**Table S1.** Current treatments that are clinically used for lung cancer

| Type | Test/Drug | Indication | Application | Features | Limitation |
|---|---|---|---|---|---|
| surgery | Open chest surgery | The surgeon to remove the tumour lesion in direct view | (Stage I, II, partially operable stage IIIA) lung cancer | Maximum guarantee of radical surgery | Post-operatively patients are prone to incisional pain and reduced lung function |
| | VATS | Transmits images of the inside of the chest cavity to a video monitor to guide the surgeon during the procedure | Minimally invasive surgical techniques for the diagnosis and treatment of chest diseases | Less invasive, less painful, faster recovery and shorter hospitalisation，particularly suitable for thoracic surgery in elderly and frail patients with poor cardiopulmonary function | Susceptible to infectious pneumonia, lung infections bleeding;<br>Temporary or permanent nerve damage to organs near the surgical site |
| | RATS | Three-dimensional imaging system with magnified surgical field of view, mechanical wrist dexterity and elimination of operator hand tremor | Tumors close to the outside of the lung and not connected to blood vessels, only suitable for some patients requiring rigorous assessment before surgery | Safe, faster recovery, reduced pain,<br>fewer complications | Leaky lungs, infection, pain, arrhythmia of the heart rate |
| radiation therapy | SRS | The high dose area is concentrated in the target | Intracranial tumours, certain small and well-defined | Efficient, precise, safe and minimally invasive, less | Mainly treats relatively small lesions, requires a |

| | | | | | |
|---|---|---|---|---|---|
| | | area, creating a knife-like interface at the edge of the target area, which acts as a scalpel | tumours which not suitable for surgery, such as lung, liver, lymph nodes, spine, neck or other soft tissues | collateral damage to surrounding tissues, shorter treatment cycles | high level of treatment team and has radiotherapy universal side effects |
| | SBRT | The SRT extends from the head to the body and is called the SBRT and has a sub-millimetre treatment accuracy | Treatment of small well-defined tumours or higher risk post-operative sites elderly patients who cannot tolerate surgery for primary and metastatic tumors | High tumour control rate, good tolerance of normal tissues, long and extremely convenient patient survival, short overall treatment period of about one week and relatively inexpensive | Patients with poor lung function have a particularly high single dose of SABR, so each treatment needs to be image-guided |
| Chemotherapy | Etoposide | Cell cycle-specific antitumor drug that acts on DNA topoisomerase II to form a drug-enzyme-DNA stable and reversible complex that impedes DNA repair | SCLC, malignant lymphoma, malignant germ cell tumour, leukaemia | Acting in the late S or G2 phase of the cell cycle, the site of action is topoisomerase II, forming a drug-enzyme-DNA stable cleavable complex that interferes with DNA topoisomerase II, rendering damaged DNA unrepaired. | Bone marrow suppression: leukopenia and thrombocytopenia, anaemia, nausea, vomiting, loss of appetite, stomatitis, diarrhoea, allergic reactions, hair loss, neurotoxicity |
| | Platinum | Cell cycle non-specific drugs, mainly by entering tumour cells and forming | Widely used for common malignancies such as lung, bladder, ovarian, cervical, | Broad anti-cancer spectrum, strong action, synergistic with various anti-tumor agents, | Nephrotoxicity, nausea, vomiting, loss of appetite and diarrhoea, reduction in |

| | | | | |
|---|---|---|---|---|
| | Pt-DNA adducts with DNA. First generation cisplatin, second generation carboplatin, nedaplatin; third generation oxaliplatin, loplatin | oesophageal, stomach, colorectal cancers | intracellular dissociation to form hydrated ligands; migration to target DNA; coordination with DNA to form Pt-DNA adducts, blocking DNA synthesis | white blood cells and/or platelets, bone marrow suppression, neurotoxicity, allergic reactions |
| Topotecan | Water-soluble semi-synthetic camptothecin derivative, a topoisomerase I inhibitor | SCLC, advanced metastatic ovarian cancer who have failed first-line chemotherapy | Topotecan interacts with topoisomerase I and DNA in a ternary complex during DNA synthesis, causing damage to double-stranded DNA and leading to cell death, and is an S-phase cell cycle specific drug with strong anti-tumour activity and a broad anti-cancer spectrum | Leukopenia, thrombocytopenia, anaemia, bone marrow suppression, nausea, vomiting, hair loss, occasional severe dermatitis and itching, neuromuscular pain |
| Pemetrexed | Anti-folate drugs containing a pyrrolopyrimidine moiety at their core inhibit tumour growth by | Lung cancer | Inhibits the activity of thymidylate synthase, dihydrofolate reductase and glycinamide nucleotide formyltransferase, all of which | Tachycardia, neutropenia, fever, dehydration, chest pain, urticaria, arrhythmia, conjunctivitis, abdominal pain, neurological disorders, |

