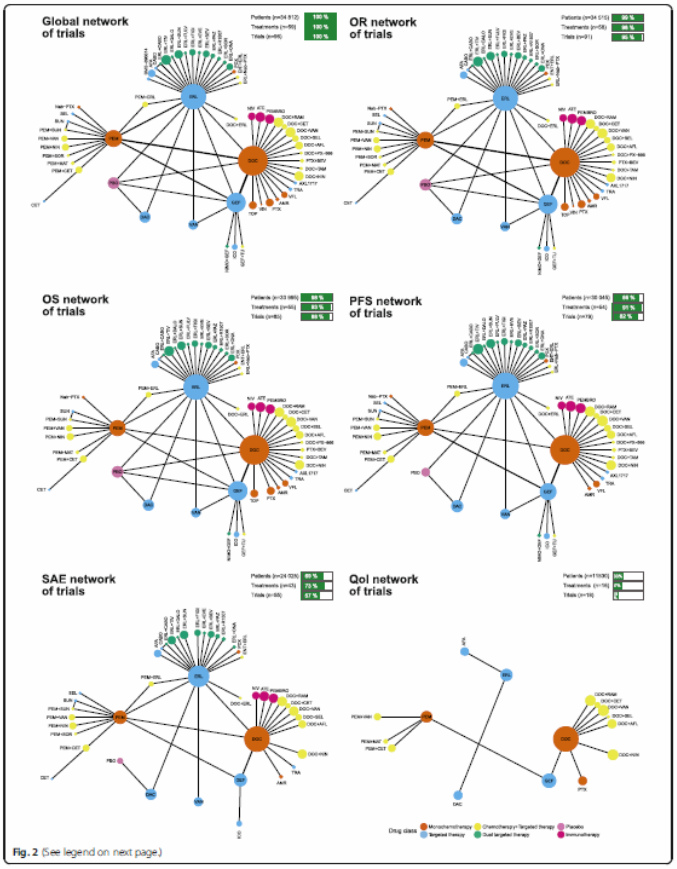


Fig. 2 Network graphs of trials assessing second-line treatments in advanced NSCLC with wild-type or unknown status for EGFR for all eligible trials, ObR, OS, PFS, SAEs, and QoL. The five trials with chemotherapy (i.e., docetaxel or pemetrexed) at the investigators' discretion and the HANSHIN trial were excluded from these networks. The thickness of the lines is

proportional to the number of trials evaluating each comparison. The size of the nodes is proportional to the number of patients allocated to the corresponding treatment.

Charakteristika der Population:

- 62% male, median age 61 years, 81% with stage IV cancer, 80% smokers, and 92% with performance status 0–1

Qualität der Studien:

- Only 47 trials (46%) described an adequate random sequence generation and 37 (36%) an adequate treatment allocation concealment. Patients and care providers were blinded in 29 trials (28%), and outcome assessors in 41 trials (40%).

Studienergebnisse:

- *Note*: Half of the trials reported safety outcomes and less than 20% quality of life.
- For OS
  - nivolumab was more effective than docetaxel (hazard ratio (HR) 0.69, 95% credible interval (CrI) 0.56–0.83), pemetrexed (0.67, 0.52–0.83), erlotinib (0.68, 0.53–0.86), and gefitinib (0.66, 0.53–0.83).
  - Pembrolizumab, atezolizumab, and pemetrexed plus erlotinib were also significantly more effective than docetaxel, pemetrexed, erlotinib, and gefitinib.
- For PFS
  - erlotinib plus cabozantinib was more effective than docetaxel (HR 0.39, 95% CrI 0.18–0.84), pemetrexed (0.38, 0.18–0.82), erlotinib (0.37, 0.18–0.78), and gefitinib (0.38, 0.18–0.82).
  - Cabozantinib and pemetrexed plus erlotinib were also significantly more effective than the four recommended treatments.
- For ObR
  - no treatment was significantly more effective. The effectiveness of the four recommended treatments was similar and they were ranked among the 25 less-effective treatments.
- For safety, evidence is insufficient to draw certain conclusions.

Anmerkung/Fazit der Autoren

Our comparative effectiveness review of second-line treatments for advanced NSCLC with wild-type or unknown status for EGFR compared 61 treatments assessed in 102 trials (36,058 patients). Our NMA revealed that immunotherapy (nivolumab, pembrolizumab, and atezolizumab) and pemetrexed plus erlotinib might be more efficacious for OS than the four recommended treatments (docetaxel, pemetrexed, erlotinib, and gefitinib) and highlighted the relatively poor performance of these four treatments. The assessment of safety and patient reporting outcomes was uncertain because of a lack of reporting.

Kommentare zum Review

- The authors did not distinguish between the different types of data; namely, they considered the 11 trials (11%) only identified through a conference abstract as the same level of evidence as published trials in the quantitative analysis
- No formal assessment of the assumption of transitivity possible because, for most of treatment comparisons, there are very few trials included

Su Q et al., 2017 [60].

PD-1/PD-L1 antibodies efficacy and safety versus docetaxel monotherapy in advanced NSCLC patients after first-line treatment option: systems assessment

Ähnliche Reviews zu dem Thema:

- **Jiang Qi et al., 2018 [28].** Anti-PD-1/PD-L1 antibodies versus docetaxel in patients with previously treated non-small-cell lung cancer
- **Huang G et al., 2018 [26].** The efficacy and safety of anti-PD-1/PD-L1 antibody therapy versus docetaxel for pretreated advanced NSCLC: a meta-analysis
- **Zhuansun Y et al., 2017 [86].** Anti-PD-1/PD-L1 antibody versus conventional chemotherapy for previously-treated, advanced non-small-cell lung cancer: a meta-analysis of randomized controlled trials
- **Ramos-Esquivel A et al., 2017 [54].** Anti-PD-1/anti-PD-L1 immunotherapy versus docetaxel for previously treated advanced non-small cell lung cancer: a systematic review and meta-analysis of randomised clinical trials
- **Ellis PM et al., 2017 [17].** Immune Checkpoint Inhibitors for Patients With Advanced Non-Small-Cell Lung Cancer: A Systematic Review
- **Ru CH et al., 2018 [55].** Efficacy and Safety of Addition of Anti-PD1 to Chemotherapy in Treatment of Non-Small Cell Lung Cancer
- **Lee CK et al., 2018 [33].** Clinical and Molecular Characteristics Associated With Survival Among Patients Treated With Checkpoint Inhibitors for Advanced Non-Small Cell Lung Carcinoma: A Systematic Review and Meta-analysis
- **Jiang T et al., 2018 [29].** Impact of Clinicopathologic Features on the Efficacy of PD-1/PD-L1 Inhibitors in Patients With Previously Treated Non-small-cell Lung Cancer
- **Liu J et al., 2018 [44].** Efficacy and safety of PD1/PDL1 blockades versus docetaxel in patients with pretreated advanced non-small-cell lung cancer: a meta-analysis
- **Wang S et al., 2018 [68].** Efficacy and safety of immune checkpoint inhibitors in non-small cell lung cancer

Fragestellung

We conducted a meta-analysis of randomized clinical trials (RCTs) to determine the efficacy and safety of PD-1 or PD-L1 antibodies compared with standard second-line therapy docetaxel alone and to assess the possible association between the level of PD-L1 and the prognosis of PD-1/PD-L1 antibodies in patients of advanced NSCLC.

Methodik

Population:

- histological confirmed SQ and/or NSQ non-small cell lung cancer

Intervention:

- PD-1/PD-L1

Komparator:

- Docetaxel

Endpunkt:

- OS, PFS, ORR, PD-L1 expression rate and adverse events (AEs) with grades 1-4 and 3/4.

Recherche/Suchzeitraum:

- Cochrane library, Embase, PubMed, China hospital knowledge database, China National Knowledge Infrastructure, Wangfang Data and Weipu Data from January 1990 to January 2017

Qualitätsbewertung der Studien:

- Cochrane risk of bias tool

Ergebnisse

Anzahl eingeschlossener Studien:

- 5 RCTs (n=3579)

Charakteristika der Population:

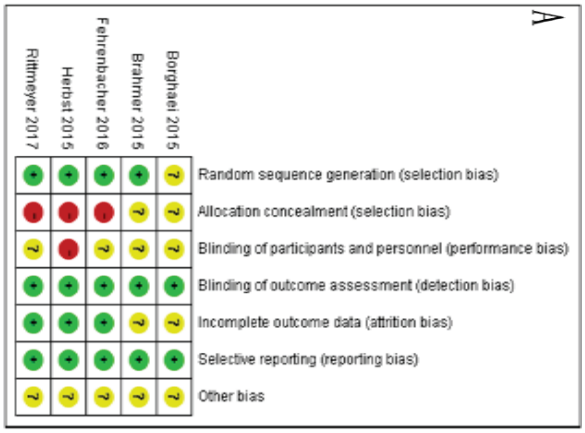
- one had data from SQ-NSCLC patients, while another one had data from NSQ-NSCLC patients, and the remaining three studies had data from both SQ and NSQ NSCLC patients.

Table 1: Characteristics of the eligible RCTs included in the meta-analysis

study[year]	Study type	histology	endpiont	Treatment arms	Patients	CR+PR(%)	OS(m)	PFS(m)
Borghaei et al. [2015]	RCT III	NSQ	OS	nivolumab 3mg/kg q2w	292	56(19%)	12.2	2.3
				DOX 75mg/m2 q3w	290	36(12%)	9.4	4.2
Brahmer et al. [2015]	RCT III	SQ	OS	nivolumab 3mg/kg q2w	135	27(20%)	9.2	3.5
				DOX 75mg/m2 q3w	137	12(9%)	6.0	2.8
Fehrenbacher[2016]	RCT II	SQ and NSQ	OS	atezolizumab 1200mg q3w	144	21(14.6%)	12.6	2.7
				DOX 75mg/m2 q3w	143	21(14.7%)	9.7	3.0
Herbst et al. [2015]1	RCT III	SQ and NSQ	OS	pembrolizumab 2mg/kg q2w	344	62(18.0%)	10.4	3.9
				DOX 75mg/m2 q3w	343	32(9.3%)	8.5	4.0
Herbst et al. [2015]2	RCT III	SQ and NSQ	OS	pembrolizumab 10mg/kg q2w	346	64(18.5%)	12.7	4.0
				DOX 75mg/m2 q3w	343	32(9.3%)	8.5	4.0
Rittmeyer et al.[2017]	RCT II	SQ and NSQ	OS	atezolizumab 1200mg q3w	425	58(13.6%)	13.8	2.8
				DOX 75mg/m2 q3w	425	57(13.4%)	9.6	4.0

RCT: randomized controlled trials; SQ: Squamous non small cell lung cancer; NSQ: Non-squamous non small cell lung cancer; DOX: docetaxel

Qualität der Studien:



Studienergebnisse:

Overall survival:

- Compared with docetaxel, we observed a significant decrease (31%) in the risk of death in PD-1/ PD-L1 antibody group (HR 0.69, 95% CI: 0.63-0.75, p < 0.001; I2 = 0%).

Progression free survival analysis

- The PD-1/PD-L1 antibodies displayed significant improvement in PFS of advanced NSCLC patients, with HR value of 0.87 (95% CI: 0.80-0.94; p < 0.001).

Overall response rate (ORR)

- overall RR value of 1.53, (95% CI: 1.16-2.01, P= 0.003; I2 = 59.2%) in favor of PD-1/PD-L1 antibodies

Adverse events analysis

- PD-1/PD-L1 antibodies showed significant increase in the incidence rate of grade 1-4 adverse events (AEs). The overall RR value for AE was 0.77 (95% CI: 0.74-0.79; P = 0.000).
- Patients receiving PD-1/PD-L1 antibodies showed significant decrease in grade 3-4 AEs with overall RR value of 0.33; 95% CI: 0.22-0.51, P < 0.001.

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Anmerkung/Fazit der Autoren

Our meta-analysis study indicated that PD-1/PD-L1 antibodies treatment indeed has beneficial effects on advanced NSCLC patients in comparison to docetaxel monotherapy, along with displaying few adverse events.

Kommentare zum Review

- Gemischte Population: Keine seperaten Angaben zum Stadium oder Status (z .B. fortgeschritten vs. metastasierte Patienten.

Passiglia F et al., 2018 [49].

Looking for the best immune-checkpoint inhibitor in pre-treated NSCLC patients: An indirect comparison between nivolumab, pembrolizumab and atezolizumab

Ähnliche Reviews zu dem Thema:

- **You W et al., 2018 [78].** A Network Meta-analysis Comparing the Efficacy and Safety of Anti-PD-1 with Anti-PD-L1 in Non-small Cell Lung Cancer
- **Kim J et al., 2018 [32].** Relative Efficacy of Checkpoint Inhibitors for Advanced NSCLC According to Programmed Death-Ligand-1 Expression: A Systematic Review and Network Meta-Analysis

Fragestellung

In absence of direct comparisons among these ICIs, it remains crucial identify any differences in both efficacy and toxicity profiles which may help clinicians to select the best drug for each patient. Therefore, we performed a systematic review and meta-analysis of all Phase II/III randomized clinical trials comparing PD1/PDL1 inhibitors versus docetaxel in pre-treated NSCLC patients.

Methodik

Population:

- Advanced NSCLC

Intervention:

- PD1/PDL1 inhibitors: nivolumab, pembrolizumab and atezolizumab

Komparator:

- Docetaxel

Endpunkte:

- OS, PFS, ORR, G3–G5 AEs, pneumonitis and discontinuation rate

Recherche/Suchzeitraum:

- Medline (PubMed), Embase-databases and Cochrane-Library up to February 2017

Qualitätsbewertung der Studien:

- Cochrane risk of bias tool

Ergebnisse

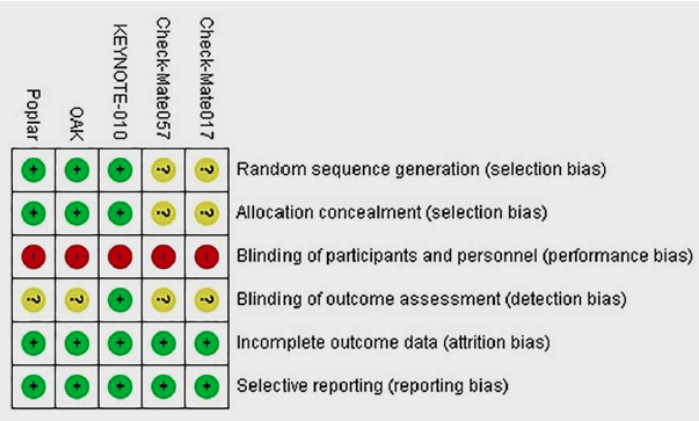
Anzahl eingeschlossener Studien:

- 5 RCTs

Charakteristika der Population:

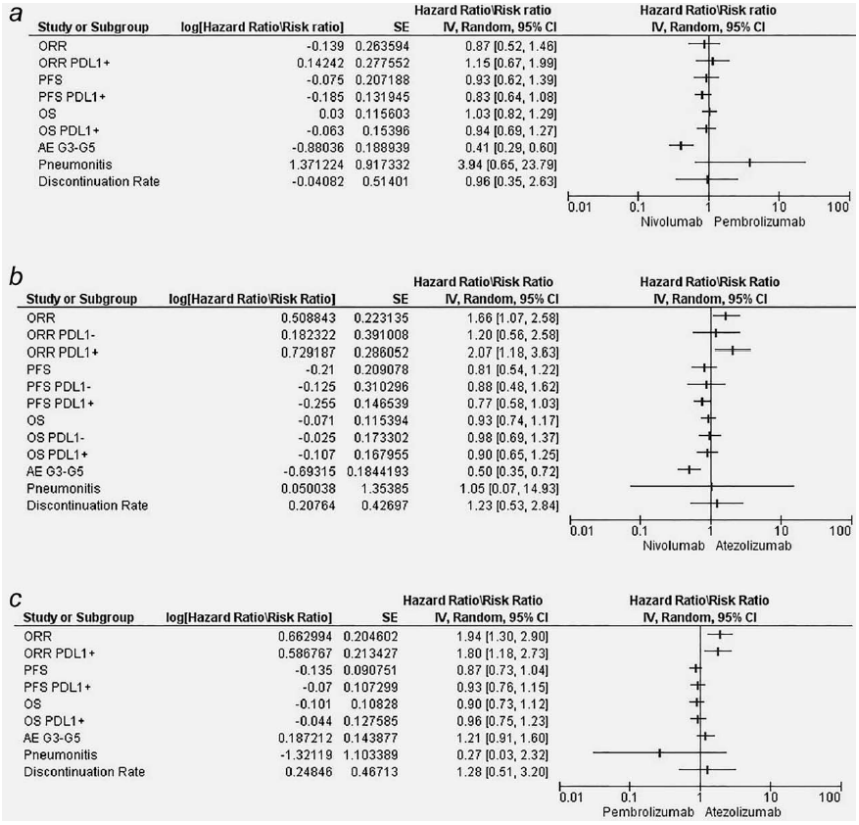
- Siehe Zhao Q et al., 2018 [10].

