Oncology Solutions for Lung Cancer

Tumor Analytics

siemens.com/oncology

Answers for life.
The more deeply you look, the more clearly you see your patients.
In oncology, understanding your patient and your patient’s disease is crucial. Lung cancer has the highest mortality of all cancer types worldwide. The number of deaths resulting from lung cancer is projected to rise over the next ten years, especially in developing countries. Because it is asymptomatic for a long time and often only detected in the later stages, prognosis is poor.

To avoid debilitating treatment side effects, there is ongoing discussion and research on how to increase the value of screening, make staging more accurate, and treatment more personalized. Overall, the challenge remains to better identify your patient’s individual risk and adapt his or her care accordingly. Which leads to the question – what more must we know in order to improve outcomes?

Tumors are as individual as patients themselves. At Siemens Healthcare, we develop imaging, laboratory, and IT solutions that help clinicians in understanding the nature and behavior of individual tumors with amazing depth and clarity. Tumor Analytics is our term for the advanced technologies that make this degree of understanding possible, and support clinicians in their selection of appropriate treatment options.

Tumor Analytics enables physicians to diagnose earlier and to personalize cancer treatment. By matching the right treatment with the right patient, Tumor Analytics helps improve patient outcomes and reduce the overall cost of oncology care for institutions and societies.

In short, the better you understand your patient’s disease, the better you can care for your patient. Ultimately, that’s what Tumor Analytics is all about.
Lung cancer

An increasing threat and burden worldwide

Epidemiological facts and challenges

Today, lung cancer is already by far the most deadly oncological disease worldwide with close to 1.6 million deaths per year. That number is unevenly distributed between men and women, with mortality in men accounting for nearly three quarters. About 70 percent of the lung cancer burden is estimated to be caused by tobacco smoke, making it the leading risk factor for lung cancer.

Therefore, tobacco use plays a central role in future estimates of lung cancer mortality. Due to a projected rise in the number of smokers in emerging markets, the total number of deaths caused by lung cancer is expected to increase.

The growing and aging population in those countries, combined with an increase in living standards and more money available to be spent on cigarettes, will lead to a rising number of lung cancer patients. Because initially lung cancer is rarely symptomatic, it is often detected at a very late stage, leaving patients with a bleak prognosis for survival.

One way to potentially lower the mortality rate is the early detection of lung cancer. In the U.S., the five-year survival rate for localized disease is 54 percent, as opposed to only four percent when the cancer has metastasized to distant organs. However, at diagnosis just 15 percent of cases are localized compared with 57 percent of cases that are already metastasized. This amounts to a five-year overall survival rate of only 16.8 percent. Therefore, together with improved therapeutic approaches, early detection may enable physicians to decrease mortality from lung cancer.

Clinical questions

**Early detection and diagnosis:**

- What type of lung cancer are we dealing with?
- What is the size, location, and stage of the tumor?

**Therapy selection, planning, and delivery:**

- What is the best therapeutic approach for the individual patient?

**Therapy monitoring and follow-up:**

- Does the therapy have the expected effect?
- How can we best support improved patient outcomes?
Clinical questions

Siemens Healthcare is helping to fight the most threatening diseases – including lung cancer. For a deeper and more detailed insight into the characteristics and nature of a lung tumor, we need to strategically combine advanced imaging, IT, and laboratory applications for early detection and diagnosis, as well as therapy monitoring and follow-up. At the same time, we must reduce the growing costs in our healthcare system, while continuing to improve the standard of patient care.

To guide screenings of patients at risk and characterize the tumors of patients newly diagnosed with lung cancer, as well as those undergoing therapy and follow-up, there are a number of clinical questions we need to answer in order to better understand the nature and behavior of the tumor.

Multidisciplinary offerings

With decades of experience and expertise with medical and diagnostic systems as well as IT solutions, we support you in successfully meeting today's clinical challenges in lung cancer workup.

Whatever the clinical question, our extensive portfolio contains everything you need to offer patient care at the highest-possible level – from ultrasound, X-ray systems, MRI, CT, PET/CT, MR/PET, SPECT/CT, and clinical chemistry testing, through to interventional imaging, radiation oncology support, and systems designed for process and workflow optimization.