| | | | | |
|---|---|---|---|---|
| | disrupting the normal intracellular folate-dependent metabolic process and inhibiting cell replication | | are necessary for the synthesis of folic acid and are involved in the biosynthesis of thymine nucleotide and purine nucleotide | elevated creatinine, renal failure |
| Doxorubicin | Cytotoxic anthracycline antibiotic, Topoisomerase-II inhibitor | Acute leukaemia, malignant lymphoma, breast cancer, osteosarcoma and soft tissue sarcoma, lung cancer | Doxorubicin inhibits DNA replication, down-regulates basal phosphorylation of AMPK and downstream acetyl-CoA carboxylase, and induces apoptosis | Bone marrow suppression, cardiotoxicity, hair loss, gastrointestinal reactions |
| Gemcitabine | Pyrimidine cell cycle-specific anti-metabolite antitumor drugs, | First-line agents for localised stage III and already metastatic stage IV NSCLC | Activated by deoxycytidine kinase and metabolized by cytosine nucleoside deaminase, main metabolites incorporated into DNA in the cell and act mainly in the G1/S phase of the cell cycle and inhibits nucleotide reductase, and inhibits deoxycytidine deaminase to reduce the degradation of | Bone marrow suppression, gastrointestinal reactions, fever, rash, and flu-like symptoms |

| | | | | | |
|---|---|---|---|---|---|
| | | | | intracellular metabolites meanwhile has a self-enhancing effect | |
| | Vinblastine | Anti-cancer drugs that interfere with protein synthesis derived from the periwinkle plant of the family Oleaceae | Malignant lymphoma, choriocarcinoma, testicular tumour, lung cancer, breast cancer | Inhibits the polymerisation of microtubule proteins and prevents the formation of spindle microtubules, causing nuclear division to stop at mid-stage. Also acts on cell membranes, interfering with the functioning of amino acids and inhibiting protein synthesis; can inhibit RNA synthesis by inhibiting RNA enzymes in G1 phase | Gastrointestinal reactions, bone marrow suppression and peripheral neuritis, muscle tremors, loss of reflexes, headache |
| targeted therapy | Bevacizumab | Recombinant human monoclonal IgG1 antibody that binds to and blocks the biological activity of VEGF | Treatment of various types of metastatic cancers such as colorectal cancer, NSCLC, breast cancer, malignant glioma and renal cell carcinoma | Binds to VEGF so that it cannot stimulate blood vessel growth, thus blocking blood, oxygen and other nutrients needed for tumour growth, stopping tumour growth or spreading to other parts of the body and achieving anti-cancer | Gastrointestinal perforation/wound dehiscence syndrome, haemorrhage, hypertensive crisis, nephrotic syndrome, nongestive heart failure |

| | | | | |
|---|---|---|---|---|
| Nintedanib | Triple vascular kinase inhibitor, acting on VEGFR1/2/3, FGFR1/2/3 and PDGFRα/β | Idiopathic pulmonary fibrosis(IPF), NSCLC, systemic sclerosis-associated interstitial lung disease (SSc-ILD) and chronic progressive fibrosing interstitial lung diseases (ILDs) | Dose-dependent inhibition of TGF-β1-induced expression of ADC-TAF and fibrosis activation markers | Diarrhoea, nausea and vomiting, abdominal pain, loss of appetite, weight loss and elevated liver enzymes |
| Gefitinib | An oral EGFR-TKI, a small molecule compound | Indicated for the treatment of locally advanced or metastatic NSCLC that has received prior chemotherapy | EGFR-TKI can hinder tumor growth, metastasis and angiogenesis and increase apoptosis of tumor cells by competing for the Mg-ATP binding site on the catalytic region of EGFR-TK and blocking its signaling | Diarrhoea, rash, itching, dry skin and acne |
| Lcotinib | EGFR-TKI | Treatment of EGFR-mutated locally advanced or metastatic NSCLC | First generation small molecule inhibitor that competitively inhibits the binding of EGFR to ATP, affecting downstream signaling and inhibiting tumor cell growth | Rash, diarrhoea, elevated ALT and/or AST, nausea |