Qualität der Studien:



Studienergebnisse:

- Direct comparisons:
  - Nivolumab versus docetaxel 2 RCTs (Check-Mate017 and Check-Mate057) 854 patients: statistically significant differences in favor of nivolumab in terms of both OS (HR 0.68, 95% CI 0.57–0.80) and ORR (RR 1.68, 95% CI 1.21–2.34). PFS was not significantly different. nivolumab was associated with a lower incidence of both G3/G5 AEs (RR 0.17, 95% CI 0.13–0.24) and treatment discontinuation (RR 0.48, 95% CI 0.25–0.94) compared to Docetaxel. Conversely a significant higher risk of pneumonitis was observed in the nivolumab arm as compared with chemotherapy arm (RR 9.22, 95% CI 1.73–49.10). Splitting ORR, PFS and OS according to the tumor PD-L1 expression, we also noted a significant benefit in favor of nivolumab for all the above mentioned endpoints in the PD–L1+ population, whereas no benefit has been observed in the PD-L1- patients.
  - Pembrolizumab versus docetaxel: 1 Phase III KEYNOTE-010 with 1,034 patients, 3 arms: pembrolizumab was significantly superior to docetaxel in OS (HR 0.66, 95% CI 0.57–0.77), PFS (HR 0.83, 95% CI 0.74–0.94) and ORR (RR 1.96, 95% CI 1.48–2.59). As for nivolumab, pembrolizumab cohort reported a significant benefit regarding the risk of G3/G5 AEs (RR 0.41, 95% CI 0.33–0.50) while the incidence of pneumonitis was significantly higher as compared to docetaxel arm (RR 2.34, 95% CI 1.21–4.52)
  - Atezolizumab versus docetaxel: 2 Trials with 1137 NSCLC Patients: no significant improvements in terms of ORR and PFS, while only OS resulted significantly longer with atezolizumab in the overall population (HR 0.73, 95% CI 0.63–0.85), regalrdless of tumor PD-L1 expression status. significant lower incidence of G3/G5 AEs (RR 0.34, 95% CI 0.28–0.41) and discontinuation rate (RR 0.43, 95% CI 0.30–0.62), and an increased risk for pneumonitis (RR 8.77, 95% CI 1.12–68.92)
- Indirect Comparisons: Forest plots for all indirect comparisons among immunecheck-point inhibitors in pre-treated NSCLC patients: nivolumab vs. pembrolizumab (a); nivolumab vs. atezolizumab (b); pembrolizumab vs. atezolizumab (c).



Anmerkung/Fazit der Autoren

However, despite some limitations, the results of our meta-analysis first revealed some additional differences among these agents, which could guide clinicians in their treatment decisions. Particularly PD1 inhibitors nivolumab and pembrolizumab could be preferred options for patients with higher tumor burden or symptomatic disease, to whom the decrease of tumor volume represents a primary objective. Nivolumab seems to be generally better tolerated than the other two agents.

Considering the limitations and the potential bias related to indirect comparisons, these evidences should not considered as a decisional tool to establish the superiority of one drug to another. However, they could only serve as a scientific support to help the oncologists in their clinical decisions in order to select the best drug for each patient.

Zhao Q et al., 2018 [83].

Anti-PD-1/PD-L1 Antibody Therapy for Pretreated Advanced or Metastatic Nonsmall Cell Lung Carcinomas and the Correlation between PD-L1 Expression and Treatment Effectiveness: An Update Meta-Analysis of Randomized Clinical Trials

Ähnliche Reviews zu dem Thema:

- **Huang Q et al., 2018 [27].** Impact of PD-L1 expression, driver mutations and clinical characteristics on survival after anti-PD-1/PD-L1 immunotherapy versus chemotherapy in non-small-cell lung cancer: A meta-analysis of randomized trials

Fragestellung

The aim of this meta-analysis is to further evaluate the efficacy and safety of anti-PD-1/PD-L1 agents in advanced NSCLC patients. A subgroup analysis was performed to determine

the correlation between PD-L1 expression level and clinical outcome and to establish guidelines for PD-L1 antibody treatment in patients with low or negative PD-L1 levels.

Methodik

Population:

- Pretreated advanced or metastatic NSCLC

Intervention:

- nivolumab" or "pembrolizumab," or "atezolizumab."

Komparator:

- Docetaxel

Endpunkte:

- primary endpoint was overall survival rate.
- Secondary endpoints included PFS, objective response rate (ORR), and safety (grade 3-5 adverse events (AEs), including fatigue, decreased appetite, nausea, vomiting, diarrhea, constipation, anemia, neutropenia, and febrile neutropenia)

Recherche/Suchzeitraum:

- PubMed, Embase, and Cochrane Library electronic databases up to March 2017

Qualitätsbewertung der Studien:

- 5-item Jadad scale

Ergebnisse

Anzahl eingeschlossener Studien:

- 5 RCTS with 3,025 patients

Charakteristika der Population:

Table 2: Baseline characteristics of RCTs included in the analysis.

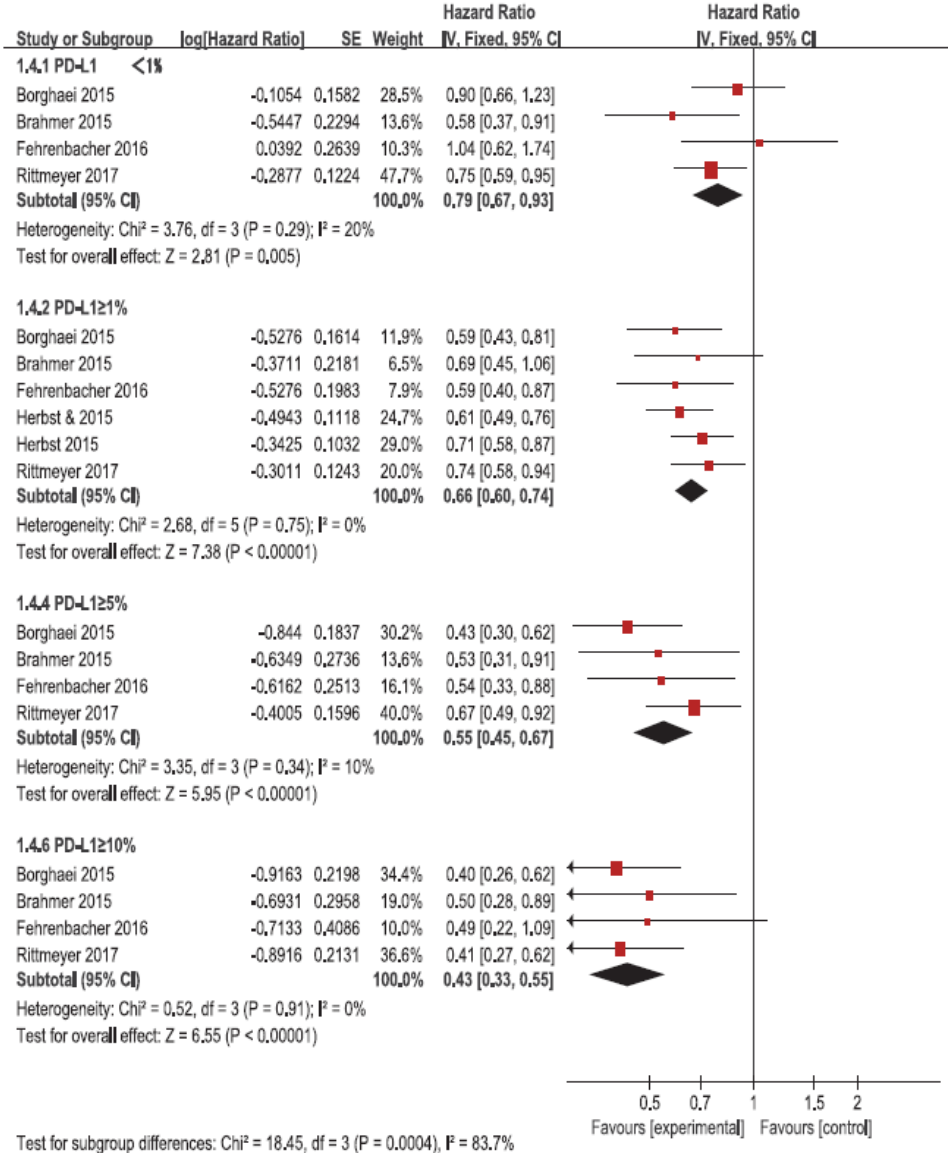
Study	Year	Study type	Intervention	Treatment regimens	No. of patients
Brahmer	2015	Phase III	Nivolumab	3mg/kg ivgtt q2w	135
			Docetaxel	75mg/m^2 ivgtt q3w	137
Borghaei	2015	Phase III	Nivolumab	3mg/kg ivgtt q2w	292
			Docetaxel	75mg/m^2 ivgtt q3w	290
Herbst	2015	Phase III	Pembrolizumab	2mg/kg ivgtt q3w	344
			Pembrolizumab	10mg/kg ivgtt q3w	346
			Docetaxel	75mg/m^2 ivgtt q3w	343
Fehrenbacher	2016	Phase II	Atezolizumab	1200mg ivgtt q3w	144
			Docetaxel	75mg/m^2 ivgtt q3w	143
Rittmeyer	2017	Phase III	Atezolizumab	1200mg ivgtt q3w	425
			Docetaxel	75mg/m^2 ivgtt q3w	425

Qualität der Studien:

- All included trials were considered high-quality data, as they were randomized (Jadad Score: 3)

Studienergebnisse:

- OS/PFS: anti-PD- 1/PD-L1 antibodies significantly improved the OS (HR=0.69, 95%CI: 0.63-0.75, P<0.0001, and P=0.67) and PFS (HR=0.87, 95%CI: 0.81-0.94, P=0.0004, and P=0.11)
- ORR: Anti-PD-1/PD-L1 antibodies resulted in higher ORR than docetaxel (RR=1.53, 95% CI: 1.16-2.01, P=0.003, and P=0.03)
- Safety: The meta-analysis showed that the rates of overall grade 3-5 adverse events (AEs) for the anti- PD-1/PD-L1 therapy were significantly lower than those of docetaxel. For any grade 3-5 AEs, the rates of hematological AEs (anemia and neutropenia), febrile neutropenia, fatigue, and diarrhea were all significantly lower for anti-PD- 1/PD-L1 antibodies than for docetaxel.
- Subgroup Analyses PD-L1 expression: this meta-analysis indicates that anti-PD- 1/PD-L1 agents exhibited high efficacy in the treatment of advanced NSCLC. Anti-PD-1/PD-L1 therapy also had considerable activity for NSCLC and was superior to docetaxel in the PD-L1<1% population. PD-1/PD-L1 inhibitors tended to be associated with PD-L1 expression level. Higher PD-L1 expression was likely to be associated with increased benefit from anti-PD-1/PD-L1 agents.



Anmerkung/Fazit der Autoren

In conclusion, we analyzed five RCTs and systemically verified favorable OS, PFS, and ORR of anti-PD-1/PD-L1 therapy for pretreated advanced or metastatic NSCLC and demonstrated higher efficacy and safety for these agents than for docetaxel. More importantly, the results of this metaanalysis suggested that anti-PD-1/PD-L1 antibodies could also improve overall survival even when PD-L1<1%, which has not been recommended by previous studies. Our results could be of great value in guiding selection of clinical therapeutic regimens.More prospective studies are necessary toconfirmthese results and to improve theoptimal dosage for PD-1/PD-L1 inhibitors in NSCLC.

Luo W et al., 2018 [45].

Safety and tolerability of PD-1/PD-L1 inhibitors in the treatment of non-small cell lung cancer: a meta-analysis of randomized controlled trials

Fragestellung

We conducted a comprehensive meta-analysis to state the safety profile of PD-1/PD-L1 inhibitors in NSCLC, and identify the exact incidence and relative risk (RR) of both summary and detailed AEs.

Methodik

Population:

- patients with lung cancer

Intervention:

- PD-1/PD-L1 inhibitor

Komparator:

- Chemotherapy

Endpunkte:

- relevant symptoms (fatigue, anorexia, nausea, constipation diarrhea, and peripheral sensory neuropathy), hematologic AEs (neutropenia and anemia), and immune-related AEs (irAEs; rash, pruritus, colitis, hypothyroidism, hyperthyroidism, hypophysitis, alanine aminotransferase (ALT)/aspartate aminotransferase (AST) elevations, and pneumonitis)

Recherche/Suchzeitraum:

- PubMed, Embase, and the Cochrane library databases to May 1, 2018

Qualitätsbewertung der Studien:

- Cochrane Collaboration’s risk of bias tool

Ergebnisse

Anzahl eingeschlossener Studien:

- 8 RCTs with 4413 patients

Charakteristika der Population:

Table 1 Characteristics of studies included in the meta-analysis (PD-1/PD-L1 inhibitors vs. chemotherapy)

Reference	Author, year	Phase	Masking	Histology	Treatment arms	Number of patients available for analysis	Age in years (median)	Follow-up duration (months)	CTCAE version
1	Brahmer, 2015	III	Open-label	Squamous NSCLC	Nivolumab	131	62	Minimum 11	4.0
					Docetaxel	129	64		
2	Borghaei, 2015	III	Open-label	Non-squamous NSCLC	Nivolumab	287	61	Minimum 13.2	4.0
					Docetaxel	268	64		
3	Carbone, 2017	III	Open-label	NSCLC	Nivolumab	267	63	Median 13.5	4.0
					Platinum-based chemo-therapy	263	65		
4	Fehren-bacher, 2016	II	Open-label	NSCLC	Atezoli-zumab	142	62	Median; 14.8 for Atezoli-zumab; 15.7 for Docetaxel	4.0
					Docetaxel	135	62		
5	Rittmeyer, 2017	III	Open-label	NSCLC	Atezoli-zumab	609	63	median 21	4.0
					Docetaxel	578	64		
6*	Herbst, 2016 (1)	II/III	Open-label	NSCLC	Pembroli-zumab 2 mg/kg	339	63	Median 13.1	4.0
					Docetaxel	309	62		
7*	Herbst, 2016 (2)	II/III	Open-label	NSCLC	Pembroli-zumab 10 mg/kg	343	63	Median 13.1	4.0
					Docetaxel	309	62		
8	Reck, 2016	III	Open-label	NSCLC	Pembroli-zumab	154	64.5	MEDIAN 11.2	4.0
					Platinum-based chemo-therapy	150	66		

*Different cohorts with different dose of PD-1/PD-L1 inhibitors in the same trial

PD-1 programmed death receptor-1, *PD-L1* programmed death ligand 1, *NSCLC* non-small cell lung cancer, *CTCAE* the Common Terminology Criteria for Adverse Events version

Qualität der Studien:

- Most of the included studies had a high risk of selection bias, performance bias, and detection bias due to their open-label design

Studienergebnisse:

Table 2 Incidence and RR of summary toxic events

Summary toxic events	Number of trials	Incidence (%, 95% CI)		Effect estimate		Heterogeneity	
		PD-1/PD-L1 inhibitor	Control	RR (95% CI)	*P*	*P*	I^2 (%)
Any all-grade AEs	8	66.20 (64.21; 68.14)	86.08 (84.54; 87.52)	0.77 (0.74; 0.80)	<0.0001	0.5215	0.0
Any high-grade AEs	8	14.26 (12.85; 15.77)	43.53 (41.42; 45.66)	0.32 (0.25; 0.41)	<0.0001	0.0001	76.2
Treatment discontinuation	8	5.94 (5.01; 6.99)	13.92 (12.48; 15.46)	0.44 (0.33; 0.59)	<0.0001	0.067	47.0
Toxic deaths	8	0.48 (0.24; 0.86)	1.12 (0.71; 1.66)	0.45 (0.23; 0.90)	0.0229	0.9858	0.0

AEs adverse events, *RR* relative risk, *CI* confidence interval, *PD-1* programmed death receptor-1, *PD-L1* programmed death ligand 1

- Incidence and relative risk of toxic symptoms
  - Patients receiving PD-1/PD-L1 inhibitors had a significantly lower risk for five evaluated all-grade toxic symptoms when compared with chemotherapy: fatigue (18.75 vs. 30.83%; RR 0.61; 95% CI: 0.55–0.68; P < 0.0001), nausea (12.54 vs. 25.69%; RR 0.45; 95% CI: 0.31–0.65; P < 0.0001), constipation (6.34 vs. 8.08%; RR 0.49; 95% CI: 0.26–0.94; P = 0.031), diarrhea (10.61 vs. 19.85%; RR 0.51; 95% CI: 0.37–0.72; P < 0.0001), and peripheral sensory neuropathy (1.32 vs. 6.31%; RR 0.13; 95% CI: 0.05–0.34; P < 0.0001). The risk of four high-grade toxic symptoms was significantly lower from PD-1/PD-L1 inhibitors therapy than chemotherapy: fatigue (1.58 vs. 4.06%; RR 0.39; 95% CI: 0.27–0.57; P < 0.0001), anorexia (0.35 vs. 1.26%; RR 0.30; 95% CI: 0.14–

0.64; P = 0.0018), diarrhea (0.75 vs. 1.77%; RR 0.44; 95% CI: 0.25–0.76; P = 0.0034), and peripheral sensory neuropathy (0.00 vs. 0.61%; RR 0.10; 95% CI: 0.02–0.53; P = 0.0068).