By partnering with leading institutes and experts, Siemens Healthcare helps to define new standards-of-care, which enable medical professionals to improve patient outcomes and maintain their quality of life.

A full range of advanced applications and technologies

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How can I detect lung cancer earlier and characterize it more precisely?

Early detection and diagnosis

The key to successful therapy

Treating late-stage lung cancer is extremely challenging. However, lung cancer treatment can be significantly more effective if the disease is detected earlier, before the onset of symptoms when the disease is still localized. The precise diagnosis and staging of lymph node involvement and distant metastases has prognostic value and is the foundation of adequate therapy selection.

Image reading and reporting (syngo.via)
Modern imaging systems generate large amounts of meaningful image data. Key to their efficient use, especially in a multimodality scenario like lung cancer, is a powerful, yet streamlined and adaptive, reading and reporting infrastructure. syngo.via® is Siemens Healthcare’s software solution for 3D reading and advanced visualization – designed for both routine and challenging cases. Dedicated, modality-specific applications are available, as well as functionalities to support structured reporting. And thanks to the server client concept, multimodality images can be accessed from anywhere®, even at the patients’ bedside.

Computed Tomography (CT)
CT is the foundation of the diagnosis and staging of lung cancer and also the key to its early detection. Selected CT systems of the SOMATOM family qualify for both diagnosing lung cancer as well as screening high-risk populations. Each solution is easy-to-use, reliable, and standardized. The CT systems are known for extraordinary image quality and for setting advanced standards in the industry for a large range of clinical applications beyond lung cancer. To meet every need in lung imaging, Siemens Healthcare has developed unique dose-saving technologies and individualized protocols that allow imaging with doses down to that of conventional X-ray imaging in selected scenarios. For the most demanding clinical cases, Siemens Healthcare offers sub-second lung imaging protocols on selected scanners.

Beyond morphology, functional information such as perfusion and ventilation is essential for individualized therapies. As the pioneer in dual-source imaging, Siemens Healthcare offers the full spectrum of functional CT imaging, including iodine quantification and xenon ventilation imaging.

CT has proven its value in guiding minimally invasive procedures. As part of the clinical workflow, CT-guided lung biopsies are routinely taken and supported by Siemens Healthcare equipment.

X-ray products
In the clinical routine, when lung disease is suspected, it is often first examined using a radiography or fluoroscopy...
system. All relevant Siemens Healthcare X-ray systems can be configured with dedicated hardware and software for lung imaging – for example, ClearRead Bone Suppression™ to suppress bone structure on the digital image for a clearer, unobstructed view of soft tissue. The reader can also be supported by a computer-aided detection technology to locate lung lesions.

**Positron Emission Tomography – Computed Tomography (PET/CT)**

PET/CT has a major role in the characterization of lung nodules, because high FDG uptake in a lung nodule is associated with a high positive predictive value for the presence of malignancy. Initial tumor staging with PET/CT can have a strong impact on prognosis and subsequent therapy decisions, and has demonstrated higher sensitivity for staging compared with CT alone.

In many cases, respiratory motion continues to impact image quality, leading to poor visualization and lower uptake values. To solve this problem, Siemens Healthcare offers fast, amplitude-based gating technology (HD•Chest) that virtually freezes respiratory motion. With Siemens FlowMotion™ continuous bed motion technology, routine imaging of motion-sensitive organs with the highest-possible resolution is now possible. You can find additional related information in the section on therapy monitoring and follow-up.

**Magnetic Resonance Imaging (MRI) and Molecular MR (MR/PET)**

MRI has established itself in lung cancer imaging. With its unmatched soft-tissue contrast and the latest robust MR techniques, MRI helps assess infiltration into the plexus, spine, or chest wall – providing valuable information for use when planning surgery, for example. In lung cancer diagnosis, MRI for whole-body staging is of special value, such as for the detection of bone or brain metastases. Multi-parametric MRI can provide additional information on cellular density, tissue perfusion, and vascularity. These applications are supported by Siemens Healthcare’s DotGO workflow engines, enabling standardized protocols and more predictable scan slots.