| | | | | |
|---|---|---|---|---|
| Erlotinib | Reversible EGFR-TKI | For third-line treatment of locally advanced or metastatic NSCLC where two or more chemotherapy regimens have failed | Erlotinib effectively inhibits the phosphorylation of EGFR in cells and blocks the proliferation of EGFR-dependent cells to achieve the purpose of inhibiting tumour cell growth | Rash, diarrhoea, loss of appetite, fatigue, breathlessness, cough, nausea, infection, vomiting, stomatitis, itching, dry skin, conjunctivitis, keratoconjunctivitis, abdominal pain |
| Afatinib | First anti-cancer target durg that irreversibly binds the ErbB family (comprising four different cancer cell epidermal growth factor receptors, EGFR, HER2, ErbB3 and ErbB4) | EGFR-mutations NSCLC | Afatinib is an oral targeted therapy, irreversible ErbB family blocker that inhibits message transmission and the major channels associated with cancer cell growth and division, reducing or delaying the proliferation of cancer cells | Diarrhoea, allergies/acne, oral mucositis |
| Osimertinib | Third-generation EGFR TKI, specifically targeting resistance mutations EGFR T790M that most commonly | Treating NSCLC with EGFR-T790M mutation after EGFR-TKI treatment | Ocitinib is an EGFR-TKI that irreversibly binds to specific EGFR mutations, including T790M, L858R and exon 19 deletions, and is selectively used | diarrhoea, rash, dry skin, nausea, eye problems, loss of appetite, constipation; serious side effects such as |

| | | | | |
|---|---|---|---|---|
| | cause resistance to first-generation targeted drugs | | for susceptibility mutations and T790M-resistant mutations | pneumonia, pulmonary embolism |
| Dacomitinib | Oral, irreversible HER-TKI | First-line treatment for patients with EGFR exon 19 deletion mutation or exon 21 L858R substitution mutation in locally advanced or metastatic NSCLC | Dacomitinib is also a pan-HER inhibitor, potentially delaying resistance problem, through binding at the ATP site and covalent modification of nucleophilic cysteine residues in the catalytic domain of ERBB family members and inhibit ERBB tyrosine kinase activity. | Diarrhoea, rash, nail infection, stomatitis, loss of appetite, dry skin, weight loss, hair loss, cough and itching |
| Necitumumab | Recombinant human-derived lgG1 monoclonal antibody that binds to EGFR, thereby blocking the binding of EGFR to its ligand | In combination with gemcitabine and cisplatin for the first-line treatment of patients with metastatic squamous NSCLC | Necitumumab binds to EGFR, induces its internalization and degradation, and also causes antibody-dependent cellular cytotoxicity (ADCC) | Rash, hypomagnesemia, muscle cramps in the stomach and other muscles, breathing difficulties, loss of appetite, nausea and vomiting, fatigue |
| Crizotinib | ATP-competitive Met/ALK/ROS multi-target protein kinase inhibitor | Advanced (metastatic) NSCLC with ROS-1 mutation | ATP-competitive multi-targeted protein kinase inhibitor that effectively inhibits the cellular bioactivity of MET/ALK/ROS | Hepatotoxic, interstitial lung disease/ non-infectious pneumonia |

| | | | | |
|---|---|---|---|---|
| | | | and shows high clinical efficacy in patients with tumours with abnormal ALK, ROS or MET kinase activity | |
| Alectinib | ATP-competitive ALK inhibitor | Oral therapeutics for advanced (metastatic) ALK-positive NSCLC | Acting on EML4-ALK expressing NCI-H2228 NSCLC cells, inhibiting ALK phosphorylation and completely inhibiting STAT3 phosphorylation at the Tyr705 site, the induced caspase-3/7 activation, which prevented the growth and spread of ALK-positive NSCLC cells, and Alectinib can penetrate the CNS and had a lesion-reducing effect on brain metastases | Fatigue, constipation, edema, muscle pain, Anemia |
| Ceritinib | A kinase inhibitor that targets ALK, insulin-like growth factor 1 receptor IGF-1R, insulin receptor | Treatment of ALK-positive metastatic NSCLC with progressive tumour disease or intolerance to Crizotinib | Ceritinib inhibits ALK autophosphorylation and blocks ALK-mediated signaling pathways in tumor cells | Gastrointestinal toxicity, diarrhoea, nausea, vomiting or abdominal pain |