- Incidence and relative risk of hematologic toxicities
  - Patients receiving PD-1/PD-L1 inhibitors were at a significantly lower risk of all-grade neutropenia (0.70 vs. 18.68%; RR 0.03; 95% CI: 0.01–0.08; P < 0.0001), thrombocytopenia (0.09 vs. 2.57%; RR 0.04; 95% CI: 0.01–0.16; P < 0.0001), and anemia (5.59 vs. 23.26%; RR 0.19; 95% CI: 0.10–0.34; P < 0.0001) when compared with chemotherapy. A significantly lower risk of high-grade neutropenia (0.13 vs. 14.53%; RR 0.02; 95% CI: 0.01–0.04; P < 0.0001), thrombocytopenia (0.04 vs. 1.40%; RR 0.05; 95% CI: 0.01–0.25; P = 0.0003), and anemia (1.01 vs. 6.03%; RR 0.17; 95% CI: 0.07–0.42; P = 0.0001) was also observed in PD-1/PD-L1 inhibitors
- Incidence and relative risk of immune-related AEs
  - The most frequently reported all-grade irAEs from PD-1/ PD-L1 inhibitors therapy included rash (5.77%), hypothyroidism (4.89%), and pneumonitis (3.21%), while the most frequently observed high-grade irAE was pneumonitis (1.45%), ALT/AST elevations (0.57%) and colitis (0.40%). Compared to chemotherapy, PD-1/PD-L1 inhibitors therapy was associated to a significantly increased risk of seven all-grade irAEs: rash (5.77 vs. 2.76%; RR 2.07; 95% CI: 1.54–2.80; P < 0.0001), pruritus (2.16 vs. 0.51%; RR 4.15; 95% CI: 2.20–7.81; P < 0.0001), colitis (0.70 vs. 0.00%; RR 5.44; 95% CI: 1.42–20.80; P = 0.013), hypothyroidism (4.89 vs. 0.23%; RR 17.59; 95% CI: 7.74–39.98; P < 0.0001), hyperthyroidism (2.11 vs. 0.37%; RR 5.27; 95% CI: 2.56–10.86; P < 0.0001), ALT/AST elevations (1.85 vs. 0.89%; RR 2.15; 95% CI: 1.31–3.51; P = 0.002), and pneumonitis (3.21 vs. 0.65%; RR 3.83; 95% CI: 2.20–6.68; P < 0.0001). There was also a small, but significantly increased risk of high-grade pneumonitis from PD-1/PD-L1 inhibitors compared with chemotherapy (1.45 vs. 0.19%; RR 3.78; 95% CI: 1.43–10.03; P = 0.007)

Anmerkung/Fazit der Autoren

Our meta-analysis has demonstrated that PD-1/PD-L1 inhibitors are generally safer and better tolerated than chemotherapy for patients with NSCLC with regard to summary toxic events, detailed toxic symptoms and hematologic toxicities. However, PD-1/PD-L1 inhibitors can generate a unique spectrum of irAEs, and several of them can be severe and even life-threatening. Clinicians should be aware of the risk of these AEs, as they may have a potentially negative impact on the patients' quality of life and survival outcome.

Khan M et al., 2018 [30].

Comparative analysis of immune checkpoint inhibitors and chemotherapy in the treatment of advanced non-small cell lung cancer A meta-analysis of randomized controlled trials.

Ähnliche Reviews zu dem Thema:

- **Peng TR und Wu TW, 2019 [51].** Efficacy of PD-1/PD-L1 inhibitors in patients with advanced non-small cell lung cancer: A meta-analysis of randomized clinical trials

Fragestellung

to gather and analyze the available evidence (Evidence level I; Randomized Controlled Trials) comparing efcacy and safety of anti-programmed cell death-1 (PD1)/programmed

cell death ligand 1 (PD-L1) therapies and chemotherapy in the treatment of advanced NSCLC.

Methodik

Population:

- Advanced non-small cell lung cancer.

Intervention/Komparator:

- comparing the anti-PD1/PD-L1 therapies with chemotherapy

Endpunkte:

- OS, PFS, ORR, TRAEs

Recherche/Suchzeitraum:

- until December 2017

Qualitätsbewertung der Studien:

- Cochrane Collaboration Tool

Ergebnisse

Anzahl eingeschlossener Studien:

- seven RCTs (n=3867)

Qualität der Studien:

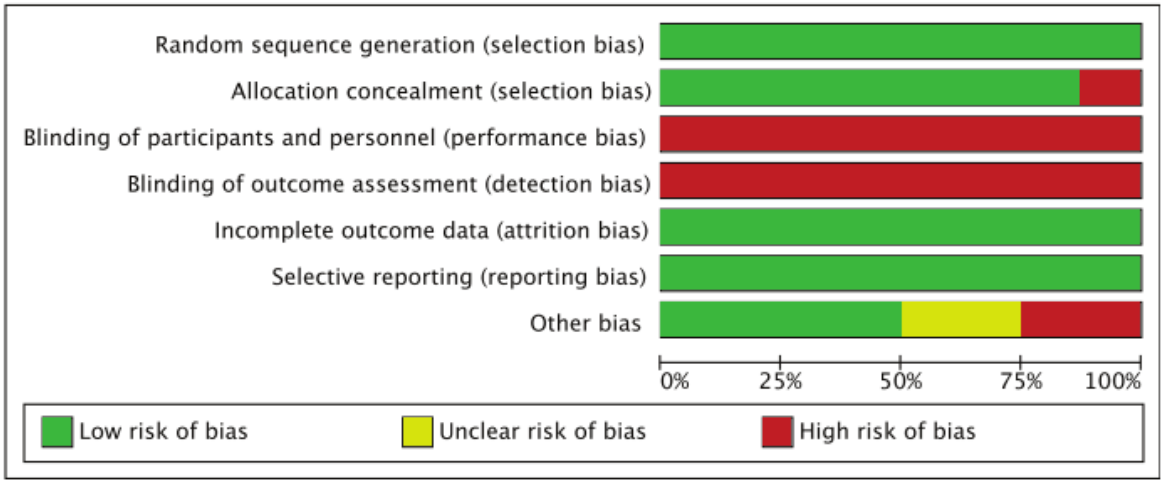


Figure 2. Risk of bias graph. +: low risk of bias; −: high risk of bias; ?: unclear risk of bias.

Studienergebnisse:

- Anti-PD1/PD-L1 therapies (nivolumab, pembrolizumab, atezolizumab) resulted in better OS (HR 0.72 [95% confidence interval [CI] 0.63, 0.82; P<.00001]), PFS (HR 0.84 [95% CI 0.72, 0.97; P<.02]), and ORR (odds ratio [OR] 1.52 [95% CI 1.08, 2.14; P<.02]) in comparison to chemotherapy in advanced NSCLC.
- Improved safety was observed with anti-PD1/PD-L1 therapies (OR 0.31 [95%CI 0.26, 0.38; P<.00001]).
- Subgroup analysis: While ECOG PS 1, squamous cell type, current/former smoker, EGFRwild type, KRAS mutant, and absent CNS metastases subgroups were associated

with better overall survival. Male sex, ECOG PS 1, never smoker, KRAS wild type and absent CNS metastases subgroups were associated with better PFS. Histology types showed no association to PFS while EGFR mutant as well as wild type was associated with significant PFS.

Anmerkung/Fazit der Autoren

Anti-PD1/PD-L1 therapies represent better choice over chemotherapy in advance NSCLC. Immune response associated with PD1 pathway inhibition in NSCLC is more complex and could not be fully explained only by PD-L1 tumor expression and hence further investigations are warranted to identify more biomarkers. Proper selection of patients is recommended in order to derive full advantage of these agents. Further studies are needed to prove efficacy of these agents in first line treatment.

Kommentare zum Review

- Gemischte Population: Keine seperaten Angaben zum Stadium oder Status (z.B. fortgeschritten vs. metastasierte Patienten.

Chen S et al., 2018 [12].

A meta-analysis of nivolumab for the treatment of advanced non-small-cell lung cancer

Fragestellung

The purpose of this meta-analysis was to systematically evaluate the efficacy and safety of nivolumab in patients with advanced NSCLC.

Methodik

Population:

- advanced NSCLC

Intervention:

- Nivolumab plus chemotherapy

Komparator:

- Chemotherapy

Endpunkte:

- OS, PFS, ORR, and SAE

Recherche/Suchzeitraum:

- PubMed, Embase, and Cochrane Library databases were searched up to June 2017

Qualitätsbewertung der Studien:

- Cochrane Handbook for Systematic Reviews of Interventions risk of bias tool

Ergebnisse

Anzahl eingeschlossener Studien:

- 3 RCTs with 1,395 patients

Charakteristika der Population:

Table 1 The primary characteristics of the eligible studies in more detail

Study	Year	Trial name	Trial phase	Stage	Histology	PD-L1 tumor expression level	Study arm (N)	Comparative arm (N)
Brahmer et al[15]	2015	CheckMate 017	3	IIIb/IV	Squamous	≥1%, ≥5%, and ≥10%	Nivolumab 3 mg/kg every 2 weeks (n=135)	Docetaxel 75 mg/m² every 3 weeks (n=137)
Borghaei et al[14]	2015	CheckMate 057	3	IIIb/IV	Nonsquamous	≥1%, ≥5%, and ≥10%	Nivolumab 3 mg/kg every 2 weeks (n=292)	Docetaxel 75 mg/m² every 3 weeks (n=290)
Carbone et al[16]	2017	CheckMate 026	3	IV or recurrent	Squamous and nonsquamous	≥1% and ≥5%	Nivolumab 3 mg/kg every 2 weeks (n=271)	Investigator's choice of platinum-based doublet chemotherapy (n=270)

Qualität der Studien:

- All included studies were based on moderate- to high-quality evidence.

Studienergebnisse:

- PFS: nivolumab did not lead to PFS benefit (odds ratio [OR]: 0.88, 95% CI: 0.64–1.20, P=0.41) compared with chemotherapy
- OS: The pooled data showed that nivolumab plus chemotherapy did not improve OS (OR: 0.77, 95% CI: 0.57–1.03, P=0.08) over chemotherapy (random effects model because of high heterogeneity)
- ORR: Pooling ORR data did not improve efficacy for nivolumab (OR: 1.40, 95% CI: 0.66–2.96, P=0.39).
- SAE: Results showed much worse (grade 3–5 adverse events) SAEs in the nivolumab group than in the chemotherapy group (OR: 0.13, 95% CI: 0.09–0.17, P<0.00001)
- Subgroup Analysis:
  - patients with tumor PD-L1 expression levels ≥5% demonstrated that nivolumab therapy did not prolong PFS (OR: 0.84, 95% CI: 0.70–1.00, P=0.05) or OS (OR: 0.63, 95% CI: 0.34–1.15, P=0.13)

Anmerkung/Fazit der Autoren

In conclusion, nivolumab monotherapy for patients with advanced NSCLC was generally well tolerated, with promising antitumor activity and a manageable safety profile. More RCTs with larger sample sizes are needed to detect relevant biomarkers that have sufficient sensitivity and specificity to predict patient populations that would most benefit from nivolumab, in particular those patients with pretreated and advanced NSCLC.

Kommentare zum Review

- *Die Interpretation der SAEs grad 3-4 zum Nachteil von Nivolumab ist nicht nachvollziehbar, da der OR Schätzer auf geringere SAEs in den Nivolumab Behandlungsgruppen hinweist.*

Zhang N et al., 2018 [81].

Systematic review and meta-analysis of third-line salvage therapy for the treatment of advanced non-small-cell lung cancer: A meta-analysis of randomized controlled trials.

Fragestellung

to investigate the efficacy of third-line treatment for advanced non-small-cell lung cancer (NSCLC)

Methodik

Population:

- NSCLC patients

Intervention:

- patients received second or later-line therapy; and available survival data regarding thirdline treatment in advanced NSCLC patients (siehe Details im Ergebnisteil)

Endpunkte:

- OS, PFS

Recherche/Suchzeitraum:

- PubMed, EMBASE, and the Cochrane library (up to May 30, 2017)

Qualitätsbewertung der Studien:

- Cochrane risk of bias tool / Jadad scale

Ergebnisse

Anzahl eingeschlossener Studien:

- 11 randomized controlled trials for analysis
- Five randomized trials compared erlotinib-based doublet versus erlotinib as third-line therapy in advanced NSCLC while the remaining trials investigated single targeted agent versus docetaxel/placebo as third-line therapy for advanced NSCLC.
- A total of 1.958 patients received third-line therapy

Qualität der Studien:

- Jadad Scale: six of the eleven randomized controlled trials were double-blind placebo controlled trials, thus had Jadad score of 5. Another seven trials were an open-label controlled trials, thus had Jadad score of 3.
- Risk of bias: All of the included studies (100%) described random sequence generation. five studies (45%) described adequate allocation concealment. Seven studies (63.6%) described blinding of participants and personnel. Four studies had high risk of bias about blinding of participants and personnel because these four studies were open label trial. Nine studies had a low risk of incomplete outcome data. Although some researches had dropout, the effect of intervention was not affected due to due to the small scale of dropout. Ten studies had low risk of selectively reporting results.

Studienergebnisse:

- Single agent therapy as third-line therapy
  - Three trials reported PFS data of single agent third therapy in NSCLC patients. The pooled hazard ratio for PFS demonstrated that the single agent third therapy in advanced NSCLC patients did not significantly improved PFS, in comparison with docetaxel/placebo. There was significant heterogeneity between trials ($I2 = 92.0\%$, $p < 0.001$), and the pooled HR for PFS was performed by using random-effects model.

- Six trials reported OS data of single targeted agent as third-line therapy in this patient population. The pooled hazard ratio for OS showed that the use of single targeted agent as third therapy did not significantly improved OS, in comparison with docetaxel/placebo.
- Sub-group analysis according to controlled therapy showed that the use of single targeted agent as third therapy did not significantly improved OS in comparison with docetaxel.

- Erlotinib-based combination as third therapy
  - Four included trials comparing erlotinib-based doublet versus erlotinib alone as third-line therapy reported survival data.
  - The pooled hazard ratio for PFS demonstrated that erlotinib-based doublet combination therapy in heavily treated NSCLC patients did not significantly improved PFS and when compared to erlotinib alone.

Anmerkung/Fazit der Autoren

In conclusion, this is the first-meta-analysis specifically assessing the efficacy of third-line therapy in the treatment of advanced NSCLC patients. The results of our study suggest that the efficacy of single novel targeted agent is comparable to that of docetaxel alone in terms of PFS and OS for heavily pretreated NSCLC patients. In addition, no survival benefits are obtained from erlotinib-based doublet therapy, thus single agent erlotinib could be recommended as third-line treatment for unselected advanced NSCLC patients. Further studies are recommended to specifically investigate the efficacy and toxicities of third-line therapy in the treatment of advanced NSCLC patients.

Kommentare zum Review

- None of the included trials report the toxicities of third-line therapy in heavily pretreated NSCLC patients
- Different targeted agents, including EGFR-TKIs and immune check point inhibitors, are included for analysis in the present study

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Zhao X et al., 2018 [84].

Ceritinib Alone for Crizotinib-naive Versus Crizotinib-pretreated for Management of Anaplastic Lymphoma Kinase-rearrangement None-Small-cell Lung Cancer: A Systematic Review

Fragestellung

The present systematic review aimed to assess the discrepancies in the efficacy and safety of ceritinib in crizotinib-naive and crizotinib-pretreated patients with ALK-rearrangement NSCLC detected by the whole body and intracranial responses.

Methodik

Population:

- crizotinib-naïve and crizotinib-pretreated patients with ALK-rearrangement NSCLC

Intervention:

- ceritinib

Komparator:

- k.A.