Biograph mMR™ combines all the benefits of MRI soft-tissue contrast and functional imaging, with the high sensitivity of PET in one single system that offers simultaneous, integrated MRI and PET. Siemens Healthcare MRI scanners provide a large range of protocols that have been optimized for lung imaging. Reading applications like syngo. MR Onco-Care, based on the syngo.via platform, enable fast and effective staging and response monitoring of lung cancer.

**Interventional imaging systems**

Suspicious imaging findings always need to be confirmed via biopsies before therapeutic steps can be taken. Especially for lesions located deep in the lungs – and if the lung is deflated – Siemens Healthcare’s angiographic imaging systems, such as Artis zeego with syngo Needle Guidance, offer an attractive option for guiding needle biopsies.
What can help me in the correct selection, planning, and execution of the optimal therapy?

Therapy selection, planning, and delivery

Success based on meaningful image information

Therapeutic approaches and therapy selection for lung cancer patients depend on the patient condition, histological and molecular characteristics of the tumor, and staging information. In the majority of cases today, the disease is detected when it is already in an advanced stage – and so therapy primarily consists of either radio(chemo)therapy potentially followed by surgery or systemic chemotherapy. Primary surgery is the treatment of choice for most tumors that are detected early and are still localized. As a rule, the success of therapeutic options depends on thorough planning and precise execution.

Interventional imaging with angiography and CT

Siemens Healthcare has been working with many clinical collaboration partners to support minimally invasive interventions whenever possible. The intention is to reduce the number of open thoracic interventions, thereby lowering the therapeutic burden, especially for elderly patients. A high degree of image integration ensures the most precise marking and planning for precise resection of the nodules. The goal is not only to save more healthy tissue, but also to minimize the risk of complications and reduce the length of time of the intervention as well as the hospitalization.

For the successful clinical implementation of these integrated procedures, the imaging equipment must be tailored to diverse clinical needs. Therefore, Siemens Healthcare not only offers superior imaging devices, it also provides their site-specific integration into the surgery theater. This paradigm shift toward hybrid ORs is supported by all imaging technologies from Siemens Healthcare.

Artis zeego, Siemens Healthcare’s unique multi-axis robotic angiography system, delivers unrivaled positioning flexibility and fully supports room hygiene category class A when in operation. It also introduces syngo DynaCT Large Volume, to acquire volumes of almost twice the diameter or height of conventional C-arm CTs, enabling visualization of both lungs and all surrounding thoracic structures. This is crucial for treatment planning of percutaneous ablations or VATS. 3D path planning and precise navigation of devices from the skin entry point to the target is supported by syngo Needle Guidance.

For the most challenging requirements in lung imaging during interventions, Siemens Healthcare also offers the MIYABI Angio-CT. This customized solution allows you to combine an Artis angiography system and a state-of-the-art CT system in a sliding gantry configuration in a one- or two-room solution.

Radiation oncology

For inoperable lung cancer, external beam radiotherapy, chemotherapy, or their combination, is frequently the
treatment of choice. Improved local tumor control may be achieved with dose escalation. However, this approach is limited by toxicity to the healthy tissue that is included in the target volume to account for organ motion.

Using Siemens Healthcare’s large-bore CT scanners, you have access to a comprehensive motion management solution. Working with the 4D multimodality image analysis tools in the syngo.via RT Image Suite, treatment can now be adapted to each individual patient’s breathing pattern. To ensure a seamless integration into radiotherapy delivery, we are partnering with Varian Medical Systems, one of the world’s leading providers of radiation therapy solutions.

The metabolic information from PET can enable a more precise dose escalation to viable tumors. Our Biograph PET/CT portfolio comprises wide-bore systems with the industry’s finest volumetric resolution and high lesion contrast. The addition of flexible respiratory motion management makes these systems ideal for planning lung treatments. Radiation-induced pneumonitis can be reduced by selective avoidance of well-perfused lung tissue defined by SPECT. Our new xSPECT technology, which fully integrates SPECT and CT, improves image quality to enable physicians to quickly differentiate between bone metastases and inflammation with one exam. xSPECT also offers automatic quantification, which further supports therapy planning.