| | | | | |
|---|---|---|---|---|
| | InsR and ROS1, with the strongest activity against ALK | | (Ras/MAPK, PI3K/AKT and JAK/STAT signaling pathways), inhibiting tumor cell proliferation and promoting apoptosis | |
| Brigatinib | A reversible dual EGFR/ALK inhibitor effective against both ALK-TK secondary mutations and other ALK-resistant mutations | ALK-positive metastatic NSCLC that has progressed or is intolerant to Crizotinib | ALK-TKI, which also has anti-kinase (including ALK, ROS1, insulin-like growth factor-1 receptor, Flt-3) and EGFR deletion and point mutation activity, and exhibits strong central nervous system penetration | Interstitial lung disease (ILD)/non-infectious pneumonia, hypertension, bradycardia,visual impairment, elevated creatine phosphokinase (CPK), elevated pancreatic enzymes, hyperglycemia |
| Lorlatinib | Oral ALK&ROS1 TKI | For previously treated advanced ALK-positive NSCLC | Dual target inhibitor of ALK/ROS1, effective against all types of ALK secondary to drug resistant mutations, with strong CNS penetration, maintaining high blood levels in brain tissue and *in vitro* inhibitory activity against ALK, ROS1, and TYK1 | Risk of severe hepatotoxicity; CNS effects; hyperlipidaemia; AV block; interstitial lung disease/pneumonia |

| | | | | | |
|---|---|---|---|---|---|
| | Dabrafenib | A BRAF V600 mutation-specific inhibitor | Dabrafenib in combination with Mekinist for the treatment of metastatic NSCLC with BRAF V600E mutation, melanoma, locally advanced or metastatic undifferentiated thyroid cancer | Dabrafenib inhibits ERK phosphorylation and enhances ErbB2 autophosphorylation, with effects on ErbB2 and Akt phosphorylation manifested through pharmacological inhibition of the MEK-ERK signalling pathway | Hyperkeratosis, headache, fever, arthritis, papilloma, alopecia, and painful palmoplantar redness and swelling syndrome |
| | Trametinib | A BRAF V600E & V600K inhibitor | BRAF V600E mutation-positive metastatic NSCLC, unresectable or metastatic melanoma with BRAF V600E or V600K mutation | In combination with dabrafenib in unresectable or metastatic melanoma with mutations in the BRAFV600E or V600K genes | Elevated liver enzymes (ALT), rash, diarrhoea, hypoalbuminemia, anaemia, lymphoedema |
| | Vemurafenib | Novel and effective BRAF V600E inhibitor | BRAF V600E mutation in metastatic NSCLC | Vemurafenib selectively inhibits BRAF V600E kinase, thereby blocking the downstream MEK-ERK pathway in tumour cells, preventing tumour growth, proliferation and invasion | Arthralgia, rash, hair loss, fatigue, photosensitivity, nausea, itching and skin papillomas |
| | Vandetanib | VEGFR2 inhibitors that | Unresectable, locally | Vandetanib inhibits the activity of | Diarrhoea, rash, acne, |