Endpunkte:

- ORR, PFS, DCR, and ORR for intracranial metastasis

Recherche/Suchzeitraum:

- Medline (via PubMed), Embase, Ovid, Web of Science, the Cochrane Library, ClinicalTrials.gov, Science Direct, and conference abstracts, between inception and August 2017

Qualitätsbewertung der Studien:

- Effective Public Health Practice Project Tool (EPHPP) assesses 6 aspects of interventions: selection bias, study design, confounders, blinding, data collection method, and withdrawals and dropouts, all of which is synthesized to calculate a global study rating, identified as strong, moderate, or weak

Ergebnisse

Anzahl eingeschlossener Studien:

- 8 reports (7 trials) with 1 015 participants included, reported from 2014 to 2017
- nine single-arm clinical studies were involved, including 968 patients altogether
  - 4 described ceritinib for crizotinib-naïve patients [18,19,21,22] and
  - 5 described ceritinib for crizotinib-pretreated patients [18-20,23,24]

Referenzen aus dem Review
18. Shaw AT, et al. Ceritinib in ALK-rearranged nonesmall-cell lung cancer. N Engl J Med 2014; 370:1189-97.
19. Kim DW, et al. Activity and safety of ceritinib in patients with ALK-rearranged non-small-cell lung cancer (ASCEND-1): updated results from the multicentre, open-label, phase 1 trial. Lancet Oncol 2016; 17:452-63.
20. Crinò L, et al. Multicenter phase II study of whole-body and intracranial activity with ceritinib in patients with ALK-rearranged non-small-cell lung cancer previously treated with chemotherapy and crizotinib: results from ASCEND-2. J Clin Oncol 2016; 34:2866-73.
21. Felip E, et al. ASCEND-3: a single-arm, open-label, multicentre phase II study of ceritinib in ALKi-naïve adult patients (pts) with ALKrearranged (ALKþ) non-small cell lung cancer (NSCLC). J Clin Oncol 2015; 90:208-17.
22. Soria JC, et al. First-line ceritinib versus platinum-based chemotherapy in advanced ALK-rearranged non-small-cell lung cancer (ASCEND-4): a randomised, open-label, phase 3 study. Lancet 2017; 389:917-29.
23. Shaw AT, et al. Ceritinib versus chemotherapy in patients with ALK-rearranged non-small-cell lung cancer previously given chemotherapy and crizotinib (ASCEND-5): a randomised, controlled, open-label, phase 3 trial. Lancet Oncol 2017; 18:874-86.
24. Hida T, et al. Ceritinib in patients with advanced, crizotinib-treated, anaplastic lymphoma kinase-rearranged NSCLC: Japanese subset. Jpn J Clin Oncol 2017; 47:618-24.

Charakteristika der Population:

- Mean Age: 45,5-56,0 years
- Female Sex: 50-67%
- Brain Metastases: 31-79%

Qualität der Studien:

- 4 (57%) classified as strong and 3 (43%) as moderate
- selection bias for 6 reports (86%) was rated as strong
- most studies representative of the target population

- blinding for 5 studies (71%) was strong (to blind the assessing researcher in most studies; was not always possible, two reports were rated as moderate because this was not reported)
- confounders and data collection methods were also relatively strong domains, with 4 (57%) and 6 (86%) reports, respectively, rated as strong (reliable and valid data collection methods used, withdrawals and dropouts reported, 1 study insufficiently described the data collection process)

Studienergebnisse:

Effect of NSCLC

- analysis for crizotinib-naive pooled data revealed a pooled ORR of 68,9% (95% CI: 64,3%-73,1%; no heterogeneity observed)
- PFS for crizotinib-naive treatment: 14,62 months (95%CI: 11,99-17,78 months; no heterogeneity observed)
- no evidence of publication bias
- most common types of **adverse events** and their incidence included
  - diarrhea (83.7%), nausea (74.9%), vomiting (61.5%), fatigue (33.3%), decreased weight (27.2%), decreased appetite (40.5%), increased alanine aminotransferase concentration (46.9%), increased aspartate aminotransferase (38.1%), increased blood alkaline phosphatase concentration (22.0%), and increased gammaglutamyltransferase (20.1%).
  - most adverse events were grade 1 or 2, a small proportion were grade 3 or 4

Effect of Brain Metastases

- pooled intracranial ORR with ceritinib used as the initial regimen: 50,4% (95% CI: 41,6%-59.2%; no heterogeneity observed)

Anmerkung/Fazit der Autoren

Ceritinib is an effective agent for both crizotinib-naive and crizotinib-pretreated patients with locally advanced or metastatic ALK-rearranged NSCLC. Ceritinib has significant activity in crizotinib-naïve patients with brain metastases.

Kommentare zum Review

- Phase I, II, III Studien eingeschlossen
- Siehe auch: Tian, W. et al., 2020 [63]

Petrelli F et al., 2018 [52].

Efficacy of ALK inhibitors on NSCLC brain metastases: A systematic review and pooled analysis of 21 studies

Fragestellung

In the current paper, we performed a pooled analysis, including data from ALK positive NSCLC patients with BMs receiving ALK inhibitors.

Methodik

Population:

- ALK positive NSCLC patients with BMs

Intervention:

- treatment with an ALK inhibitor

Komparator:

- k.A.

Endpunkte:

- intracranial objective response rate (IC ORR), intracranial disease control rate (ICC DCR): complete response, partial response, or stable disease for at least 24 weeks
- median PFS, median OS, one-year OS

Recherche/Suchzeitraum:

- PubMed (MEDLINE), EMBASE, The Cochrane Library, Scopus, and Web of Science, between inception and 30th June 2017

Qualitätsbewertung der Studien:

- assessed by Jadad scale for randomized controlled studies and Newcastle-Ottawa Scale (NOS) for retrospective cohort studies

Ergebnisse

Anzahl eingeschlossener Studien:

- 21studies , which included data from 1 016 patients with ALK positive NSCLC and BMs
  - 7 studies evaluated crizotinib [7-13], 5 ceritinib [14-18], 4 alectinib [19-22], 1 both crizotinib and alectinib [23], 1 included different ALK inhibitors [5], 2 evaluated brigatinib [24, 25]
  - in 1, the used ALK inhibitor(s) not specified [26]
  - 4 studies conducted in first line setting [9, 18, 23, 26]

Referenzen aus dem Review

9. Solomon BJ, et al. Intracranial Efficacy of Crizotinib Versus Chemotherapy in Patients With Advanced ALK-Positive Non-Small-Cell Lung Cancer: Results From PROFILE 1014. J Clin Oncol. 2016; 34(24):2858-65.
18. Soria JC, et al. First-line ceritinib versus platinum-based chemotherapy in advanced ALK-rearranged non-small-cell lung cancer (ASCEND-4): a randomised, open-label, phase 3 study. Lancet. 2017.
23. Peters S, et al. Alectinib versus Crizotinib in Untreated ALK-Positive Non-Small-Cell Lung Cancer. N Engl J Med. 2017.
26. Doherty MK, et al. Treatment options for patients with brain metastases from EGFR/ALK-driven lung cancer. Radiother Oncol. 2017; 123 (2):195-202.

  - 14 studies included patients pre-treated with at least one line of therapy [5, 7, 8, 12-17, 19-22, 25]
  - Three a cohort of patients receiving ALK inhibitors in different lines (first or beyond) [10, 11, 24]

Charakteristika der Population:

- No patient of the first-line studies had a previous chemotherapy.
- Between 38 and 100% had a previous local therapy.

Qualität der Studien:

- RCTs (Solomon BJ, et al.; Soria JC, et al.; Peters S, et al.): 4 points on Jadad scale with moderate risk of selection and attrition bias
- Retrospective study (Doherty MK, et al.): 6 points on NOS scale
- no evidence of publication bias observed

Studienergebnisse:

- **IC ORR and IC DCR** available in three out of five studies
- pooled ICC ORR: 39,17% (95%CI 13.1-65,2%), with heterogeneity observed
- pooled IC DCR: 70,3% (95%CI 47,7-86,0%), random effect model
- ICC ORR with alectinib: 59,0% (95%CI 29,3-83,0%),
- ICC ORR with ceritinib: 56,6% (95%CI 33,3-77,4%),
- ICC ORR with crizotinib: 26,0% (95%CI 8,9-55,9%)
- median **PFS** in naive patients: 7,3 months (range 5,9-10,7),
- median **IC PFS** was 13,2 months (range 7,0-15,7)
- median **OS**: 23 months
- pooled **one-year OS:** 64,0% (range 59,0-81,0%), data from two studies

Anmerkung/Fazit der Autoren

In conclusion, there is evidence, albeit of limited quality, that ALK positive NSCLC patients with BMs derive significant clinical benefit from ALK inhibitors with or without previous (whole) brain radiotherapy, and the efficacy is similar to that observed for extracranial systemic disease.

Based on these data, ALK inhibitors are effective in both naive and pre-treated patients with similar IC ORR and IC DCR, irrespective of the line of therapy.

Kommentare zum Review

- Funding: The authors received no specific funding for this work.
- Competing interests: The authors have declared that no competing interests exist.

Fan J et al., 2018 [19].

The efficacy and safety of alectinib in the treatment of ALK+ NSCLC: a systematic review and meta-analysis

Fragestellung

We performed this meta-analysis to synthesize the results of different clinical trials to evaluate the efficacy and safety of alectinib.

Methodik

Population:

- ALK+ NSCLC patients

Intervention:

- alectinib at any dose

Komparator:

- k.A.

Endpunkte:

- overall response rate (ORR), disease control rate, progression-free survival, intracranial ORR
- discontinuation rate, rate of dose reduction or interruption due to adverse events, incidence of several adverse events

Recherche/Suchzeitraum:

- PubMed, Web of Science, the Cochrane Library, from the inception through September 5, 2017

Qualitätsbewertung der Studien:

- Cochrane collaboration ROB tool, Newcastle–Ottawa scale (NOS) used

Ergebnisse

Anzahl eingeschlossener Studien:

- 8 studies (2 RCTs and 6 single-arm trials) with 626 patients (255 in the 2 RCTs and 371 in the 6 single-arm trials)
  - 3 studies with ALKi-naïve or untreated patients (Phase II or III)

Referenzen aus dem Review

15. Peters S, et al. Alectinib versus crizotinib in untreated ALK-positive non-small-cell lung cancer. N Engl J Med. 2017; 377(9):829–838.
23. Hida T, et al. Alectinib versus crizotinib in patients with ALK-positive non-small-cell lung cancer (J-ALEX): an open-label, randomised phase 3 trial. Lancet. 2017;390:29–39.
26. Seto T, et al. CH5424802 (RO5424802) for patients with ALK-rearranged advanced non-small-cell lung cancer (AF-001JP study): a single-arm, open-label, phase 1–2 study. Lancet Oncol. 2013; 14:590–598.

Charakteristika der Population:

- Median age (years): 48-61
- Median duration of follow-up (months): 7,6-18,6

Qualität der Studien:

- Cochrane ROB tool: high risk (2 phase III studies)
- NOS: 6 points (considered to be “moderate”)

Studienergebnisse:

- ORR 70% (95% CI: 57% to 82%),
- disease control rate 88% (95% CI: 82% to 94%),
- progression-free survival 9,36 months (95% CI: 7.38% to 11.34%),
- intracranial ORR 52% (95% CI: 45% to 59%)
- **ALK inhibitor-naïve patients**
  - better responses than crizotinib-pretreated patients (59%, 95% CI: 47% to 71% vs 48%, 95% CI: 38% to 57%)

- aggregate discontinuation rate is 7% (95% CI: 4% to 10%),
- pooled rate of dose reduction or interruption is 33% (95% CI: 24% to 42%)
- incidences of most adverse events were relatively low
- incidences of myalgia (18%) and anemia (25%) higher than with crizotinib

Anmerkung/Fazit der Autoren

Generally, alectinib is a drug with preferable efficacy and tolerable adverse effects, and it is suitable for the treatment of intracranial metastases.

Chen RL et al., 2019 [11].

The efficacy of PD-1/PD-L1 inhibitors in advanced squamous-cell lung cancer: a meta-analysis of 3112 patients.

Fragestellung

to conduct a meta-analysis of all eligible published studies to explore the efficacy of PD-1/PD-L1 inhibitors for advanced squamous-cell lung cancer patients.

Methodik

Population:

- patients with advanced squamous NSCLC

Intervention/Komparator:

- chemotherapy or immunotherapy (nivolumab, pembrolizumab, atezolizumab or avelumab) alone or in combination

Endpunkte:

- OS and/or PFS

Recherche/Suchzeitraum:

- Pubmed,Embase and the Cochrane library to identify all eligible trials regarding NSCLC, from the inception to each database until 1 May 2019

Qualitätsbewertung der Studien:

- Jadad scoring system

Ergebnisse

Anzahl eingeschlossener Studien:

- 11 studies involving 3112 patients with advanced squamous-cell NSCLC
- 6 were conducted in first-line setting, whereas five were conducted with second or additional lines oftherapy.

Charakteristika der Population:

Table 1. Characteristics of the studies included in the meta-analysis.

Clinical trials	Study	Phase	Line	Treatment groups	Patients	Median follow-up	Overall survival	Progression-free survival	Quality assessment
							HR (95% CI)	HR (95% CI)	
Checkmate 017 [19]	Brahmer *et al.* (2015)	3	>1	Nivolumab vs docetaxel	272	11.0	0.5 (0.44–0.79)	0.62 (0.47–0.81)	3
Checkmate 026 [22]	Carbone *et al.* (2017)	3	1	Nivolumab vs ICC	129	13.5	0.82 (0.54–1.24)	0.83 (0.54–1.26)	3
Checkmate 078 [17]	Wu *et al.* (2018)	3	>1	Nivolumab vs docetaxel	200	10.4	0.61 (0.42–0.89)	0.61 (0.42–0.87)	3
KEYNOTE 010 [18]	Herbst *et al.* (2016)	2/3	>1	Pembrolizumab vs docetaxel	222	13.1	0.74 (0.50–1.09)	0.86 (0.62–1.20)	3
KEYNOTE 024 [26]	Reck *et al.* (2016)	3	1	Pembrolizumab vs ICC	56	11.2	NA	0.35 (0.17–0.71)	3
KEYNOTE 042 [27]	Mok *et al.* (2019)	3	1	Pembrolizumab vs ICC	492	12.8	0.75 (0.6–0.93)	NA	3
KEYNOTE 407 [20]	Paz-Ares *et al.* (2018)	3	>1	Pembrolizumab + ICC vs placebo + ICC	559	7.8	0.64 (0.49–0.85)	0.56 (0.45–0.70)	5
OAK [16]	Rittmeyer *et al.* (2016)	3	>1	Atezolizumab vs docetaxel	222	21.0	0.73 (0.54–0.98)	NA	3
POPLAR [21]	Fehrenbacher *et al.* (2016)	2	>1	Atezolizumab vs docetaxel	97	14.8	0.80 (0.49–1.30)	NA	3
IMpower 131 [23]	Jotte *et al.* (2018)	3	1	Atezolizumab + CnP vs CnP	683	17.1	0.96 (0.78–1.18)	0.71 (0.60–0.85)	3
JAVELIN LUNG 200 [15]	Barlesi *et al.* (2018)	3	>1	Avelumab vs docetaxel	180	18.3	0.70 (0.48–1.01)	NA	3

CnP: Paclitaxel plus carboplatin; ICC: Investigator's choice of chemotherapy; NA: Not available.

Qualität der Studien:

- Siehe Charakteristika der Population (Tabelle 1)

Studienergebnisse:

- PD-1/PD-L1 inhibitors demonstrated significant superiority to chemotherapy in overall survival (OS) (hazard ratio [HR]: 0.74; $p < 0.001$) and progression-free survival (PFS) (HR: 0.66; $p < 0.001$) for squamous NSCLC.
- The OS and PFS benefits of PD-1/PD-L1 inhibitors for squamous NSCLC were similar in subgroup analyses of line settings, PD-L1 expression and different study methodologies.
- No advantage in OS was found in advanced squamous NSCLC patients treated with atezolizumab (HR: 0.87; $p = 0.087$).

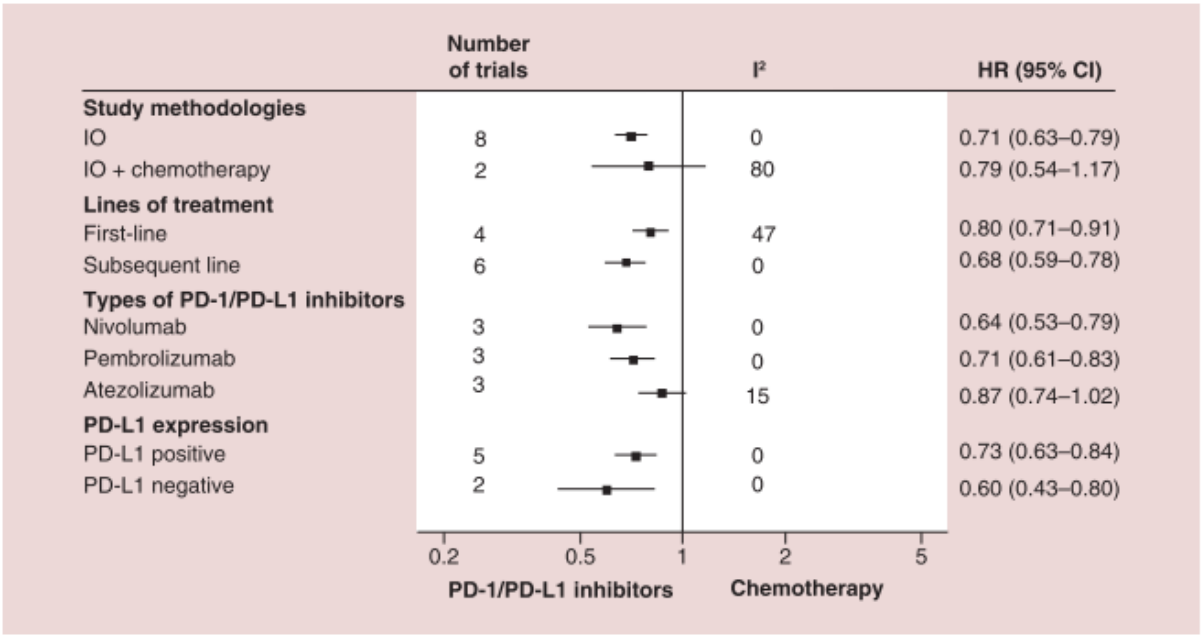


Figure 4. Subgroup analyses on overall survival according to study methodologies, lines of treatment, types of PD-1/PD-L1 inhibitors and PD-L1 expression.
HR: Hazard ratio; IO: Immunotherapy; IO+Chemotherapy: The combination of immunotherapy and chemotherapy; PD-1: Programmed death-1; PD-L1: Programmed death-ligand-1.