Ultrasound

Ultrasound is a highly sensitive method for detecting pleural or pericardial effusions. It is extremely valuable for guiding chest drainage procedures and reducing the associated complication rates. Ultrasound represents a beneficial adjunct to initial CT or MR imaging in the preoperative assessment of the chest wall infiltration of a tumor. Contrast-enhanced ultrasound also allows you to assess perfusion in tumor tissue. While today, this procedure is often performed using whole-body PET/CT, ultrasound is an effective tool for evaluating the potential infiltration of the liver and adrenal gland by lung cancer.
Computed Tomography (CT)

CT plays an important role in response monitoring and follow-up. It is widely integrated in clinical guidelines. Standardization of protocols and quality control are the basis for meaningful measurements of tumor size during and after therapy. However, response monitoring and follow-up today means more than just morphological imaging. Siemens Healthcare’s premium SOMATOM CT systems allow functional examinations such as tissue perfusion or iodine quantification, which enable the earlier assessment of tumor response or disease progression. syngo.via-based reading applications for CT data permit standardized and efficient image analysis. Longitudinal studies of the same patient are automatically registered, and the trending of, for example, RECIST or volumetry measures is automatically visualized. This concerted approach also benefits the referring physicians, as structured reporting permits efficient communication across departments and disciplines.

Positron Emission Tomography – Computed Tomography (PET/CT)

The metabolic response of lung tumors to chemo (radio) therapy can be visualized earlier than morphological change. PET/CT has shown to be an early predictor of response and progression-free survival – after only one week of therapy.
Accurate and reproducible quantification is critical in measuring and evaluating tumor response. Advanced system calibration of Biograph mCT PET/CT system helps ensure consistent quantitative accuracy across multiple time points. Software tools, such as those that automatically estimate the SUVpeak and PERCIST thresholds, provide an efficient response evaluation in sequential PET/CT studies. Because the reproducibility of standard uptake volume (SUV) across different PET systems is still a central challenge, syngo.via-based EQ/PET software provides equalization, to reduce quantitative variations between different systems and vendors.

Lung cancer is associated with high recurrence rates, and so effective follow-up procedures are crucial. PET/CT is highly sensitive in detecting local recurrences of lung carcinoma thanks to its ability to delineate metabolically active tumors in the presence of post-treatment fibrosis and to differentiate between tumor and scar tissue.

Continuous bed motion, made possible by FlowMotion™ technology, eliminates overlapping bed acquisitions and maintains uniform noise sensitivity across the entire scan range, in order to provide accurate and reproducible quantification from edge to edge. This supports precise disease characterization in therapy monitoring, thus making earlier decisions possible when evaluating the effectiveness of the therapy.

**Laboratory diagnostics**

Siemens Healthcare Diagnostics has a comprehensive menu of oncology tests that employ both the automated immunoassay and clinical chemistry methods. The clinical chemistry tests provide routine workups, including general and specific tests to assess side effects in the patient. From a monitoring standpoint, tumor markers such as carcinoembryonic antigen (CEA) can be used to support the management of cancer patients.
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3 WHO: Globocan 2012; globocan.iarc.fr
4 WHO: www.who.int/cancer/prevention
5 SEER 18 2004-2010; www.seer.cancer.gov
6 syngo.via can be used as a stand-alone device or together with a variety of syngo.via-based software options, which are medical devices in their own right.
7 Prerequisites include: Internet connection to clinical network, DICOM compliance, meeting of minimum hardware requirements, and adherence to local data security regulations.
8 Based on volumetric resolution available in competitive literature for systems greater than 70 cm bore size. Data on file.
9 xSPECT is not commercially available in all countries. Due to regulatory reasons its future availability cannot be guaranteed. Please contact your local Siemens organization for further details.
10 At the time of publication, the U.S. Food and Drug Administration has cleared ultrasound contrast agents only for use in LVO. Check current regulations for the country in which you are using this system for contrast agent clearance.