| | | | | | |
|---|---|---|---|---|---|
| | | also inhibit VEGFR3 and EGFR | advanced or metastatic symptomatic or progressive medullary thyroid cancer, advanced non-small cell lung cancer, advanced breast cancer and advanced multiple myeloma | tyrosine kinases, including the EGFR and VEGFR families, RET, BRK, TIE2, EPH receptors and members of the Src kinase family, increasing apoptosis and inducing autophagy by increasing levels of ROS | nausea, hypertension, headache, fatigue, loss of appetite, abdominal pain, decreased calcium, increased ALT, and decreased glucose |
| | Cabozantinib | Multi-targeted oral broad-spectrum anti-tumour targeted drugs (small molecule TKI) | Thyroid cancer, kidney cancer, liver cancer, non-small cell lung cancer, and other solid tumours | Cabozantinib inhibits RET, human hepatocyte growth factor receptor, MET, VEGFR, stem cell factor receptor, and participating in pathological processes such as tumor angiogenesis and invasion. | Diarrhoea, stomatitis, PPES, weight loss, loss of appetite, nausea, fatigue, oral pain, change in hair colour, taste disturbance, hypertension, abdominal pain and constipation |
| | Trastuzumab | Human-derived recombinant antibody inhibitor that binds to the extracellular domain of HER2 | HER2-positive NSCLC, breast cancer, gastric cancer | Trastuzumab down- regulates HER2 expression and the PI3K signalling pathway. Trastuzumab binding occupies Fc receptors on immune effector cells, leading to antibody- dependent cytotoxicity with anti-angiogenic and anti- | Fatigue, nausea, skeletal muscle pain, bleeding, thrombocytopenia, headache, increased transaminases, constipation and nosebleeds |

| | | | | | |
|---|---|---|---|---|---|
| | | | | tumour activity. | |
| | Ramucirumab | Antagonist of VEGFR 2 | Stomach Cancer, Lung Cancer, Colorectal Cancer, Esophageal Cancer | Ramucirumab inhibits ligand-induced activation of VEGFR2, thereby inhibiting ligand-induced proliferation, human endothelial cell migration and angiogenesis | Fatigue, peripheral oedema, hypertension, abdominal pain, loss of appetite, proteinuria, nausea and ascites |
| | Anlotinib | VEGFR2 selective inhibitor, a small molecule multi-target tyrosine kinase inhibitor that effectively inhibits VEGFR, PDGFR, FGFR, c-Kit and other kinases | Broad spectrum anti-tumour, NSCLC, soft tissue sarcoma, gastric cancer, colorectal cancer, medullary thyroid cancer, differentiated thyroid cancer and squamous oesophageal cancer | Anlotinib is a small molecule multi-target tyrosine kinase inhibitor that effectively inhibits VEGFR, PDGFR, FGFR, c-Kit and other kinases, with anti-tumour angiogenic and tumour growth inhibitory effects | Hypertension, fatigue, skin reactions in hands and feet, gastrointestinal reactions, abnormal liver function, abnormal thyroid function, hyperlipidemia and proteinuria |
| Immunotherapy | Durvalumab | PD-L1 IgG1κ monoclonal antibody that recognises and attaches to specific structures of proteins in certain cells in the human body | NSCLC<br>SCLC | Binds to PD-L1 expressed on tumor cells, blocks PD-L1 binding to PD-1 on the surface of T cells to mediate immunosuppression, re-energizes T cells to recognize and kill tumor cells, thereby inhibiting | cough, fatigue, pneumonia or radiation pneumonia, upper respiratory tract infection, dyspnoea, rash |

| | | | | |
|---|---|---|---|---|
| | | | tumor growth | |
| Atezolizumab | PD-L1 monoclonal antibody | Metastatic/recurrent uroepithelial carcinoma, lung cancer, breast cancer | Atezolizumab binds to PD-L1 expressed on tumor cells, blocks PD-L1 binding to PD-1 on the surface of T cells to mediate immunosuppression, re-energizes T cells to recognize and kill tumor cells, thereby inhibiting tumor growth | Fatigue, nausea, constipation, cough, shortness of breath, loss of appetite, hair loss |
| Nivolumab | PD-1 antibody | Advanced squamous NSCLC, unresectable or metastatic melanoma | Nivolumab restores the anti-tumour function of T cells with immune checkpoint suppressive activity and anti-tumour activity | Cough, nausea, rash, dyspnoea, diarrhoea, constipation, loss of appetite, back pain, arthralgia, severe immune-mediated organ adverse reactions |
| Pembrolizumab | PD-1antibody | Melanoma and NSCLC for EGFR mutation-negative and ALK rearrangement-negative NSCLC that has deteriorated after treatment with | Targets PD-1 on the surface of T cells with negative immunomodulatory function, blocks the immunosuppressive signalling pathway triggered by | Fatigue, cough, nausea, itchy skin, rash |

| | | |
|---|---|---|
| | platinum-containing chemotherapy regimens | PD-1 / PD-2, re-energizes T cells to recognize and kill tumor cells, thereby inhibiting tumor growth |