Anmerkung/Fazit der Autoren

In summary, treatment with PD-1/PD-L1 inhibitors resulted in significantly longer OS and PFS in advanced squamous NSCLC patients compared with chemotherapy. With improved PFS and OS, immunotherapy may be an optional treatment for squamous NSCLC patients.

Kommentar zum Review:

- Siehe auch: Li, S. et al., 2019 [38]

3.3 Leitlinien

National Institute for Health and Care Excellence (NICE), 2019 [48].

Lung cancer: diagnosis and management

- This guideline replaces CG121.
- This guideline is the basis of QS17.

Leitlinienorganisation/Fragestellung

This guideline covers diagnosing and managing non-small-cell and small-cell lung cancer. It aims to improve outcomes for patients by ensuring that the most effective tests and treatments are used, and that people have access to suitable palliative care and follow-up.

Methodik

Grundlage der Leitlinie

Update (This guideline replaces CG121, and is the basis of QS17).

- Repräsentatives Gremium;
- Interessenkonflikte und finanzielle Unabhängigkeit dargelegt;
- Systematische Suche, Auswahl und Bewertung der Evidenz;
- Formale Konsensusprozesse und externes Begutachtungsverfahren dargelegt;
- Empfehlungen der Leitlinie sind eindeutig und die Verbindung zu der zugrundeliegenden Evidenz ist explizit dargestellt;
- Regelmäßige Überprüfung der Aktualität gesichert.

Recherche/Suchzeitraum:

- NICE initially produced guidance on the diagnosis and treatment of lung cancer in February 2005, which was substantially updated and replaced in 2011 and has since been partially updated in March 2019. However pleural interventions were not included in either update, and so the recommendations below on pleural effusion date back to development of the original guideline in February 2005.
- The searches were conducted between October 2017 and April 2018 for 9 review questions (RQ).
- Searches were re-run in May 2018.

LoE

- trifft nicht zu (sieh sonstige methodische Hinweise)

GoR

- To avoid giving the impression that higher grade recommendations are of higher priority for implementation, NICE no longer assigns grades to recommendations.

Sonstige methodische Hinweise (Bei Einschränkung der o. g. Kriterien)

The guideline committee discussed the review questions and the need for clinical guidance in this area [note: systemic anti-cancer therapy] and agreed that instead of updating the chemotherapy for NSCLC recommendations (2005 recommendations 1.4.40 – 1.4.43) the guideline update should develop an algorithm outlining the treatment pathway for

systemic anti-cancer therapy treatments. This algorithm would provide a clear overview and contextualisation of systemic anti-cancer therapy treatments.

In March 2019, we reviewed the evidence and made new recommendations on:

- intrathoracic lymph node assessment
- brain imaging for people with non-small-cell lung cancer
- radical radiotherapy (including stereotactic ablative radiotherapy [SABR]) for people with non-small-cell lung cancer
- chemoradiotherapy and surgery for people with stage IIIA-N2 non-small-cell lung cancer
- thoracic radiotherapy and prophylactic cranial irradiation for people with small-cell lung cancer

We checked this guideline in June 2019. We found no new evidence that affects the recommendations in this guideline.

Updates-Kennzeichnung:

- These recommendations are marked [2005, amended 2019] or [2011, amended 2019].
- Recommendations marked [2005] or [2011] last had an evidence review in 2005 or 2011. In some cases, minor changes have been made to the wording to bring the language and style up to date, without changing the meaning.

Empfehlungen

Non-Squamous non-small-cell lung cancer, stages IIIB and IV

EGFR-TK mutation

- 1.4.45 For guidance on treatment for stage IIIB and IV non-squamous NSCLC in people with the epidermal growth factor receptor tyrosine kinase (EGFR-TK) mutation:
  - on progression for people with the EGFR T790M mutation, see the NICE technology appraisal guidance on osimertinib.
  - on progression after afatinib, erlotinib, gefitinib or osimertinib, offer pemetrexed with carboplatin or other platinum doublet chemotherapy.
  - on progression after first-line chemotherapy, see the NICE technology appraisal guidance on atezolizumab, nivolumab, pembrolizumab and nintedanib with docetaxel or offer docetaxel monotherapy. [2019]

ALK gene rearrangement

- 1.4.46 For guidance on treatment for stage IIIB and IV non-squamous NSCLC in people with the anaplastic lymphoma kinase-positive gene rearrangement:
  - on progression after first-line crizotinib, see the NICE technology appraisal guidance on ceritinib and brigatinib for second-line treatment
  - on progression, offer pemetrexed with carboplatin or other platinum doublet chemotherapy [5]
  - on progression after first-line chemotherapy, see the NICE technology appraisal guidance on atezolizumab, nivolumab, pembrolizumab and nintedanib with docetaxel or offer docetaxel monotherapy. [2019]

PDL1≥50% and no gene mutation or fusion protein

- 1.4.47 For guidance on treatment for stage IIIB and IV non-squamous NSCLC in people whose tumours express PD-L1 at 50% or above and who have no gene mutation or fusion protein:
  - on progression after pembrolizumab, offer pemetrexed with carboplatin or other platinum doublet chemotherapy [5]
  - on progression after first-line chemotherapy or pembrolizumab combination, see the NICE technology appraisal guidance on nintedanib with docetaxel or offer docetaxel monotherapy. [2019]

ROS1 positive

- 1.4.48 For guidance on treatment for stage IIIB and IV ROS1-positive non-squamous NSCLC:
  - on progression offer pemetrexed with carboplatin or other platinum doublet chemotherapy [5]
  - on progression after first-line chemotherapy see the NICE technology appraisal guidance on atezolizumab, nivolumab, pembrolizumab and nintedanib with docetaxel or offer docetaxel monotherapy. [2019]

No gene mutation or fusion protein and PD-L1<50%

- 1.4.49 For guidance on treatment for stage IIIB and IV non-squamous NSCLC in people who do not have a gene mutation, fusion protein or biomarker:
  - on progression after first-line chemotherapy see the NICE technology appraisal guidance on atezolizumab, nivolumab, pembrolizumab and nintedanib with docetaxel or offer docetaxel monotherapy
  - on progression after pembrolizumab combination, see the NICE technology appraisal guidance on nintedanib with docetaxel or offer docetaxel monotherapy. [2019]

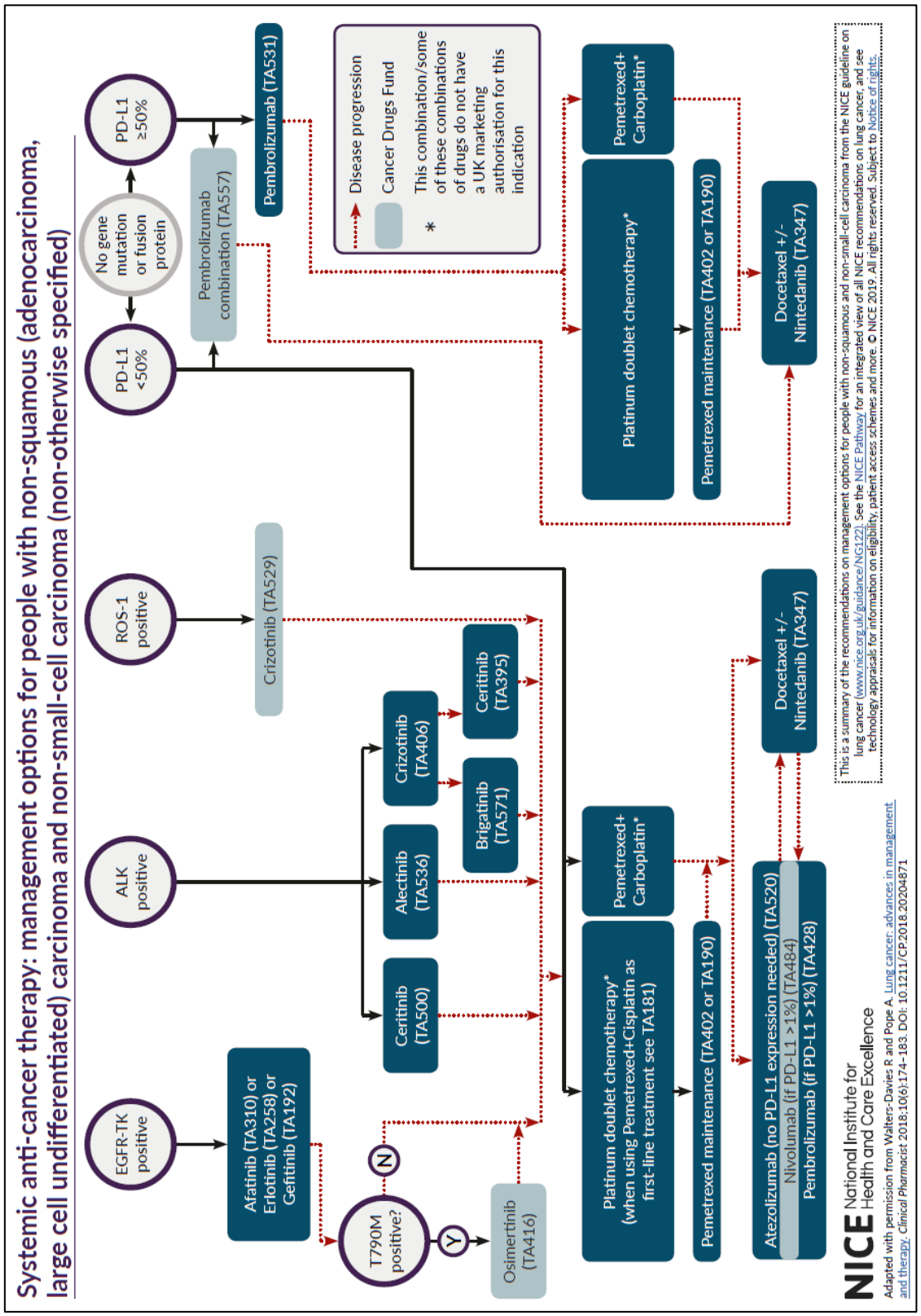
Squamous non-small-cell lung cancer

- PDL1≥50%: For guidance on treatment for squamous NSCLC in people whose tumours express PD-L1 at or above 50%:
  - on progression, offer gemcitabine or vinorelbine and cisplatin or carboplatin
  - on progression after first-line chemotherapy, offer docetaxel monotherapy. [2019]

PDL1<50%

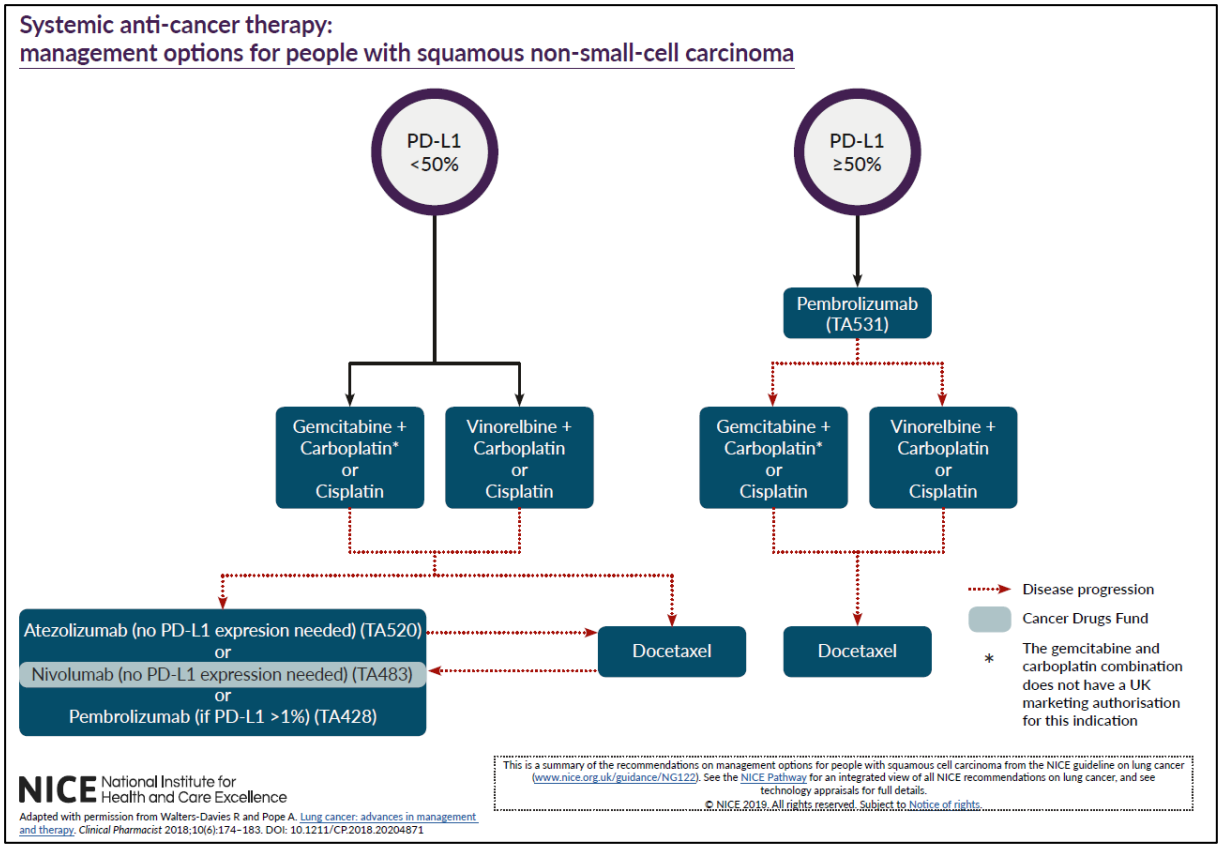
- 1.4.51 For guidance on treatment for squamous NSCLC in people whose tumours express PD-L1 below 50%:
  - on progression after first-line chemotherapy, see the NICE technology appraisal guidance on atezolizumab, nivolumab and pembrolizumab, or offer docetaxel monotherapy. [2019]

Systemic anti-cancer therapy (SACT) for advanced non-small-cell lung cancer (non-squamous)



Squamous non-small-cell lung cancer, stages IIIB and IV

Systemic anti-cancer therapy (SACT) for advanced non-small-cell lung cancer (squamous)



Leitlinienprogramm Onkologie (Deutsche Krebsgesellschaft (DKG), et al., 2018 [36].

Prävention, Diagnostik, Therapie und Nachsorge des Lungenkarzinoms (AWMF-Registernr. 020-007)

Siehe auch: Leitlinienprogramm Onkologie (Deutsche Krebsgesellschaft (DKG), et al., 2018 [35].

Fragestellung

Von der Steuergruppe wurden für die Aktualisierung der Leitlinie die folgenden Themen priorisiert:

- …
- Therapie des NSCLC im Stadium IIB & IV
- …

Methodik

Grundlage der Leitlinie

Update: gezielte Aktualisierung der Originalversion von 2010

- Repräsentatives Gremium;
- Interessenkonflikte und finanzielle Unabhängigkeit dargelegt;
- Systematische Suche, Auswahl und Bewertung der Evidenz;

- Formale Konsensusprozesse und externes Begutachtungsverfahren dargelegt;
- Empfehlungen der Leitlinie sind eindeutig und die Verbindung zu der zugrundeliegenden Evidenz ist explizit dargestellt;
- Regelmäßige Überprüfung der Aktualität gesichert.

Recherche/Suchzeitraum:

- 1. Aktualisierung für den Zeitraum 2013-2018

LoE

- entsprechend der Vorgaben des Oxford Centre for Evidence-Based Medicine

GoR

- Stärke der aktualisierten Empfehlung (gekennzeichnet mit „2018“) unterschieden in A/B/0, die sich auch in der Formulierung der Empfehlungen widerspiegeln

Sonstige methodische Hinweise (Zitat aus dem Leitlinienreport):

Unter dem Stichwort „Personalisierte Therapie“ oder „Stratifizierende Therapie“ hatten sich die Prinzipien insbesondere der Chemotherapie im metastasierten Stadium tiefgreifend geändert. Dieses galt in 2013 insbesondere für die Erstlinien-Chemotherapie bei Nachweis einer EGFR-Mutation sowie für die Zweitlinien-Chemotherapie bei Nachweis einer EML4-ALK-Translokation.

Ein weiterer Aspekt der Chemotherapie im metastasierten Stadium des NSCLC mit neuen wissenschaftlichen Erkenntnisse war die sog. Erhaltungschemotherapie: nach Abschluss der Erstlinienchemotherapie kann durch die sich sofort anschließende Therapie mit dem Tyrosinkinase-Inhibitor Erlotinib oder dem Zytostatikum Pemetrexed eine Verlängerung des Progressionfreien Überlebens (PSF) – allerdings nicht der Gesamtüberlebenszeit – erreicht werden.

Im Zuge des Aktualisierungsprozesses wurde weitere neue Arzneimittel für die Therapie des Lungenkarzinoms zugelassen. Dies machte weitere Diskussionen der Therapieempfehlungen notwendig.

Empfehlungen

Empfehlungen zur molekularen Testung (siehe Kapitel 6.6.10)	
EK	Anhand des zur Verfügung stehenden Tumorgewebes / der Tumorzellen von allen nicht kurativ behandelbaren nichtplattenepithelialen NSCLC sollen molekularpathologische Untersuchungen hinsichtlich aller therapeutisch relevanten molekularer Veränderungen (nach gegenwärtigem Stand vor Erstlinientherapie als Mindestanforderung EGFR-Mutationen in den Exonen 18-21, ALK-Fusionen und ROS1-Fusionen, BRAF V600 Mutationen) eingeleitet werden. Dies gilt ebenfalls für Plattenepithelkarzinome von Nie-Rauchern/Leichtrauchern.
EK	In den Gewebeproben von Therapie-naiven Patienten im Stadium IV soll parallel zu den molekularpathologischen Untersuchungen eine immunhistochemische Untersuchung auf PD-L1-Expression durchgeführt werden*. Das Ergebnis ist als Prozentsatz membranös positiver Tumorzellen (sog. Proportion Score) anzugeben. Eine externe Qualitätssicherung im Rahmen von Ringversuchen soll nachgewiesen werden. * Die Empfehlung zur Untersuchung der PD-L1-Expression gilt für alle histologischen NSCLC-Typen (siehe auch Therapiealgorithmus NSCLC IV).

Zweitlinientherapie bei Patienten mit Plattenepithelkarzinom und ohne Mutationsnachweis

8.78.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad **A**	Patienten mit Plattenepithelkarzinom in gutem Allgemeinzustand (ECOG 0,1) mit einer Erkrankungsprogression nach primärer Kombinations-Chemotherapie soll eine Zweitlinientherapie bis zum Progress oder Auftreten von Toxizitäten angeboten werden.	
Level of Evidence **1b**	Literatur: [835-841]	
	Konsensstärke: 96 %	

8.79.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad **A**	Patienten mit Plattenepithelkarzinom in gutem Allgemeinzustand (ECOG 0,1) und keinen Kontraindikationen gegen eine Immuncheckpoint-Inhibitor-Therapie soll ein PD1-Antikörper in der Zweitlinientherapie angeboten werden.	
Level of Evidence **1b**	Literatur: [840]	
	Konsensstärke: 75 %	

8.80.	Konsensbasierte Empfehlung	2018
EK	Bei Patienten mit Plattenepithelkarzinom mit ECOG 2 und keinen Kontraindikationen gegen eine Immuncheckpoint-Inhibitor-Therapie kann ein PD1-Antikörper in der Zweitlinientherapie angeboten werden.	
	Konsensstärke: 81 %	

8.81.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad **0**	Patienten mit Plattenepithelkarzinom in gutem Allgemeinzustand (PS 0,1) und keinen Kontraindikationen gegen einen Angiogenese-Inhibitor kann eine Zweitlinientherapie mit Docetaxel und Ramucirumab angeboten werden.	
Level of Evidence **1b**	Literatur: [841]	
	Konsensstärke: 83 %	

8.82.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad **0**	Patienten mit Plattenepithelkarzinom in gutem Allgemeinzustand (PS 0,1) kann eine Zweitlinientherapie mit Afatinib angeboten werden.	
Level of Evidence **1b**	Literatur: [839]	
	Konsensstärke: 85 %	

8.83.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad **0**	Bei Patienten mit Plattenepithelkarzinom, die als Zweitlinientherapie eine Immuncheckpoint-Inhibitortherapie erhalten haben und keine Kontraindikationen gegen eine Drittlinientherapie aufweisen, kann Docetaxel oder Docetaxel/Ramucirumab oder Afatinib angeboten werden.	
Level of Evidence 1b	Literatur: [840, 842]	
	Konsensstärke: 81 %	

8.84.	Evidenzbasierte Empfehlung	2018
EK	Bei der Verfügbarkeit von mehreren Therapieoptionen kann Patienten mit Plattenepithelkarzinom und gutem Allgemeinzustand nach Versagen einer Immuntherapie bei Progress die Durchführung einer Chemotherapie angeboten werden.	
	Konsensstärke: 86 %	

Zweitlinientherapie bei Patienten mit nicht-Plattenepithelkarzinom ohne Mutationsnachweis

8.85.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad **B**	Patienten mit Nicht-Plattenepithelkarzinom ohne Treibermutation und bei nachgewiesener PDL1-Positivität sollte in der Zweitlinientherapie eine Therapie mit einem PD1-Inhibitor angeboten werden.	
Level of Evidence **1b**	Literatur: [842, 843]	
	Konsensstärke: 96 %	

8.86.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad **A**	Bei Patienten (ECOG 0-1) mit Nicht-Plattenepithelkarzinom und PDL1-Negativität soll eine 2. Linientherapie angeboten werden. Therapieoption sind: - Docetaxel-Nintedanib, - Docetaxel-Ramucirumab, - Pemetrexed, - Docetaxel, - Erlotinib - Nivolumab.	
Level of Evidence **1b**	Literatur: [835-838, 841-845]	
	Konsensstärke: 88 %	

8.87.	Konsensbasierte Empfehlung	2018
EK	Bei Patienten mit Nicht-Plattenepithelkarzinom und PDL-1-Negativität sollten in die Entscheidung der Positionierung der Therapie in die Zweit- oder Drittlinie klinische Faktoren wie Rezidivzeitpunkt, Raucherstatus, Tumordynamik, Mutationsstatus, Komorbiditäten, und die Verträglichkeit der Erstlinientherapie einbezogen werden.	
	Konsensstärke: 100%	

8.88.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad **B**	Patienten mit Nicht-Plattenepithelkarzinom, die als Zweitlinientherapie eine Immuncheckpoint-Inhibitor-Therapie erhalten haben und keine Kontraindikationen gegen eine Drittlinientherapie aufweisen, sollte eine weitere Therapielinie angeboten werden. Therapieoptionenen sind: - Docetaxel - Pemetrexed - Docetaxel mit Ramucirumab/Nintedanib - Erlotinib.	
Level of Evidence **1b**	Literatur: [835-838, 841, 844, 845]	
	Konsensstärke: 96 %	

8.89.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad **0**	Patienten mit Nicht-Plattenepithelkarzinom mit ECOG 2 und keinen Kontraindikationen gegen eine Immuncheckpoint-Inhibitor-Therapie kann ein PD1 Antikörper in der Zweitlinientherapie angeboten werden.	
Level of Evidence **1b**	Literatur: [842, 843]	
	Konsensstärke: 93 %	

Systemtherapie bei Patienten mit aktivierender Mutation des EGF-Rezeptors (ECOG 0-4)

8.90.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad **A**	Bei Vorliegen einer aktivierenden EGFR Mutation soll bei Patienten mit ECOG 0-2 in der Erstlinientherapie ein EGFR-TKI abgeboten werden.	
Level of Evidence **1a**	Literatur: [850-862]	
	Konsensstärke: 100 %	

8.91.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad B	Aufgrund der Überlebensdaten sollte bei Exon 19 deletierten Tumoren Afatinib angeboten werden.	
Level of Evidence 1b	Literatur: [859]	
	Konsensstärke: 88 %	

8.92.	Evidenzbasierte Empfehlung	2018
EK	Bei Vorliegen einer aktivierenden EGFR Mutation sollte bei Patienten mit ECOG 3-4 in der Erstlinientherapie ein EGFR-TKI angeboten werden.	
	Konsensstärke: 96 %	

8.92.	Evidenzbasierte Empfehlung	2018
EK	Bei Vorliegen einer aktivierenden EGFR Mutation sollte bei Patienten mit ECOG 3-4 in der Erstlinientherapie ein EGFR-TKI angeboten werden.	
	Konsensstärke: 96 %	

8.93.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad B	Bei Patienten mit seltenen EGF-R Tumormutationen der Gruppe 1 sollten TKI angeboten werden. Die Datenlage spricht für den bevorzugten Einsatz von Afatinib.	
Level of Evidence 1b	Literatur: [861]	
	Konsensstärke: 89 %	

8.94.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad A	Bei Patienten mit seltenen EGF-R Tumormutationen der Gruppen 2 sollen T790M spezifische Substanzen angeboten werden.	
Level of Evidence 1b	Literatur: [863]	
	Konsensstärke: 89 %	

8.95.	Konsensbasierte Empfehlung	2018
EK	Patienten mit seltenen EGF-R Tumormutationen der Gruppe 3 sollten - bis zur Verfügbarkeit von spezifischen Substanzen - wie EGFR-Wildtyp-Patienten behandelt werden.	
	Konsensstärke: 92 %	

8.96.	Evidenzbasiertes Statement	2018
Level of Evidence 2	Eine Erstlinientherapie mit Erlotinib und Bevacizumab bei EGFR-mutierten Patienten wurde in einer kleinen japanischen Studie untersucht. Aktuell kann nicht beurteilt werden, ob diese Kombinationstherapie für ein größeres Patientenkollektiv z.B. auch bei Kaukasiern in Frage kommt.	
	Literatur: [869]	
	Konsensstärke:89 %	

Resistenzmechanismen und Zweitlinientherapie bei EGFR mutierten Patienten

8.97.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad A	Bei Nachweis einer erworbenen EGFR-TKI-Resistenz durch Akquisition einer EGFR-T790M-Mutation soll eine T790M spezifische Substanz angeboten werden.	
Level of Evidence 1b	Literatur: [863, 870]	
	Konsensstärke: 100 %	

8.98.	Konsensbasierte Empfehlung	2018
Empfehlungsgrad EK	Bei fehlendem Nachweis einer erworbenen EGFR-T790M-Mutation und fehlendem Nachweis von weiteren therapierbaren genetischen Alterationen sollte analog zur Erstlinientherapie - Wildtyp vorgegangen werden.	
	Konsensstärke: 96 %	

8.99.	Evidenzbasierte Empfehlung	2018
EK	Bei Resistenzmechanismen, die potentiell therapierbar sind, sollten Patienten in Studien eingeschlossen werden. Falls dies nicht möglich ist, sollte der Einsatz von potentiell wirksamen Substanzen unabhängig vom Zulassungsstatus erwogen werden.	
	Konsensstärke: 100 %	

Systemtherapie bei Patienten mit ALK-Translokation oder weiteren bekannten Treibermutationen (ECOG 0-4)

8.6.6.2. Zweitlinientherapie nach Versagen einer platinbasierten Standardchemotherapie

8.101.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad **A**	ALK positiven NSCLC-Patienten mit Progress nach platinbasierter Standardchemotherapie, die in der Erstlinie keinen ALK-Inhibitor erhalten haben, soll Crizotinib angeboten werden.	
Level of Evidence **1b**	Literatur: [875]	
	Konsensstärke: 100 %	

8.6.6.3. Therapie nach Crizotinib-Versagen

8.102.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad **A**	ALK-Inhibitoren der zweiten Generation sollen ALK positiven NSCLC Patienten bei Crizotinib/ALK-TKI Versagen angeboten werden.	
Level of Evidence **1b**	Literatur: [876]	
	Konsensstärke: 85 %	

8.6.6.4. Therapie nach Versagen der zugelassenen ALK-Inhibitoren Crizotinib und Ceritinib

8.103.	Evidenzbasierte Empfehlung	2018
EK	ALK positive NSCLC-Patienten mit Versagen von zugelassenen ALK-Inhibitoren sollten nach Möglichkeit in klinische Studien oder Compassionate-Use-Programme mit weiteren ALK-Inhibitoren eingeschlossen werden. Falls dies nicht möglich ist, werden sie mit Chemotherapie entsprechend Wildtyp-Patienten behandelt. Pemetrexed hat die höchste intrinsische Effektivität bei ALK + Tumoren.	
	Konsensstärke: 100 %	

8.104.	Evidenzbasierte Empfehlung	2018
EK	Bei Zulassung neuer-ALK Inhibitoren sollte eine Rebiopsie in Analogie zur akquirierten EGFR-Resistenz erfolgen.	
	Konsensstärke: 84 %	

Systemtherapie bei Patienten mit ROS1-Fusionsgenen (ROS1 + NSCLC)

8.6.7.2. **Zweitlinientherapie (bei Crizotinib-Versagen)**

8.106.	Konsensbasierte Empfehlung	2018
EK	Bei Progress unter Therapie mit Crizotinib und fehlender Möglichkeit des Einschlusses in eine Studie mit einem Nächstgenerations-ROS1-Inhibitor sollte, abhängig vom Allgemeinzustand des Patienten, entweder mit einer platinbasierten Kombinationschemotherapie oder einer Monotherapie angeboten werden (siehe Kapitel Chemotherapie).	
	Konsensstärke: 100 %	

8.6.8. Systemtherapie bei Patienten mit BRAF-V600-Mutation

8.107.	Evidenzbasierte Empfehlung	2018
Empfehlungsgrad B	NSCLC IV- Patienten mit nachgewiesener BRAF-V600-Mutation sollte eine Kombination aus Dabrafenib und Trametinib angeboten werden.	
Level of Evidence 2b	Literatur: [880]	
	Konsensstärke: 100 %	

Therapie bei sonstigen Treibermutationen beim NSCLC

8.108.	Konsensbasierte Empfehlung	2018
EK	Bei Patienten mit Wildtypkonfiguration für EGFR, ALK und ROS1 sowie BRAF V600 Mutationen sollte eine umfassende Genotypisierung auf bekannte Treibermutationen stattfinden, um bei dem Nachweis einer solchen eine zielgerichtete Therapie im Rahmen der Zulassung (z.B. für BRAF-V600 Mutationen), einer Studie oder im Off-Label-Use zu ermöglichen. Diese Analyse sollte insbesondere HER2-Mutationen, MET-Amplifikationen, MET-Exon-14-skipping-Mutationen und RET-Fusionen beinhalten. Vor dem Hintergrund der dynamischen Entwicklung in der molekularen Pathologie soll dadurch eine umfassende Analyse von potentiell therapierbaren Treibermutationen und ein auf dem Ergebnis der Mutationsanalyse basierendes Therapieangebot an den Patienten (inkl. Aufnahme in klinische Studien) ermöglicht werden.	
	Konsensstärke: 92 %	

Hintergrund zu MET.Amplifikation:

(…) High-level MET-Amplifikationen oder aktivierende Mutationen im Exon 14 des MET-Gens wurden ebenfalls als Treibermutationen beschrieben. Sie kommen in ca. 2-4 % der Adenokarzinome und ca. 1-2 % der Plattenepithelkarzinome der Lunge vor [888]. Verschiedene MET-Inhibitoren werden in klinischen Studien evaluiert. Bei Behandlung von Patienten mit MET-Amplifikation mit dem ALK/ROS/MET Inhibitor Crizotinib wurde in der Zwischenanalyse einer Phase-II-Studie Ansprechen in Abhängigkeit von der Höhe der MET-Amplifikation gezeigt (high-level MET Amplifikation: ORR 50% (3/6) (NCT00585195, [889].

Die Endergebnisse dieser Studie stehen noch aus. Laufende Stu-dien evaluieren zahlreiche MET-Inhibitoren in dieser NSCLC-Subgruppe.

Weitere Treibermutationen werden zur Zeit als therapeutische Targets in zahlreichen klinischen Studien evaluiert (z.B. NTRK 1/2/3-Fusionen, DDR2-Mutationen, FGFR1-Mutationen/-amplifikationen u.a).

(…)

Systemtherapie (Drittlinie und ggf. weitere)

8.109.	Konsensbasierte Empfehlung	2018
EK	Bei Patienten in adäquatem Allgemeinzustand (ECOG 0-2), die nach einer Zweitlinientherapie progredient sind, sollte eine Drittlinientherapie angeboten werden.	
	Konsensstärke: 100 %	

8.110.	Konsensbasierte Empfehlung	2018
EK	Patienten mit adäquatem Allgemeinzustand (ECOG 0-2) und mit längerfristigem Krankheitsverlauf kann bei entsprechender klinischer Situation zur Symptom-kontrolle eine weitere Antitumortherapie auch nach der Drittlinienbehandlung angeboten werden.	
	Konsensstärke: 100 %	

National Cancer Control Programme Guideline Development Group (GDG), 2017 [47].

Diagnosis, staging and treatment of patients with lung cancer.

Leitlinienorganisation/Fragestellung

Recommendations for patients with advanced/stage IV NSCLC.

Methodik

Grundlage der Leitlinie

- Repräsentatives Gremium (ohne Patientenvertretung);
- Standardisierter Umgang mit Interessenkonflikten beschrieben aber nicht offengelegt und finanzielle Unabhängigkeit dargelegt;
- Systematische Suche, Auswahl und Bewertung der Evidenz;
- Konsensusprozesse nicht erwähnt und externes Begutachtungsverfahren (Patientinnen und Patienten, Interessenvertretungen, internationale Fachleute) dargelegt;
- Empfehlungen der Leitlinie sind eindeutig und die Verbindung zu der zugrundeliegenden Evidenz ist indirekt über den Hintergrundtext dargestellt;
- Regelmäßige Überprüfung der Aktualität gesichert.

Recherche/Suchzeitraum:

- literature was updated prior to publication, made a complete review and rewrite of the medical oncology section in July 2016 necessary

LoE/GoR

- SIGN grading system 1999-2012
- B: A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; or extrapolated evidence from studies rated as 1++ or 1+.

Empfehlungen

Second and third-line therapy:

Recommendation 2.6.7.1	Grade
Second-line systemic anticancer therapy (SACT) with single agent drugs should be considered. The choice of agent to be used should be made on a case by case basis taking into account previous treatment, mutation status and co-morbidities.	B

Hanna N et al., 2021 [24].

Therapy for Stage IV Non-Small-Cell Lung Cancer With Driver Alterations: ASCO and OH (CCO) Joint Guideline Update.

Fragestellung

to provide evidence-based recommendations updating the 2017 ASCO guideline on systemic therapy for patients with stage IV non–small-cell lung cancer (NSCLC) without driver alterations. A guideline update for patients with stage IV NSCLC with driver alterations will be published separately

Methodik

Grundlage der Leitlinie

Update der Version von Hanna N. et al. 2020 [25] & 2017 [23]

- Repräsentatives Gremium;
- Interessenkonflikte untersucht, finanzielle Unabhängigkeit nicht erwähnt;
- Systematische Suche, Auswahl und Bewertung der Evidenz;
- Formale und informale Konsensusprozesse durchgeführt und externes Begutachtungsverfahren dargelegt;
- Empfehlungen der Leitlinie sind eindeutig und die Verbindung zu der zugrundeliegenden Evidenz ist explizit dargestellt;
- Regelmäßige Überprüfung der Aktualität gesichert.

Recherche/Suchzeitraum:

- a systematic review of randomized controlled trials (RCTs) from December 2015 to January 2020 and meeting abstracts from ASCO 2020.

LoE/SoE:

- GRADE

Recommendations

Recommendation 1.9. For patients with stage IV NSCLC and driver alterations in *EGFR* causing resistance to first- and second-generation EGFR TKIs

- In the first-line setting, for patients with *EGFR* exon 20 insertion mutation causing resistance to first- and second-generation EGFR TKIs, doublet chemotherapy with or without bevacizumab or standard treatment outlined in the ASCO/OH nondriver mutation guideline may be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: moderate).

Recommendations 2.1 and 2.2. For patients with stage IV NSCLC and driver alterations in *EGFR*

- In the second-line setting, for patients who did not receive osimertinib and have a T790M mutation at the time of progressive disease, osimertinib should be offered (Evidence quality: high; Strength of recommendation: strong).
- In the second-line setting, for patients with any *EGFR* mutation who have progressed on EGFR TKIs with no T790M mutation OR whose disease has progressed on osimertinib, treatment based on the ASCO/OH nondriver mutation guideline may be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: moderate).

Recommendations 4.1, 4.2, and 4.3. For patients with stage IV NSCLC and driver alterations in *ALK*

- In the second-line setting, if alectinib or brigatinib was given in the first-line setting, lorlatinib may be offered (Type: informal consensus; Evidence quality: low; Strength of Recommendation: moderate).
- In the second-line setting, if crizotinib was given in the first-line setting, then alectinib, brigatinib, or ceritinib should be offered (Evidence quality: intermediate; Strength of recommendation; strong).
- In the third-line setting, if crizotinib was given in the first-line setting and alectinib, brigatinib, or ceritinib in the second-line setting, then lorlatinib may be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: moderate) or standard treatment based on the ASCO/OH nondriver mutation guideline may be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: weak).

Recommendations 6.1 and 6.2. For patients with stage IV NSCLC and driver alterations in *ROS1*

- In the second-line setting, if ROS1-targeted therapy was given in the first-line setting, standard treatment based on the ASCO/OH nondriver mutation guideline should be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: moderate).
- In the second-line setting, if nontargeted therapy was given in the first-line setting, crizotinib, ceritinib, or entrectinib may be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: moderate).

Recommendations 8.1, 8.2, 8.3, and 8.4. For patients with stage IV NSCLC and driver alterations with *BRAF* V600E mutation

- In the second-line setting, if previous BRAF/MEK-targeted therapy (dabrafenib/trametinib) was given in the first-line setting, standard treatment based on the ASCO/OH nondriver mutation guideline should be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: moderate).
- In the second-line setting, if BRAF-targeted therapy was not given in the first-line setting, dabrafenib/trametinib may be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: moderate) or dabrafenib or vemurafenib alone may be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: weak).
- If previous chemotherapy, immunotherapy, and/or BRAF-targeted therapy were given in the first- or subsequent-line setting, standard treatment based on the ASCO/OH nondriver mutation guideline should be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: moderate).

Recommendation 8.4. For patients with stage IV NSCLC and driver alterations with *BRAF* mutations other than V600E

- In the second-line setting, standard treatment based on the ASCO/OH nondriver mutation guideline should be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: moderate).

Recommendations 10.1 and 10.2. For patients with stage IV NSCLC and *MET* exon 14 skipping mutation

- In the second-line setting, for *MET* abnormalities other than exon 14 skipping mutations or if MET-targeted therapy was given in the first-line setting, standard treatment based on the ASCO/OH nondriver mutation guideline should be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: moderate).

- In the second-line setting, patients with an *MET* exon 14 skipping mutation who previously received or were ineligible for first-line chemotherapy with or without immunotherapy (ie, if MET-targeted therapy was not given in the first-line setting), capmatinib or tepotinib may be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: moderate).

Recommendations 12.1, 12.2, and 12.3. For patients with stage IV NSCLC and driver alterations in *RET*

- In the second-line setting, if RET-targeted therapy was given in the first-line setting, standard treatment based on the ASCO/OH nondriver mutation guideline may be offered (Type: informal consensus; Evidence quality: low; Strength of Recommendation: moderate).
- In the second-line setting, if RET-targeted therapy was not given in the first-line setting, selpercatinib may be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: moderate) or pralsetinib* may be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: weak).

Recommendations 14.1 and 14.2. For patients with stage IV NSCLC and driver alterations in *NTRK*

- In the second-line setting, if NTRK-targeted therapy was given in the first-line setting, standard treatment based on the ASCO/OH nondriver mutation guideline may be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: moderate).
- In the second-line setting, if NTRK-targeted therapy was not given in the first-line setting, entrectinib or larotrectinib may be offered (Type: informal consensus; Evidence quality: low; Strength of recommendation: moderate).

Note: Unless otherwise listed, recommendations apply to patients with a PS of 0-2.

Australian Government Cancer Council Australia, 2017 [5].

Clinical practice guidelines for the treatment of lung cancer

Leitlinienorganisation/Fragestellung

In a project commissioned by Cancer Australia (CA), CCA undertook to develop a sustainable web-based wiki platform with revised guidelines for the treatment of lung cancer as the first topic.

Methodik

Grundlage der Leitlinie

- The small Management Committee appointed in 2009 is responsible to oversee the guidelines revision project. The Management Committee is responsible for the overall management and strategic leadership of the guidelines review process.
- The Management Committee proposed lead authors for each included clinical question.
- The Management Committee agreed to use Cancer Council Australia's Cancer Guidelines Wiki Platform and approach to develop the guidelines. The Wiki Platform is web-based and supports all processes of guidelines development, such as the literature search, critical appraisal, data extraction, evidence assessment and summary processes, as well as content and recommendation development, online consultation, review and web publication.
- Steps in preparing clinical practice guidelines
  1. Develop a structured clinical question in PICO format
  2. Search for existing relevant guidelines and SR answering the clinical question
  3. Perform systematic review process (systematic review protocol and systematic literature search strategy for each PICO question; Body evidence table of all included literature)
  4. Summarise the relevant data
  5. Assess the body of evidence and formulate recommendations
  6. Write the content narrative
- Funding: The revised Clinical practice guidelines for the prevention and diagnosis of lung cancer are developed by Cancer Council Australia. No external funding has been received.

Recherche/Suchzeitraum:

- Bis 2015

LoE

- NHMRC Evidence Hierarchy (Siehe Anhang Abbildung 3)

GoR

Component of Recommendation	Recommendation Grade			
	A Excellent	B Good	C Satisfactory	D Poor
Volume of evidence 1**	one or more level I studies with a low risk of bias or several level II studies with a low risk of bias	one or two level II studies with a low risk of bias or a systematic review/several level III studies with a low risk of bias	one or two level III studies with a low risk of bias, or level I or II studies with a moderate risk of bias	level IV studies, or level I to III studies/systematic reviews with a high risk of bias
Consistency 2**	all studies consistent	most studies consistent and inconsistency may be explained	some inconsistency reflecting genuine uncertainty around clinical question	evidence is inconsistent
Clinical impact	very large	substantial	moderate	slight or restricted
Generalisability	population/s studied in body of evidence are the same as the target population for the guideline	population/s studied in the body of evidence are similar to the target population for the guideline	population/s studied in body of evidence differ to target population for guideline but it is clinically sensible to apply this evidence to target population[3]	population/s studied in body of evidence different to target population and hard to judge whether it is sensible to generalise to target population
Applicability	directly applicable to Australian healthcare context	applicable to Australian healthcare context with few caveats	probably applicable to Australian healthcare context with some caveats	not applicable to Australian healthcare context

Table 3. Overall recommendation grades

Grade of recommendation	Description
A	Body of evidence can be trusted to guide practice
B	Body of evidence can be trusted to guide practice in most situations
C	Body of evidence provides some support for recommendation(s) but care should be taken in its application
D	Body of evidence is weak and recommendation must be applied with caution

Sonstige methodische Hinweise

- Da diese Leitlinie die Empfehlungen erst im Jahr 2015 getroffen hat, wird die zugrundeliegende Literatur aufgeführt.

Empfehlungen - Stage IV inoperable NSCLC

What is the optimal second-line chemotherapy regimen in patients with stage IV inoperable NSCLC?

Evidence summary	Level	References
In previously treated patients with advanced NSCLC, single agent docetaxel 75 mg/m2 improves survival compared with best supportive care or vinorelbine and ifosfamide. Last reviewed September 2017	II	[1], [2]
In previously treated patients with advanced NSCLC not suitable for immunotherapy, single agent pemetrexed has similar efficacy but fewer side effects than three-weekly docetaxel. Last reviewed September 2017	II	[5]
In previously treated patients with advanced NSCLC, compared with docetaxel, pemetrexed appears to have greater efficacy in non-squamous cell carcinoma histology, and inferior efficacy in squamous cell carcinoma. Last reviewed September 2017	I	[7]

+ Evidence-based recommendation?	Grade
In unselected patients previously treated for advanced NSCLC not suitable for immunotherapy, chemotherapy with docetaxel or pemetrexed may be used as second-line therapy. Pemetrexed is preferred in non-squamous cell carcinoma histology, and docetaxel is preferred in squamous cell carcinoma. Last reviewed September 2017	B

Evidence summary	Level	References
Doublet therapy as second-line treatment of advanced NSCLC increases response rate and progression free survival, but is more toxic and does not improve overall survival compared with single agent chemotherapy. Last reviewed September 2017	I	[10], [11]

+ Evidence-based recommendation?	Grade
Doublet therapy is not recommended as second-line treatment of advanced NSCLC . Last reviewed September 2017	A

Evidence summary	Level	References
Erlotinib is inferior to docetaxel as 2nd line therapy in patients without EGFR activating mutations. Last reviewed September 2017	II	[9], [8]

+ Evidence-based recommendation?	Grade
Erlotinib is not effective in WT EGFR patients. Last reviewed September 2017	B

Monotherapy in unselected patients

Several randomised controlled trials (RCTs) have been reported examining the role of second line systemic therapy in unselected patients. The first studies examined docetaxel, establishing it as a standard of care in suitably fit patients. Subsequent studies examined different schedules of docetaxel, or examined the efficacy of new agents using it as the reference standard.

In 2000, two key RCTs were reported evaluating the efficacy of single agent docetaxel in previously treated NSCLC. Shepherd et al evaluated the efficacy of docetaxel versus best supportive care in 104 patients previously treated with platinum-based chemotherapy.[1] Compared with best supportive care, docetaxel 75 mg/m2 Q three-weekly, improved one-year survival (37% versus 11%; P = 0 .003).[1] Fossella et al randomised 373 previously treated patients with advanced NSCLC to two dose regimens of docetaxel compared with control arm of vinorelbine or ifosfamide.[2] one-year survival was significantly greater with docetaxel 75 mg/m2 than with the control treatment (32% versus 19%; P = 0.025,). Based on these two studies, docetaxel became the standard of care as second-line treatment of advanced NSCLC. Further supporting the clinical value of docetaxel was the results of the QOL analysis in the Shepherd study, which indicated less deterioration in QOL for docetaxel treated patients compared with best supportive care.[3]

Bria et al, compared the efficacy of weekly docetaxel with the reference standard of three-weekly, by evaluating data from 1018 patients from six RCTs. No significant differences in OS or RR in favour of the weekly schedule were found, however weekly docetaxel was associated with fewer grade ¾ neutropaenic events.[4]

Hanna et al, then compared single agent pemetrexed to three-weekly docetaxel as second line monotherapy of advanced NSCLC.[5] This study of 571 patients, randomised to three-weekly pemetrexed or docetaxel, showed equivalent efficacy outcomes (PFS, one-year survival) but significantly fewer side effects in favour of pemetrexed.[5] Consequently, pemetrexed was soon registered as an alternative second-line agent in NSCLC. Scagliotti et al in a post hoc analysis of data from two RCTS of pemetrexed, subsequently showed that pemetrexed increased OS in patients with non-SCC histology (p = 0.047), whereas OS was decreased with pemetrexed in SCC histology (p = 0.018).[6] A subsequent systematic review has confirmed this treatment-by-histology interaction effect with pemetrexed treatment showing greatest benefit in non-SCC histology.[7]

Older studies in patients not tested for EGFR activating mutations had indicated that EGFR TKIs were potential 2nd line therapies in patients without EGFR mutations. However, in the TAILOR study of 222 patients, erlotinib and docetaxel were compared as 2nd line therapy in patients with wild type EGFR.[8] Overall survival was superior for docetaxel (median OS 8.2 vs 5.4 months, HR 0.73, p=0.05). There were some imbalances between the arms of this study, with more squamous tumours and current or former smokers in the erlotinib arm. However, the results were confirmed by the DELTA study, a Japanese study involving 301 patients.[9] Patients with wild-type EGFR were randomised to docetaxel or erlotinib as 2nd or 3rd line therapy. PFS favoured docetaxel (median 2.9 vs 1.3 months, p=0.01), with no significant difference in overall survival (median 10.1 vs 9.0 months, p=0.91). Note that in this study, docetaxel was administered at a dose of 60mg/m2 every 3 weeks, as this is the standard dose in Japan.

Combination therapy in unselected patients

Di Maio et al, examined whether doublet chemotherapy is more effective than single agent chemotherapy as second-line treatment of advanced NSCLC in 847 patients from six RCTS from 1999 – 2005.[10] Single agents evaluated include docetaxel (three studies), irinotecan, cisplatin, or pemetrexed. Response rate was greater for doublet therapy (15 % versus 7.3 %, p = 0.0004), as was PFS (HR 0.79, 95% CI 0.68 – 0.91).[10] However, there was no significant difference in OS between single agent and doublet chemotherapy and there were significantly more grade ¾ haematologic and non-haematologic toxicities with doublet chemotherapy.[10]

Qi et al, examined whether doublet pemetrexed based therapy is more effective than single agent pemetrexed as second-line treatment of advanced NSCLC in 1,186 patients from five RCTS from 1999 – 2005.[11] Only one of these studies was a phase III RCT, that of the dual targeted TKI vandetanib (anti-VEGF and anti EGFR).[12] Here doublet therapy was associated with a greater RR, but did not improve PFS).[12] The other four phase II RCTS evaluated the addition of carboplatin, and the new agents enzastorurin, matuzumab and bortezomib to pemetrexed.[11] Overall, there was improvement in RR and PFS with

doublet therapy but not survival.[11] Furthermore, there was more grade ¾ neutropaenia and thrombocytopaenia with the doublet therapy.[11]

Herbst et al, also evaluated the efficacy of vandetanib. In their double blind RCT, the effect of Vandetanib plus docetaxel was compared with docetaxel as second-line treatment for patients with advanced NSCLC, on PFS in 1391 patients.[13] Vandetanib plus docetaxel was shown to be an active regimen with significant improvement in PFS versus placebo plus docetaxel (HR 0.79, 97.58% CI 0.70–0.90; p<0.0001).[13], however, the size of the effect on median PFS was small (4.0 months (vandetanib) versus 3.2 months (placebo), and therefore of questionable clinical significance, and survival benefit not shown.[13]

What is the optimal third-line therapy in unselected patients with stage IV inoperable NSCLC?

Evidence summary and recommendations

Evidence summary	Level	References
In unselected previously treated patients with advanced NSCLC who have received two lines of therapy, single agent docetaxel administered 3 weekly is a potential option in fit patients. Last reviewed September 2017	II	[4]

+ Evidence-based recommendation?	Grade
In fit, previously treated patients with advanced NSCLC who have received two lines of therapy, single agent docetaxel administered 3 weekly can be considered. Last reviewed September 2017	B

Few randomised controlled trials (RCTs) have evaluated third line therapy in unselected patients with advanced NSCLC. The aforementioned negative RCT (ISEL) of gefitinib versus placebo in 1692 patients included 847 patients (50%) that had received two previous lines of therapy.[1] The positive RCT (BR21) of erlotinib versus placebo in 731 patients included approximately 50% of patients having received two previous lines of therapy. Univariate analysis of OS by number of prior regimens found OS remained in favour of erlotinib (compared with placebo) by similar magnitude to the overall study population results (HR 0.80, p = 0.02).[2] The study by Kim et al, comparing gefitinib to docetaxel in previously treated advanced NSCLC, only included 235 (16%) patients that had received two previous lines of therapy. Analysis of OS number of prior regimens found OS more in favour of docetaxel. But as this is a post hoc analysis with small patient numbers, it is not appropriate to draw conclusions.[3]

The Japanese DELTA study enrolled both 2nd and 3rd line patients, but only 17% of patients were 3rd line in this study.[4] In this study of 301 patients, PFS favoured docetaxel (median 2.9 vs 1.3 months, p=0.01), with no significant difference in overall survival (median 10.1 vs 9.0 months, p=0.91). With PD-1 or PD-L1 immunotherapy having been shown to be superior to docetaxel as 2nd line therapy (see immunotherapy section), the DELTA trial and other studies support the use of docetaxel as 3rd line therapy in fit patients.

What is the optimal systemic therapy regimen in selected patients for treatment of stage IV inoperable NSCLC?

- currently being updated

Passiglia F et al., 2020 [50].

Italian Association of Medical Oncologyg (AIOM)

Treatment of advanced non-small-cell lung cancer: The 2019 AIOM (Italian Association of Medical Oncology) clinical practice guidelines.

Leitlinienorganisation/Fragestellung

Evidence-based guideline for the management of lung tumors.

Methodik

Grundlage der Leitlinie

- Repräsentatives Gremium;
- Interessenkonflikte und finanzielle Unabhängigkeit dargelegt;
- Systematische Suche, Auswahl und Bewertung der Evidenz;
- Formale Konsensusprozesse und externes Begutachtungsverfahren dargelegt;
- Empfehlungen der Leitlinie sind eindeutig und die Verbindung zu der zugrundeliegenden Evidenz ist explizit dargestellt;
- Regelmäßige Überprüfung der Aktualität gesichert.

Recherche/Suchzeitraum:

- Medline (PubMed), Embase-databases and Cochrane-Library, up to September 2019.
- Update von Facchinetti F et al., 2019 [18]

LoE/GoR

- GRADE

The global quality of evidence was defined as follow:

- High (high grade of confidence in the study results): high probability that the estimated effect is similar to the true effect.
- Moderate (moderate grade of confidence in the study results): moderate probability that the estimated effect is similar to the true effect, but limited possibility that it is substantially different.
- Low (low grade of confidence in the study results): limited probability that the estimated effect is similar to the true effect, with high possibility that it is substantially different
- Very low (very low grade of confidence in the study results): very limited probability that the estimated effect is similar to the true effect, with very high possibility that it is substantially different.

Strength of recommendation The strength of clinical recommendations is graduated on four levels according to their clinical relevance, considering the benefit/risk outcomes ratio, the quality of evidence and other additional variables (equity, acceptability, feasibility, and patients' preference):

- Strong for: The intervention should be considered as the treatment of choice (benefits are higher than risks)
- Conditional for: The intervention may be considered as treatment of choice (not sure that benefits are higher than risks)
- Conditional against: The intervention should not be considered as treatment of choice, except for selected cases after discussion with the patient (not sure that benefits are higher than risks)

Recommendations

Table 1
Clinical Recommendations for the Treatment of oncogene-addicted advanced NSCLC.

Global quality of evidence GRADE	Clinical recommendation	Strength of recommendation
Low	For patients with metastatic NSCLC harboring *"classic"* (exon 19 deletions, L858R) *EGFR* mutations, first-line therapy with osimertinib should be considered as treatment of choice, compared to first-generation EGFR inhibitors (gefitinib, erlotinib).	Strong for
Very low	For patients with metastatic NSCLC harboring *"classic"* (exon 19 deletions, L858R) *EGFR* mutations, first-line therapy with an EGFR inhibitor (gefitinib, erlotinib, afatinib) should be considered as treatment of choice, compared to chemotherapy.	Strong for
Very low	For patients with metastatic NSCLC harboring *EGFR* mutations, who experienced radiological progression to first/second generation EGFR inhibitors (gefitinib, erlotinib or afatinib), and had *T790M* mutation (detected through liquid or tumor biopsy), osimertinib should be considered as treatment of choice (compared to chemotherapy).	Strong for
Moderate	For patients with metastatic NSCLC harboring *ALK* rearrangements, first-line therapy with alectinib should be considered as treatment of choice compared to crizotinib.	Strong for
Moderate	For patients with metastatic NSCLC harboring *ALK* rearrangements, first-line therapy with crizotinib or ceritinib should be considered as treatment of choice, compared to chemotherapy.	Strong for
Low	For patients with metastatic NSCLC harboring *ALK* rearrangements, who experienced radiological progression to crizotinib, second-line therapy with ceritinib or alectinib should be considered as treatment of choice, compared to chemotherapy.	Strong for
Very low	For patients with metastatic NSCLC harboring *ROS1* rearrangements, first-line therapy with crizotinib should be considered as treatment of choice.	Strong for

Table 2
Clinical Recommendations for the Treatment of non oncogene-addicted advanced NSCLC.

Global quality of evidence GRADE	Clinical recommendation	Strength of recommendation
Moderate	For patients with EGFR/ALK wild-type, advanced NSCLC and PD-L1 TPS ≥ 50 %, first-line therapy with Pembrolizumab should be considered as treatment of choice	Strong for
Low	For patients with advanced, non-squamous NSCLC who completed 4–6 cycles of first-line chemotherapy with platinum-pemetrexed and experienced partial response or stable disease, maintenance therapy with single agent pemetrexed until disease progression or unacceptable toxicities could be considered as a treatment option.	Conditional for
Moderate	For patients with advanced NSCLC who experienced disease progression after first-line chemotherapy, immunotherapy with nivolumab, or atezolizumab, or pembrolizumab (PD-L1 TPS ≥ 1 %), should be considered as a treatment of choice	Strong for
Very low	For patients with advanced lung adenocarcinoma who experienced disease progression after first-line chemotherapy, the combination of nintedanib plus docetaxel could be considered as a treatment option.	Conditional for

4 Detaillierte Darstellung der Recherchestrategie

Cochrane Library - Cochrane Database of Systematic (Issue 12 of 12, December 2021) am 08.12.2021

#	Suchfrage
1	[mh “Carcinoma, Non-Small-Cell Lung”]
2	[mh “Lung Neoplasms”] AND [mh “Neoplasm Metastasis”]
3	#1 OR #2
4	((((non NEXT small) OR nonsmall) NEXT cell NEXT lung) OR pulmon*):ti,ab,kw
5	(cancer* OR tum*r* OR carcinoma* OR neoplas* OR adenocarcinoma* OR sarcoma* OR lesions* OR malignan*):ti,ab,kw
6	(advanced OR metastat* OR metastas* OR recurren* OR relaps*):ti,ab,kw
7	#4 AND #5 AND #6
8	nsclc*:ti,ab,kw
9	#3 OR #7 OR #8
10	#9 with Cochrane Library publication date from Dez 2016 to present

Systematic Reviews in Medline (PubMed) am 08.12.2021

#	Suchfrage
1	Carcinoma, Non-Small-Cell Lung[majr]
2	((((non[tiab]) AND small[tiab]) OR nonsmall[tiab]) AND cell[tiab]) AND lung[tiab]
3	(((((((((tumor[tiab]) OR tumors[tiab]) OR tumour*[tiab]) OR carcinoma*[tiab]) OR adenocarcinoma*[tiab]) OR neoplas*[tiab]) OR sarcoma*[tiab]) OR cancer*[tiab]) OR lesions*[tiab]) OR malignan*[tiab]
4	#1 OR (#2 AND #3)
5	(#4) AND (((((advanced[tiab]) OR metastat*[tiab]) OR metastas*[tiab]) OR recurren*[tiab]) or relaps*[tiab])
6	(#6) AND (((Meta-Analysis[ptyp] OR systematic[sb] OR ((systematic review [ti] OR meta-analysis[pt] OR meta-analysis[ti] OR systematic literature review[ti] OR this systematic review[tw] OR pooling project[tw] OR (systematic review[tiab] AND review[pt]) OR meta synthesis[ti] OR meta-analy*[ti] OR integrative review[tw] OR integrative research review[tw] OR rapid review[tw] OR umbrella review[tw] OR consensus development conference[pt] OR practice guideline[pt] OR drug class reviews[ti] OR cochrane database syst rev[ta] OR acp journal club[ta] OR health technol assess[ta] OR evid rep technol assess summ[ta] OR jbi database system rev implement rep[ta]) OR (clinical guideline[tw] AND management[tw]) OR ((evidence based[ti] OR evidence-based medicine[mh] OR best practice*[ti] OR evidence synthesis[tiab]) AND (review[pt] OR diseases category[mh] OR behavior and behavior mechanisms[mh] OR therapeutics[mh] OR evaluation study[pt] OR validation study[pt] OR guideline[pt] OR pmcbook)) OR ((systematic[tw] OR systematically[tw] OR critical[tiab] OR (study selection[tw]) OR (predetermined[tw] OR inclusion[tw] AND criteri* [tw]) OR exclusion criteri*[tw] OR main outcome

#	Suchfrage
	measures[tw] OR standard of care[tw] OR standards of care[tw]) AND (survey[tiab] OR surveys[tiab] OR overview*[tw] OR review[tiab] OR reviews[tiab] OR search*[tw] OR handsearch[tw] OR analysis[ti] OR critique[tiab] OR appraisal[tw] OR (reduction[tw] AND (risk[mh] OR risk[tw]) AND (death OR recurrence))) AND (literature[tiab] OR articles[tiab] OR publications[tiab] OR publication [tiab] OR bibliography[tiab] OR bibliographies[tiab] OR published[tiab] OR pooled data[tw] OR unpublished[tw] OR citation[tw] OR citations[tw] OR database[tiab] OR internet[tiab] OR textbooks[tiab] OR references[tw] OR scales[tw] OR papers[tw] OR datasets[tw] OR trials[tiab] OR meta-analy*[tw] OR (clinical[tiab] AND studies[tiab]) OR treatment outcome[mh] OR treatment outcome[tw] OR pmcbook)) NOT (letter[pt] OR newspaper article[pt])) OR Technical Report[ptyp]) OR (((((trials[tiab] OR studies[tiab] OR database*[tiab] OR literature[tiab] OR publication*[tiab] OR Medline[tiab] OR Embase[tiab] OR Cochrane[tiab] OR Pubmed[tiab])) AND systematic*[tiab] AND (search*[tiab] OR research*[tiab]))) OR ((((((((((HTA[tiab]) OR technology assessment*[tiab]) OR technology report*[tiab]) OR (systematic*[tiab] AND review*[tiab])) OR (systematic*[tiab] AND overview*[tiab])) OR meta-analy*[tiab]) OR (meta[tiab] AND analyz*[tiab])) OR (meta[tiab] AND analys*[tiab])) OR (meta[tiab] AND analyt*[tiab]))) OR (((review*[tiab]) OR overview*[tiab]) AND ((evidence[tiab]) AND based[tiab]))))))
8	((#7) AND ("2016/12/01"[PDAT] : "3000"[PDAT]) NOT "The Cochrane database of systematic reviews"[Journal]) NOT (animals[MeSH:noexp] NOT (Humans[mh] AND animals[MeSH:noexp]))
9	(#8) NOT (retracted publication [pt] OR retraction of publication [pt])

Leitlinien in Medline (PubMed) am 08.12.2021

#	Suchfrage
1	Carcinoma, Non-Small-Cell Lung[mh]
2	Lung Neoplasms/therapy/drug therapy
3	Medical Oncology/methods/standards
4	((((non[tiab]) AND small[tiab]) OR nonsmall[tiab]) AND cell[tiab]) AND lung[tiab]
5	(((((((((tumor[tiab]) OR tumors[tiab]) OR tumour*[tiab]) OR carcinoma*[tiab]) OR adenocarcinoma*[tiab]) OR neoplas*[tiab]) OR sarcoma*[tiab]) OR cancer*[tiab]) OR lesions*[tiab]) OR malignan*[tiab]
6	lung[ti] AND #5
7	(#4 AND #5) OR #6
8	#1 OR #2 OR #3 OR #7
9	(#8) AND (Guideline[ptyp] OR Practice Guideline[ptyp] OR guideline*[Title] OR Consensus Development Conference[ptyp] OR Consensus Development Conference, NIH[ptyp] OR recommendation*[ti])
10	(((#9) AND ("2016/12/01"[PDAT] : "3000"[PDAT])) NOT (animals[MeSH:noexp] NOT (Humans[MesH] AND animals[MeSH:noexp])) NOT ("The Cochrane database of systematic reviews"[Journal]) NOT ((comment[ptyp]) OR letter[ptyp]))
11	(#10) NOT (retracted publication [pt] OR retraction of publication [pt])

Iterative Handsuche nach grauer Literatur, abgeschlossen am 09.12.2021

- Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften (AWMF)
- Leitlinienprogramm Onkologie (Deutsche Krebsgesellschaft, Deutsche Krebshilfe, AWMF)
- Nationale VersorgungsLeitlinien (NVL)

- National Institute for Health and Care Excellence (NICE)
- Scottish Intercollegiate Guideline Network (SIGN)
- World Health Organization (WHO)

- *Alberta Health Service (AHS)*
- *European Society for Medical Oncology (ESMO)*
- *National Comprehensive Cancer Network (NCCN)*
- *National Cancer Institute (NCI)*

- ECRI Guidelines Trust (ECRI)
- Dynamed / EBSCO
- Guidelines International Network (GIN)
- Trip Medical Database

5 Referenzen

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Anhang

Level	Intervention	Diagnosis	Prognosis	Aetiology	Screening
I	A systematic review of level II studies	A systematic review of level II studies	A systematic review of level II studies	A systematic review of level II studies	A systematic review of level II studies
II	A randomised controlled trial	A study of test accuracy with: an independent, blinded comparison with a valid reference standard, among consecutive patients with a defined clinical presentation	A prospective cohort study	A prospective cohort study	A randomised controlled trial
III-1	A pseudo-randomised controlled trial (i.e. alternate allocation or some other method)	A study of test accuracy with: an independent, blinded comparison with a valid reference standard, among non-consecutive patients with a defined clinical presentation	All or none	All or none	A pseudo-randomised controlled trial (i.e. alternate allocation or some other method)
III-2	A comparative study with concurrent controls: • Non-randomised, experimental trial • Cohort study • Case-control study • Interrupted time series with a control group	A comparison with reference standard that does not meet the criteria required for Level II and III-1 evidence	Analysis of prognostic factors amongst untreated control patients in a randomised controlled trial	A retrospective cohort study	A comparative study with concurrent controls: • Non-randomised, experimental trial • Cohort study • Case-control study
III-3	A comparative study without concurrent controls: • Historical control study • Two or more single arm study • Interrupted time series without a parallel control group	Diagnostic case-control study	A retrospective cohort study	A case-control study	A comparative study without concurrent controls: • Historical control study • Two or more single arm study
IV	Case series with either post-test or pre-test/post-test outcomes	Study of diagnostic yield (no reference standard)	Case series, or cohort study of patients at different stages of disease	A cross-sectional study	Case series

Abbildung 1: NHMRC Evidence Hierarchy (Australian Government Cancer Council Australia)